

SIXTH CANADIAN EDITION

Introduction to Information Systems

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WILEY

Introduction to Information Systems: Supporting and Transforming Business

Sixth Canadian Edition

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Cover Photo: Tyler / Adobe Stock Images

This book was set in 9.5/12 STIXTwoText by Lumina Datamatics, Ltd.

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ISBN (e-PUB) 978-1-394-16416-5

The inside back cover will contain printing identification and country of origin if omitted from this page. In addition, if the ISBN on the cover differs from the ISBN on this page, the one on the cover is correct.

Printed and bound in the United States.

10 9 8 7 6 5 4 3 2 1

Wiley

John Wiley & Sons Canada, Ltd.

501 – 700 Dorval Drive

Oakville, ON

Visit our website at: www.wiley.ca

What Do Information Systems Have to Do with Business?

This edition of Rainer, Prince, Sánchez-Rodríguez, Ebrahimi, and Splettstoesser's *Introduction to Information Systems* will answer this question for you. In every chapter, you will see how real global businesses use technology and information systems to increase their profitability, gain market share, improve their customer service, and manage their daily operations. In other words, you will learn how information systems provide the foundation for modern business enterprises.

We have several goals for all business majors, particularly undergraduates. First, we want to teach you how to use information technology to help you master your current or future jobs and thus contribute to your organizations' success. Second, we want you to become informed users of information systems and information technology. Third, we want you to understand the digital transformation that your organization will likely be undergoing. The digital transformation of organizations is the acceleration of existing business processes and the development of new processes and business models. In this way, organizations can capitalize on the capabilities and opportunities of various technologies to improve performance. Examples of these technologies include Big Data, cloud computing, artificial intelligence, the Internet of Things, mobile computing, and electronic commerce. We address each of these in our book. To accomplish these goals, we focus on not merely learning the concepts of information technology but also applying those concepts to perform business more effectively and efficiently. We concentrate on placing information systems in the context of business so that you will more readily grasp the concepts we present in the text.

What's In IT For Me

The theme of this book, *What's in IT for me?*, is a question asked by most students who take this course. Our book will show you that IT is the backbone of any business, whether you're majoring in Accounting, Finance, Marketing, Production/Operations Management, Human Resource Management, or Management Information Systems.

New to This Edition

The sixth edition contains many exciting additions and changes. These elements make the text more interesting and readable for students of all majors, while still providing the most current information possible in the rapidly changing field of information systems.

Digital Transformation of Organizations More than likely, students will go to work for companies that are undergoing digital transformation. In this edition, we emphasize digital transformation and the information technologies that drive such transformations. The technologies that drive digital transformation include Big Data (see Chapter 5), broadband internet access (see Chapter 6), wireless and mobile computing (see Chapter 8), the Internet of Things (see Chapter 8), social computing (see Chapter 9), enterprise systems (see Chapter 10), Customer Relationship and Supply Management Systems (Chapter 11), business analytics (see Chapter 12), agile systems development methods (see Chapter 13), artificial intelligence (see Chapter 14), and cloud computing (see Technology Guide 3).

Indigenous Perspectives Throughout the text, we focus on highlighting some of the unique characteristics of Indigenous businesses and their use of technology.

- Chapter 3 includes an IT's About Business feature that explores how Indigenous values and principles are bound together to enable love in relationships that include delivery of information technology services.
- Chapter 4 shares how Indigenous financial resources are being used to improve access to reliable power by financing solar power systems and battery energy storage systems.
- Chapter 6 features an opening case that presents the most recent picture of the Digital Divide in Canada, with a special focus on its effect on First Nations. IT's About Business 6.3 contains an illustrative example of how network technologies are helping one First Nation collaborate in onboarding new interns.
- Chapter 8 has an opening case that highlights the use of state-of-the-art satellite technology to address the gap in broadband internet access in First Nations and rural communities across Canada.
- Chapter 13 includes an IT's About Business feature that illustrates how the effective use of middleware and packaged software improved the effectiveness of data entry at gas stations and retail operations located on reserves.

Artificial Intelligence In our all-new Chapter 14, we address the critically important topic of artificial intelligence:

- We first carefully define AI in terms of the tasks that humans perform, rather than how humans think. We then compare the capabilities of natural intelligence and artificial intelligence.
- We differentiate between weak AI and strong AI.
- We define supervised machine learning, semi-supervised machine learning, reinforcement learning, unsupervised machine learning, and deep learning.
- We address bias in machine-learning systems.

- We define neural networks and how they function.
- We discuss various applications of AI, including computer vision, natural language processing, robotics, speech recognition, and intelligent agents.
- In IT's About Business 14.2, we discuss ChatGPT. We define ChatGPT as a large language model and discuss how developers build such models. We describe its capabilities, advantages, and disadvantages. We then turn our attention to areas where the system is making an impact. These areas include education, journalism, search engines, and software engineering. We close with a look at ChatGPT-4 and ChatGPT detector systems.

We provide a thorough discussion of AI applications in the functional areas, including accounting, finance, marketing, production/operations management, human resource management, and MIS.

Other Highlights

Information Security and Controls In Chapter 4, we see how businesses are managing to grapple with the pervasive threat of ransomware, recovering rapidly after being brought down.

Telecommunications and Networking In Chapter 6, we provide an expanded discussion of the evolution of the Web, from Web 1.0 to Web 5.0.

E-Business and E-Commerce In Chapter 7, we provide an expanded discussion of blockchain technology. We provide examples of the use of blockchains, including cryptocurrencies such as Bitcoin, the energy grid, and digital content creators (e.g., music and journalism).

The Chapter 7 opening case introduces the arrival of Chinese discount e-commerce marketplace Temu in Canada, with an interesting discussion of the challenges and benefits for consumers.

Chapter 7 also provides recent statistics about the magnitude of online fraud in Canada, common types of online fraud, and different resources for Canadian businesses and entrepreneurs to avoid and report online fraud.

Social Computing In Chapter 9, we added a section called “Problems with Social Computing.” We address three serious issues with social media platforms: First, they allow almost anyone to publish any content. Second, the platforms employ psychological measures to keep visitors on their sites longer. Third, third-party entities employ various means to spread their messages. Our discussion covers bots, cyborgs, trolls, troll farms, fake news, and deepfakes, as well as the infinite scroll and randomly scheduled rewards.

IT's About Business 9.2 offers the example of the successful Canadian social network platform Wattpad, with a detailed description of its business model. In addition, IT's About Business 9.3 provides several examples of how large and small

Canadian businesses are using social computing in their marketing efforts.

Business Analytics In Chapter 12, we expanded our discussion of the difference between analytics and statistics, added real-world scenarios that allow students to apply the business analytics process (Figure 12.3), and added a discussion of Google Analytics.

Acquiring Information Systems and Applications Chapter 13 discusses how the user-centred approach in design thinking addresses the improvement of user-IT collaboration.

Technology Guides Tech Guides at the end of the textbook provide more details on the hardware, software, and other technology underlying the key information systems discussed throughout the text. In this way, the chapters can focus on how technology is used in organizations, while the technology guides allow students to “look under the hood” to see how things work.

In Technology Guide 1 (Hardware), we added

- a new section addressing augmented reality (AR), virtual reality (VR), and mixed reality (MR);
- numerous real-world examples of AR, VR, and MR;
- a brief discussions of graphics processing units and quantum computing.

In Technology Guide 3 (Cloud Computing), we added

- a new section comparing the “Big Three” cloud computing vendors: Amazon Web Services, Microsoft Azure, and the Google Cloud Platform.
- a discussion of multi-cloud computing environments.

Key Features

We have been guided by the following goals that we believe will enhance the teaching and learning experience.

“What’s In IT For Me?” Theme We show why IT is important by calling attention in each chapter to how that chapter’s IT topic relates to students in each major.

Every chapter concludes with a summary of how the concepts relate to each functional area (“What’s in IT for me?”).

Active Learning We recognize the need to actively involve students in problem solving, creative thinking, and capitalizing on opportunities. Therefore, we have included a variety of hands-on exercises and activities, including exercises that require students to use software application tools. Other active learning opportunities included in the Wiley online course include ethics cases and spreadsheet activities.

In addition, the Wiley online course includes career readiness materials that will be invaluable for students as they prepare for jobs in the real world.

Through these activities available in the text and online, we enable students to apply the concepts they learn.

Diversified and Unique Examples from Different Industries Extensive use of vivid examples from large corporations, small businesses, and government and not-for-profit organizations helps to enliven concepts by demonstrating the capabilities of IT, its cost and justification, and innovative ways in which real corporations are using IT in their operations. Each chapter constantly highlights the integral connection between IT and business. This is especially evident in the “IT’s About Business” boxes.

Misuse of IS Like other textbooks, this text presents many examples of IS success. But we also provide numerous examples of IS failures, in the context of lessons that can be learned from such failures. Misuse of IS can be very expensive, as we illustrate.

Innovation and Creativity In today’s rapidly changing environment, creativity and innovation are essential for a business to operate effectively and profitably. Throughout the text we demonstrate how IT facilitates these concepts.

Canadian and Global Focus A Canadian perspective is provided through the use of examples of Canadian companies, legislation, and society. In addition, because an understanding of global competition, partnerships, and trading is essential to success in a modern business environment, we provide a broad selection of international cases and examples. We discuss the role of information systems in facilitating export and import, the management of international companies, and electronic trading around the globe.

Focus on Ethics With corporate scandals appearing in the headlines almost daily, ethics and ethical questions have come to the forefront of business people’s minds. In addition to a chapter that concentrates on ethics and privacy (Chapter 3), we have included examples and cases that focus on business ethics throughout the chapters.

A Guide to Word Marks

As you read this text, you will notice a variety of word marks interspersed throughout the chapters.

These word marks highlight material relating to different functional areas. MIS concepts are relevant to all business careers, not just careers in IT. The functional area icons help students in different majors quickly pick out concepts and examples of particular relevance to them. Below is a quick reference list of these icons:

- **ACCT** **For the Accounting Major** highlights content relevant to the functional area of accounting.

- **FIN** **For the Finance Major** highlights content relevant to the functional area of finance.
- **MKT** **For the Marketing Major** highlights content relevant to the functional area of marketing.
- **POM** **For the Production/Operations Management Major** highlights content relevant to the functional area of production/operations management.
- **HRM** **For the Human Resource Major** highlights content relevant to the functional area of human resources.
- **MIS** **For the MIS Major** highlights content relevant to the functional area of Management Information Systems.

Pedagogical Structure

Other pedagogical features provide a structured learning system that reinforces the concepts through features such as chapter-opening organizers, section reviews, study aids, frequent applications, and hands-on exercises and activities.

Chapter-opening organizers include the following pedagogical features:

- The *Learning Objectives* provide an overview of the key concepts students should come away with after reading the chapter.
- The *Chapter Outline* lists the major chapter topics.
- An *Opening Case* identifies a business problem faced by an actual company, describes the IT solution applied to the business problem, presents the results of the IT solution, and summarizes what students can learn from the case.

Study aids are provided throughout each chapter. These include the following:

- *IT’s About Business* cases provide real-world applications, with questions that relate to concepts covered in the text. Icons relate these sections to the specific functional areas.
- Examples interspersed throughout the text illustrate the use (and misuse) of IT by real-world organizations, thus making the conceptual discussion more concrete.
- *Tables* list key points or summarize different concepts.
- Simple multiple choice questions interspersed throughout each section in the ebook enable students to check their understanding of key concepts and consolidate their learning.
- End-of-section reviews (*Before You Go On...*) prompt students to pause and test their understanding of basic concepts before moving on to the next section.

End-of-chapter study aids provide extensive opportunity for the reader to review and “do something” with the concepts they have just studied:

- *What’s in IT for me?* is a unique chapter summary section that demonstrates the relevance of topics for different functional areas (Accounting, Finance, Marketing, Production/Operations Management, Human Resource Management, and MIS).

- The *Summary*, keyed to learning objectives listed at the beginning of the chapter, enables students to review the major concepts covered in the chapter.
- *Discussion Questions* and *Problem-Solving Activities* provide practice through active learning. These exercises are hands-on opportunities to use the concepts discussed in the chapter.
- A *Closing Case* presents a brief case study organized around a business problem and explains how IT helped to solve it. Questions at the end of the case relate it to concepts discussed in the chapter.

Apply the Concept Activities This text's unique pedagogical structure is designed to keep students actively engaged with the course material. Reading material in each chapter subsection is supported by new "Apply the Concept" activities that are directly related to a chapter objective. These activities include links to online videos and articles and other hands-on activities that require students to immediately apply what they have learned. Each Apply the Concept has the following elements:

- Background (places the activity in the context of relevant reading material)
- Activity (a hands-on activity that students carry out)
- Deliverable (various tasks for students to complete as they perform the activity)

Engaging Students Digitally

The *WileyPLUS* course for *Information Systems*, Sixth Canadian Edition, features a suite of teaching and learning resources. Many dynamic resources are integrated into the course to help students build their knowledge and understanding, stay motivated, and prepare for decision making in a real-world context. The course also includes integrated adaptive practice that helps students build proficiency and use their study time most effectively. Additional features of the course include:

Data Analytics & Decision Making Module With the emergence of Data Analytics transforming the business environment, Wiley has partnered with business leaders in the Business-Higher Education Forum (BHEF) to identify the competencies graduates need to be successful in their careers. As a result, this module has been created from industry-validated content to prepare business students with professional competencies needed for the changing workforce.

Video Activities This new feature offers a set of graded video activities to support cutting-edge video content. The corresponding video activities challenge students to tie content directly to real-world scenarios and offer them an applied, engaging learning experience to supplement their introductory business course.

Ethics Cases Cases with discussion questions that feature topics such as electronic monitoring and intellectual property rights encourage students to think critically about how these topics are relevant to business and to their own lives.

PowerPoint Presentations PowerPoint presentations are provided for each chapter and include an outline of key points (with accompanying lecture notes), learning objectives, key terms, figures, and tables.

Lecture Overview Videos Each learning objective in the course is accompanied by a brief overview of its topic delivered by one of the authors, who succinctly explains the highlights of the learning objective.

Practice Quizzes This resource allows students to test their knowledge and understanding of key chapter content. Practice quizzes are available in Wiley's online course.

What's New to This Course

- The Environmental, Social, and Corporate Governance (ESG) Module introduces students to how organizations need to factor these important concepts into their business models.
- You Got This! Career Skills Combo Course add-on (including videos and assessments) prepares students for the workforce by leveraging the National Association of Colleges and Employers' (NACE) eight career readiness competencies including critical thinking, emotional intelligence, and more.
- Data Analysis Technology Bootcamps help students develop foundational data analytics software skills. Data Analysis Technology Bootcamps are available for Excel, Tableau, Power BI, Alteryx, and SQL. Each bootcamp includes Overview Videos, How-To Videos, and Solution Walkthrough Videos to ensure students have the support they need to learn how to use the software and perform specific tasks, as well as assignable application exercises and data sets to help students demonstrate their understanding of the tool in an accounting context.

Instructor Resources

This text also facilitates the teaching of an introductory IS course by providing support materials for instructors and students.

Instructor's Manual The *Instructor's Manual* includes a chapter overview, teaching tips and strategies, answers to all end-of-chapter questions, supplemental mini-cases with essay questions and answers, and experiential exercises that relate to particular topics.

Test Bank The Test Bank is a comprehensive resource for test questions. It contains multiple-choice, short answer, and essay questions for each chapter. The multiple-choice and

questions are labelled according to difficulty: easy, medium, or hard.

The test bank is available for use in TestGen's easy-to-use software. TestGen is a powerful tool for creating and managing exams that can be printed on paper or published directly to Canvas, Blackboard, and other eLearning systems. For more information, please visit your Wiley online courseware.

PowerPoint Presentations The *PowerPoint Presentations* consist of a series of slides for each chapter of the text that are designed around the text content, incorporating key points from the text and all text illustrations as appropriate. The PowerPoint presentations include media-rich PowerPoint slides with links to websites and videos. Students also have lecture slides for note-taking.

Weekly Updates Weekly updates, harvested from around the Web by David Firth of the University of Montana, provide you with the latest IT news and issues. These are posted every Monday morning throughout the year at wileyinformationsystemsupdates.com and include links to articles and videos as well as discussion questions to assign or use in class.

Image Library All textbook figures are available for download in the Wiley online course. These figures can easily be added to PowerPoint presentations.

Wiley E-Textbook E-textbooks are complete digital versions of the text that help students study more efficiently as they:

- Access content online and off-line on their desktop, laptop, and mobile device
- Search across the entire book content
- Take notes and highlight
- Copy and paste or print key sections
- Answer multiple-choice review questions in the text

Wiley Custom Services

This group's services allow you to:

- Adapt existing Wiley content and combine texts
- Incorporate and publish your own materials
- Collaborate with our team to ensure your satisfaction

Acknowledgements

Creating, developing, and producing a text for an introductory course to information technology is a formidable undertaking. First of all, we would like to thank our students to whom this book is dedicated. We would like to reiterate our commitment to them and thank them for their feedback in improving this textbook.

Also, we would like to extend our thanks to all those instructors who use this textbook in the classroom. You are the reason for the sixth edition. We are also grateful for the efforts of our supplement contributors, Victor Bilodeau, Raymond Chiu, Laura De Luca, Wendy Tarrel, Cheryl Wilson, and ShiKui Wu, who contributed so much to the related supplements. Many thanks to our course content developer, Daleara Hirjikaka, and our acquisitions editors, Jennifer Manias and Julia Chase, and the team at John Wiley & Sons Canada, Limited, for all their work and effort. Along the way, we were fortunate to receive continuous evaluation, critique, and direction from many colleagues who regularly teach this course. We thank the following reviewers, who have provided suggestions for improvement and insightful comments over the past several editions of this text:

Anteneh Ayanso, *Brock University*
Gokul Bhandari, *University of Windsor*
Victor Bilodeau, *MacEwan University*
James Douglas Clark, *University of Lethbridge*
Ken Cudeck, *York University*
Dale Foster, *Memorial University of Newfoundland*
Franca Giacomelli, *Humber College*
Debbie Gorval, *Kwantlen Polytechnic University*

Rebecca Grant, *University of Victoria*
Ernest Johnson, *University of Regina*
Leo Kerklaan, *McGill University*
Dennis Kira, *Concordia University*
Sherrie Yi Xiao Komiak, *Memorial University of Newfoundland*
Marcelo Machado, *Kwantlen Polytechnic University*
Laura De Luca, *Fanshawe College*
Francisco B. P. Moro, *University of Windsor*
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Baset Zarrug, *Mount Royal University*

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Toronto, Ontario
June 2023

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Introduction to Information Systems

CHAPTER OUTLINE

LEARNING OBJECTIVES

1.1 Why Should I Study Information Systems?	1.1 Identify the reasons why being an informed user of information systems is important in today's world.
1.2 Overview of Computer-Based Information Systems	1.2 Describe the various types of computer-based information systems in an organization.
1.3 How Does IT Impact Organizations?	1.3 Discuss ways in which information technology can affect managers and non-managerial workers.
1.4 Importance of Information Systems to Society	1.4 Identify positive and negative societal effects of the increased use of information technology.

Opening Case

MKT Plus-Size Clothing Ads on Social Media

Social media are websites and mobile applications that let users create and share content for the purpose of social networking. Given the vast numbers of users, many networks end up being used as platforms for promoting products, ideas, businesses, political agendas, opinions, humour, and much more. TikTok is an extremely popular social media platform that allows users to post short videos and to like, comment on, and follow other users. It has become an ideal medium for videos to go viral, reaching millions of users. In fact, it can literally make a person a superstar overnight. The platform is now available in more than 150 markets worldwide in 75 languages.

As of January 2023, TikTok has over 1.5 billion users, 1 billion of whom are active monthly users. TikTok is especially popular among younger generations: more than 35 percent of its users are under 35 years old. These characteristics have made TikTok a popular platform for e-commerce brands (we will discuss e-commerce in more detail in Chapter 7). Penningtons, a Canadian fashion brand that specializes in plus-size women's clothing, is one such brand.

As a designer and producer of plus-size fashion, Penningtons advocates for body diversity and size inclusivity and strives to empower women to embrace fashion as a form of self-celebration. In 2021, Penningtons worked closely with Alicia Mccarvell, a

Canadian content creator, to raise the profile of the brand's newest line of swimwear while remaining true to Mccarvell's style. This type of advertising—where the ad is in the form of normal, regular content—is called native advertising.

To promote Penningtons' swimwear, Mccarvell, a plus-size model, was captured trying on various pieces of swimwear while sharing her story of how she became confident enough to appear publicly in swimwear. Her powerful message of self-love combined with creativity made Mccarvell a great ambassador for Penningtons' new swimwear line. By partnering with an influencer who aligned with their values, Penningtons saw more positive sentiment in the comments section, which indicated that brand perception had improved; in addition, brand engagement increased, as did swimwear sales. Furthermore, the content on TikTok received 53 percent more comments, 18 percent more likes, and 55 percent more views than the company's content on other platforms.

Since this successful experience, Penningtons has partnered with several other plus-size content creators who are advocates of self-love, such as Mélissa Bédard and Stephanie Valentine (aka glamzilla) as well as Inuk, an Inuvialuit social media influencer. While sharing their stories about their personal journeys, these influencers also promote Penningtons' different products.

However, the landscape is not all rosy. Many plus-size content creators have described negative experiences with social

media because their content has been censored for being against the media's "community standards." These standards are rooted in the widespread stereotypes established in many countries about people with higher body weight or larger body size, known as weight stigma. In fact, a 2021 international study with almost 14,000 participants across six different countries found that 58 percent of participants had experienced weight stigma.

While sources of such stigma have traditionally been families, friends, workplaces, schools, and health care settings, social media have made it even more possible for plus-size individuals to experience weight stigma, not only by receiving hurtful comments from the public but also by feeling discriminated against when their content is removed by the platforms. In December 2019, TikTok admitted to suppressing the reach of some contents that the platform found "vulnerable to cyberbullying." Examples of such content include people with facial disfigurements, autism, Down's syndrome, and disabilities. This admission was made after *Netzpolitik*, a German news website on digital rights and digital culture, reported that TikTok moderators were asked to watch short videos and decide if the creator could be at risk for cyberbullying. While the team at TikTok that developed this policy might have believed that they were developing safeguards against bullying, they were in fact adding to the problem, as not only does online harassment remain an ongoing problem, but the policy led to discriminatory behaviour against vulnerable individuals.

Although more frequently reported about TikTok, this issue has been observed on other social media platforms too. For instance, Facebook has been blamed for removing pictures of an amputee model and Instagram has been reported to remove content from plus-size creators. Meta, Instagram's and Facebook's parent company, has responded to the concerns by saying that it is always possible to appeal post removals or account takedowns. On the other hand, influencers argue that removing or restricting the audience of their posts by social media platforms affects their

business as they cannot fulfill their promises to brands with whom they have signed agreements. In fact, censoring by social media platforms denies vulnerable people their personal, economic, and even cultural and political opportunities and in that sense can be considered discriminatory.

Questions

1. Identify and discuss three ways in which social media can help plus-size clothing brands achieve success.
2. Identify and discuss three ways in which social media can create challenges for plus-size clothing brands.
3. Identify and discuss ways in which social media can impact body size inclusivity positively or negatively.

Sources: Compiled from "Inuvialuit Social Media Influencer Breaks Mold with Penningtons Fashion Teamup," *CBC News*, October 17, 2022; J. Chaney, "In 2022, It's Still Impossibly Hard to Be a Fat Content Creator Online," *Allure*, May 4, 2022; M. Cyca, "23 Important TikTok Stats Marketers Need to Know in 2023," *Hootsuite*, March 9, 2022; R. Puhl, "Weight Stigma Study in the U.S. and 5 Other Nations Shows the Worldwide Problem of Such Prejudice," *The Washington Post*, June 12, 2021; J. Rodríguez, "TikTok's Success and Controversies," *LatinAmerican Post*, April 4, 2020; R. Perper, "TikTok Admits It Hid Disabled Users' Videos Appearing on the App's Main Feed, Claiming the 'Blunt' Policy Was Used to Prevent Bullying," *Business Insider*, December 3, 2019; E. Botella, "TikTok Admits It Suppressed Videos by Disabled, Queer, and Fat Creators," *Slate*, December 4, 2019; C. Köver and M. Reuter, "TikTok Curbed Reach for People with Disabilities," *Netzpolitik*, February 12, 2019; "Celebrating Self-Love through Sleek Swimwear," *TikTok for Business*, <https://www.tiktok.com/business/en-CA/inspiration/penningtons-404>, accessed on March 15, 2023; A. Ishmael, "Plus-Size Creators Are Fed Up with TikTok's Community Guidelines," *Grazia*, <https://graziamagazine.com/us/articles/plus-size-creators-tiktok/>, accessed on March 12, 2023.

Introduction

Information technology (IT) refers to any computer-based tool that people use to work with information and support an organization's information and information-processing needs. IT has far-reaching effects on individuals, organizations, and our planet. Although this text is largely devoted to the many ways in which IT is transforming modern organizations, you will also learn about the significant impacts of IT on individuals and societies, the global economy, and our physical environment. IT is making our world smaller, enabling more and more people to communicate, collaborate, and compete, thereby levelling the playing field.

The COVID-19 pandemic forced people to depend on IT in new ways and demonstrated how far-reaching technology can be. Specifically, IT has come to the forefront of electronic commerce, distance education, and even health care. As you will see, in this course, we draw attention to IT's impact on the pandemic, and vice versa, quite extensively.

This text focuses on the successful applications of IT in organizations; that is, how organizations can use IT to solve business problems and achieve competitive advantage in the marketplace. However, not all business problems can be solved with IT. Therefore, you must continue to develop your business skills!

When you graduate, either you will start your own business or you will work for an organization, whether it is public sector, private sector, for-profit, or not-for-profit. Your organization will have to survive and compete in an environment that has been radically transformed by information technology. This environment is global, massively interconnected, intensely competitive, 24/7/365, real-time, rapidly changing, and information intensive. To compete successfully, your organization must use IT effectively.

As you read this chapter and this text, keep in mind that the information technologies you will learn about are important to businesses of all sizes. No matter which area of business you major in, which industry you work for, or the size of your company, you will benefit from learning about IT. Who knows? Maybe you will use the tools you learn about in this class to make your great idea a reality by becoming an entrepreneur and starting your own business!

The modern environment is intensely competitive not only for your organization, but for you as well. You must compete with human talent from around the world. Therefore, you personally will have to make effective use of IT.

Accordingly, this chapter begins with a discussion of three reasons why you should become knowledgeable about IT. Next, it distinguishes among data, information, and knowledge, and it differentiates computer-based information systems from application programs. Finally, it considers the impacts of information systems on organizations and on society in general.

1.1

Why Should I Study Information Systems?

LEARNING OBJECTIVE

Identify the reasons why being an informed user of information systems is important in today's world.

No doubt, you have noticed that the title of this book is about information systems. Although information systems, is a term that relates to information technology closely, it is not interchangeable with it. So, before we proceed, we will differentiate information technology from information systems. As previously defined, **information technology (IT)** refers to any computer-based tool that people use to work with information and support an organization's information and information-processing needs. An **information system (IS)** collects, processes, stores, analyzes, and disseminates information for a specific purpose. While we will discuss IT, the primary purpose of this text is to build your knowledge of the ways that modern organizations make use of IT and IS in their daily operations.

Your use of IT makes you part of the most connected generation in history: you have grown up online; you are, quite literally, never out of touch; you use more information technologies (in the form of digital devices) for more tasks; and you are bombarded with more information than any generation in history. The *MIT Technology Review* refers to you as *Homo connexus*. Information technologies are so deeply embedded in your lives that your daily routines would be almost unrecognizable to a university student just 20 years ago.

Essentially, you practise *continuous computing*, surrounded by a movable information network. This network is created by constant communication among the digital devices you carry and wear (e.g., laptops, tablets, smartphones, and wearables); the wired and wireless networks that you access as you move about; and Web-based tools for finding information and communicating and collaborating with other people. Your network enables you to pull information about virtually anything from anywhere at any time, and to push your own ideas back to the Web, from wherever you are, via a mobile device. Think of everything you do online, often with your smartphone: register for classes; take classes (not just at your university); access class syllabi, information, PowerPoints, and lectures; research class papers and presentations; conduct banking; pay your bills; research, shop, and purchase products from companies and other people; sell your "stuff"; search for, and apply for, jobs; make your travel reservations (hotel, airline, rental car); create your own blog and post your own podcasts and videos to it; design your own page on Facebook and LinkedIn; make and upload videos to YouTube and TikTok; take, edit, and share your own digital photographs; stream music and movies to your personal libraries; use RSS feeds to create your personal electronic newspaper; text and Tweet your friends and family throughout your day; send Snaps; order a ride from

Uber or Lyft; track the location and arrival time of the next campus bus; select a place or room to rent on Airbnb; and many other activities. (Note: If any of these terms are unfamiliar to you, don't worry. You will learn about everything mentioned here in detail later in this text.)

Let's put the preceding paragraph in perspective. What would a typical day for you be like if you had no access to computing devices of any kind, including your phone? This scenario also means that you have no access to the internet.

The Informed User—You!

So, the question is: Why should you learn about information systems and information technology? After all, you can comfortably use a computer (or other electronic devices) to perform many activities, you have been surfing the Web for your entire life (or a good part of it), and you feel confident that you can manage any IT application that your organization's MIS department installs. Let's look at three reasons why you should learn about ISs and IT.

informed user A person who is knowledgeable about information systems and information technology.

MIS The first reason to learn about information systems and information technology is to become an **informed user**; that is, a person knowledgeable about ISs and IT. In general, informed users obtain greater value from whichever technologies they use. You will enjoy many benefits from being an informed user of IT, including:

- You will benefit more from your organization's IT applications because you will understand what is “behind” those applications (see [Figure 1.1](#)). That is, what you see on your computer screen is brought to you by your MIS department, who are operating “behind” your screen.
- You will be aware of potential security issues and be more prepared to avoid them. IT's About Business 1.1 presents a scenario where social engineering was used to hack Uber in 2022. An informed user should not have made this mistake.
- Even as a new graduate, you will quickly be in a position to recommend—and perhaps to help select—which IT applications your organization will use. In essence, you will enhance the quality of your organization's IT applications with your input.



FIGURE 1.1 MIS provides what users see and use on their computers.

- Being an informed user will keep you abreast of both new information technologies and rapid developments in existing technologies. Remaining “on top of things” will help you to anticipate the impacts that “new and improved” technologies will have on your organization and to make recommendations regarding the adoption and use of these technologies.
- You will understand how using IT can improve your organization’s performance and teamwork as well as your own productivity.
- If you have ideas of becoming an entrepreneur, then being an informed user will help you to utilize IT when you start your own business.

IT’s About Business 1.1

MIS Informed Users Are an Important Part of Security

Every organization is vulnerable to attack. In some ways, vulnerability is a business requirement because employees need access to data to do their jobs. Anytime access is granted, however, there is an opportunity for an unauthorized party to access those data and use them for malicious purposes.

But an organization’s data assets are protected behind passwords, multifactor authentication, and other security protocols, right? (You will learn more about these topics in Chapter 4: Information Security.) Of course, they are protected! Unfortunately, sometimes it takes only a little old-fashioned trickery to access these assets. In the IT world, we refer to this trickery as social engineering.

Social engineering is an attempt to gain access that has not been granted to you. Specifically, social engineering techniques are intended to manipulate authorized employees into providing unauthorized parties with access to private information; for example, by sharing their passwords. These actions are the digital equivalent of stealing a master key from a security guard. You now have access, but it is not legal access. At this point, you can go anywhere with the keys, and you don’t even have to break in.

Social engineering has been used to carry out several high-profile hacks in recent years. In 2020 alone, more than 100 prominent Twitter accounts—including Elon Musk, Barack Obama, Bill Gates, and Michael Bloomberg—were hacked and used to promote a Bitcoin scam. These hacks were the work of teenagers who gained access to Twitter’s internal networks by targeting just a few employees. Significantly, social engineering doesn’t require access to everything. Rather, just one open door is often sufficient.

Social engineering is one of the easier ways to hack an organization. If a hacker wants in, it is easier if someone hands over a password. Many experts believe that humans are the “weakest link” in cybersecurity because they can be easily deceived. That is why there has been a sharp rise in social engineering attacks. The Canadian Anti-Fraud Centre (CAFC) reported that in 2021 Canadians lost over CAD \$100 million to online fraud. According to CAFC’s report, 42 percent of Canadians were subjects of cybersecurity incidents during the first several months of the COVID-19 pandemic in 2020. During this six-month period, 14 percent of CAFC’s survey respondents reported having received fake (i.e., phishing) emails related to COVID-19 test results. The following case explains how Uber was subject to an online cybersecurity attack.

Uber Under Attack

In September 2022, Uber announced that its systems had been hacked. In response, it shut down several internal information systems until it could verify that the systems had not been compromised. A hacker socially engineered an Uber employee after discovering the employee’s WhatsApp number. The employee was tricked into logging in to a fake Uber site that captured their username and password, giving the hacker access to the genuine Uber site.

However, simply obtaining the password was not sufficient. Uber also employs multifactor authentication, or MFA, which requires both a password and an “approval” on another device. In this case, the employee was prompted to push a button on a smartphone to verify that the login was legitimate. One attempt was not enough. So, the hacker repeatedly logged the credentials into the site, repeatedly prompting the driver to approve the MFA. Finally, the employee, confused or tired, approved the login. Now, the attacker was inside the gates.

Once inside Uber’s system, the intruder uncovered administrative credentials that gave access to some of Uber’s network resources. Uber reacted by quickly shutting down some of its internal systems while it determined how much the intruder had been able to access.

How Should Companies Prevent Social Engineering?

Companies can employ multiple strategies to prevent social engineering attacks. The first and most important strategy is to train your employees to become informed users of information technologies. Some experts recommend that organizations think beyond generic training and focus on training that is more specific to each user. For example, the riskiest employees—those with the most access—should receive more in-depth training to match the nature of their access rights. Specifically, they should be informed of the social engineering techniques they are most likely to encounter and what steps they should take in case something suspicious occurs.

One widely accepted best practice is to limit access privileges to those that employees actually need to fulfill their job duties. This practice seems logical and straightforward to implement. Keep in mind, however, that it is common for employees’ roles to change, or for employees to change jobs completely, requiring different levels of access. If access rights are not continuously updated to reflect these changes, then employees can access data they do not need. Furthermore, implementing this strategy can be challenging due to the number of identities, assets, and access privileges, not to mention the identity and access management (IAM) structures each app and service uses.

Limiting privileges cannot prevent social engineering. However, it can minimize the damage because the employee has access only to limited data.

Additionally, outside contractors and consultants who do not work for an organization often have access to its data. Permissions granted to these external parties should be strictly limited to the data they need to fulfill their responsibilities. Further, they should be removed as soon as access is no longer needed.

Uber's Results

After it investigated the September 2022 breach, Uber reported it found “no evidence” that users’ private information had been compromised. The company quickly restored all services including Uber, Uber Eats, Uber Freight, and the Uber Driver app. It also brought back all the internal software tools it had taken down as a precaution following the attack.

Conclusions

According to a 2022 report, attacks that utilize insider threats and compromise user credentials continue to grow by 47 percent each year. Organizations must manage this risk through regular training, security awareness sessions, and cybersecurity techniques.

Human error and failure to follow best practices will always exist. Security experts must bear in mind that most employees of an organization don’t have the focus on preventing security breaches that the experts would like them to have. Ultimately, informed users, who can recognize and spot a trick, are your best defence.

Questions

1. How did a hacker gain access to Uber's systems?
2. Define and discuss social engineering.
3. What steps should organizations take to better secure their systems against social engineering attacks?

Sources: Compiled from A. O’Driscoll, “Canada Cyber Security and Cyber Crime Statistics (2020-2022),” Camparitech, February 9, 2023; R. Turner, “Meaningful Learnings from the Uber Breach,” *Infosecurity Magazine*, September 27, 2022; S. Vaughan-Nichols, “Uber Hack: It’s the Simple Things That Kill Your Security,” *The New Stack*, September 27, 2022; B. Schneier, “The Uber Hack Exposes More Than Failed Data Security,” *The New York Times*, September 26, 2022; S. Sabin, “Uber Hack Challenges Popular Login Security Practices,” *axios.com*, September 23, 2022; D. Winder, “Likely Uber Hacking Suspect, 17, Arrested By City of London Police,” *Forbes*, September 23, 2022; S. Ray, “Social Engineering: How A Teen Hacker Allegedly Managed To Breach Both Uber and Rockstar Games,” *Forbes*, September 20, 2022; E. Gately, “Latest Uber Data Breach Caused by Hacker Tricking Worker,” *Data Center Knowledge*, September 20, 2022; G. Avner, “3 Tips for Mitigating the Uber Hack,” *Security Boulevard*, September 19, 2022; R. Lakshmanan, “Uber Claims No Sensitive Data Exposed in Latest Breach... But There’s More to This,” *The Hacker News*, September 17, 2022; D. Goodin, “Uber Was Breached to Its Core, Purportedly by an 18-Year-Old. Here’s What’s Known,” *arstechnica.com*, September 16, 2022; F. Siddiqui, and J. Menn, “Uber Suffers Computer System Breach, Alerts Authorities,” *The Washington Post*, September 16, 2022.

digital transformation The business strategy that leverages IT to dramatically improve employee, customer, and business partner relationships; support continuous improvement in business operations and business processes; and develop new business models and businesses.

The second reason to learn about IS and IT is that the organization you join will undoubtedly be undergoing a digital transformation. In fact, digital transformation has become one of the most important strategies for organizations. A December 2019 survey by *Forbes* magazine noted that 70 percent of companies surveyed had a digital transformation strategy in place or were working on such a strategy, and 27 percent of companies stated that digital transformation was a matter of survival.

Digital transformation is the business strategy that leverages IT to dramatically improve employee, customer, and business partner relationships; to support continuous improvement in business operations and business processes; and to develop new business models and businesses. The information technologies that drive digital transformation include:

- Big Data (see Chapter 5);
- Business Analytics (see Chapter 12);
- Broadband Internet access (see Chapter 6);
- Mobile Computing (see Chapter 8);
- The Internet of Things (see Chapter 8);
- Social Computing (see Chapter 9);
- Agile Systems Development methods (see Chapter 13);
- Cloud Computing (see Technology Guide 3);
- Artificial Intelligence (see Chapter 14);

The third reason to learn about ISs and IT is that managing the IS function within an organization is no longer the exclusive responsibility of the IS department. Rather, users now play key roles in every step of this process. The overall objective in this text is to provide you with the necessary information to contribute immediately to managing the IS function in your organization. In short, our goal is to help you become a very informed user!

IT Offers Career Opportunities

MIS Because IT is vital to the operation of modern businesses, it offers many employment opportunities. The demand for traditional IT staff—programmers, business analysts, systems

analysts, and designers—is substantial. In addition, many well-paid jobs exist in areas such as the Internet and electronic commerce (e-commerce), mobile commerce (m-commerce), network security, telecommunications, and multimedia design.

The IS field includes the people in various organizations who design and build information systems, the people who use those systems, and the people responsible for managing those systems. At the top of the list is the chief information officer (CIO).

The CIO is the executive in charge of the IS function. In most modern organizations, the CIO works with the chief executive officer (CEO), the chief financial officer (CFO), and other senior executives. Therefore, he or she actively participates in the organization's strategic planning process. In today's digital environment, the IS function has become increasingly strategic within organizations. As a result, although most CIOs still rise from the IS department, a growing number are coming up through the ranks in the business units (e.g., marketing, finance). Regardless of your major, you could become the CIO of your organization one day. This is another reason to be an informed user of information systems!

Table 1.1 provides a list of IT jobs, along with a description of each one. For further details about careers in IT, see www.linkedin.com, www.computerworld.com/category/careers/, and www.monster.ca.

Career opportunities in IS are strong and are projected to remain strong over the next 10 years. In fact, Randstad (www.randstad.ca), a leading provider of human resources solutions, recently announced the top 15 jobs in Canada for 2023, while LinkedIn listed 20 of the fastest-growing job titles over the past five years in Canada. Let's take a look at these rankings. (Note that the rankings differ because these two organizations used different criteria in their

TABLE 1.1 Information Technology Jobs

Position	Job Description
Chief Information Officer	Highest-ranking IS manager; responsible for all strategic planning in the organization
IS Director	Manages all systems throughout the organization and the day-to-day operations of the entire IS organization
Information Centre Manager	Manages IS services such as help desks, hotlines, training, and consulting
Applications Development Manager	Coordinates and manages new systems development projects
Project Manager	Manages a particular new systems development project
Systems Analyst	Interfaces between users and programmers; determines information requirements and technical specifications for new applications
Operations Manager	Supervises the day-to-day operations of the data and/or computer centre
Programming Manager	Coordinates all applications programming efforts
Social Media Manager	Coordinates all social media development efforts and all social media monitoring and response efforts
Business Analyst	Focuses on designing solutions for business problems; interfaces closely with users to demonstrate how IT can be used innovatively
Systems Programmer	Creates the computer code for developing new systems software or maintaining existing systems software
Applications Programmer	Creates the computer code for developing new applications or maintaining existing applications
Emerging Technologies Manager	Forecasts technology trends; evaluates and experiments with new technologies
Network Manager	Coordinates and manages the organization's voice and data networks
Database Administrator	Manages the organization's databases and oversees the use of database-management software
Auditing or Computer Security Manager	Oversees the ethical and legal use of information systems
Webmaster	Manages the organization's website
Web Designer	Creates websites and pages

research.) As you can see, jobs suited for MIS majors appear in both lists, many of them quite high. The job rankings are as follows:

Randstad’s list of top jobs in Canada (out of 15)

- #1 Software developer
- #12 Business systems analyst
- #14 Digital marketing coordinator

LinkedIn’s list of fastest-growing job titles over the past five years in Canada (out of 20)

- #4 Technical program manager
- #8 Information technology associate
- #9 Site reliability engineer
- #13 Security engineer
- #14 Data engineer
- #15 E-commerce coordinator
- #16 Technical product manager
- #17 Cyber security specialist

Not only do IS careers offer strong job growth, but the pay is excellent as well. Indeed (www.indeed.ca) released a list of the 15 highest-paying jobs in Canada in 2023. These jobs include:

Job	National Average Salary
#9 Software engineer manager	\$143,044
#10 Director of information technology	\$117,890
#11 Software architect	\$119,021
#12 Enterprise architect	\$110,083
#15 Data scientist	\$84,630

According to CIO ITBrew.com, a July 2022 Gartner survey of 128 CFOs and CEOs indicates that technology spending will remain strong, even if the economy does not. The survey found that 41 percent of respondents would cut mergers and acquisitions first, followed by sustainability, workforce training and talent development, capital expenditure for physical network expansion, and product innovation. The item “improvements in technology for improved efficiency and scalability” was in last place for cuts, with only 23 percent of respondents identifying it as a top area for belt-tightening. In fact, around 45 percent of the executives identified the category as the last place they would seek cuts. This is great news for students looking for strong job opportunities.

Managing Information Resources

Managing information systems in modern organizations is a difficult, complex task. Several factors contribute to this complexity. First, information systems have enormous strategic value to organizations. Firms rely on them so heavily that, in some cases, when these systems are not working (even for a short time), the firm cannot function. (This situation is called “being hostage to information systems.”) Second, information systems are very expensive to acquire, operate, and maintain.

A third factor contributing to the difficulty of managing information systems is the evolution of the management information systems (MIS) function within the organization. When businesses first began to use computers in the early 1950s, the MIS department “owned” the only computing resource in the organization: the mainframe. At that time, end users did not interact directly with the mainframe.

MIS In contrast, in the modern organization, computers are located in all departments, and almost all employees use computers in their work. This situation, known as *end user computing*, has led to a partnership between the MIS department and the end users. The MIS department now acts as more of a consultant to end users, viewing them as customers. In fact, the main function of the MIS department is to use IT to solve end users' business problems.

MIS As a result of these developments, the responsibility for managing information resources is now divided between the MIS department and the end users. This arrangement raises several important questions. Which resources are managed by whom? What is the role of the MIS department, its structure, and its place within the organization? What is the appropriate relationship between the MIS department and the end users? Regardless of who is doing what, it is essential that the MIS department and the end users work in close co-operation.

There is no standard way to divide responsibility for developing and maintaining information resources between the MIS department and the end users. Instead, that division depends on several factors: the size and nature of the organization, the amount and type of IT resources, the organization's attitudes toward computing, the attitudes of top management toward computing, the maturity level of the technology, the amount and nature of outsourced IT work, and even the countries in which the company operates. Generally speaking, the MIS department is responsible for corporate-level and shared resources, and the end users are responsible for departmental resources. **Table 1.2** identifies both the traditional functions and various new, consultative functions of the MIS department.

So, where do the end users come in? Take a close look at Table 1.2. Under the traditional MIS functions, you will see two functions for which you provide vital input: managing systems development and infrastructure planning. Under the consultative MIS functions, in contrast, you exercise the primary responsibility for each function, while the MIS department acts as your adviser.

TABLE 1.2 The Changing Role of the Information Systems Department

Traditional Functions of the MIS Department

- Managing systems development and systems project management
 - As an end user, you will have critical input into the systems development process. You will learn about systems development in Chapter 13.
- Managing computer operations, including the computer centre
- Staffing, training, and developing IS skills
- Providing technical services
- Infrastructure planning, development, and control
 - As an end user, you will provide critical input about the IS infrastructure needs of your department.

New (Consultative) Functions of the MIS Department

- Initiating and designing specific strategic information systems
 - As an end-user, your information needs will often mandate the development of new strategic information systems.
- You will decide which strategic systems you need (because you know your business needs and requirements better than the MIS department does), and you will provide input into developing these systems.
- Incorporating the internet and electronic commerce into the business
 - As an end user, you will be primarily responsible for effectively using the internet and electronic commerce in your business. You will work with the MIS department to accomplish these tasks.
- Managing system integration, including the internet, intranets, and extranets
 - As an end user, your business needs will determine how you want to use the internet, your corporate intranets, and extranets to accomplish your goals. You will be primarily responsible for advising the MIS department on the most effective use of the internet, your corporate intranets, and extranets.
- Educating non-MIS managers about IT
 - Your department will be primarily responsible for advising the MIS department on how best to educate and train your employees about IT.

(continued)

TABLE 1.2 The Changing Role of the Information Systems Department (continued)

New (Consultative) Functions of the MIS Department

- Educating the MIS staff about the business
 - Communication between the MIS department and business units is a two-way street. You will be responsible for educating the MIS staff on your business, its needs and requirements, and its goals.
- Partnering with business unit executives
 - Essentially, you will be in a partnership with the MIS department. You will be responsible for seeing that this partnership is one “between equals” and ensuring its success.
- Managing outsourcing
 - Outsourcing is driven by business needs. Therefore, the outsourcing decision resides largely with the business units (i.e., with you). The MIS department, working closely with you, will advise you on technical issues such as communications bandwidth and security.
- Proactively using business and technical knowledge to see innovative ideas about using IT
 - Your business needs will often drive innovative ideas about how to effectively use information systems to accomplish your goals. The best way to bring these innovative uses of IS to life is to partner closely with your MIS department. Such close partnerships have amazing synergies!
- Creating business alliances with business partners
 - The needs of your business unit will drive these alliances, typically along your supply chain. Again, your MIS department will act as your adviser on various issues, including hardware and software compatibility, implementing extranets, communications, and security.

Before you go on...

1. Rate yourself as an informed user. (Be honest; this isn’t a test!)
2. Explain the benefits of being an informed user of information systems.
3. Discuss the various career opportunities offered in the IT field.

1.2 Overview of Computer-Based Information Systems

LEARNING OBJECTIVE

Describe the various types of computer-based information systems in an organization.

information technology (IT)

Any computer-based tool that people use to work with information and support an organization’s information and information-processing needs.

information system

(IS) A system that collects, processes, stores, analyzes, and disseminates information for a specific purpose.

Organizations refer to their management information systems functional area by several names, including the MIS Department, the Information Systems (IS) Department, the Information Technology (IT) Department, and the Information Services Department. Regardless of the name, however, this functional area deals with the planning for—and the development, management, and use of—information technology tools to help people perform all the tasks related to information processing and management. Recall that **information technology** relates to any computer-based tool that people use to work with information and support the information and information-processing needs of an organization.

As previously stated, an **information system** collects, processes, stores, analyzes, and disseminates information for a specific purpose. The purpose of information systems has been defined as getting the right information to the right people, at the right time, in the right amount, and in the right format. Because information systems are intended to supply useful information, we need to differentiate between information and two closely related terms: data and knowledge (see **Figure 1.2**).

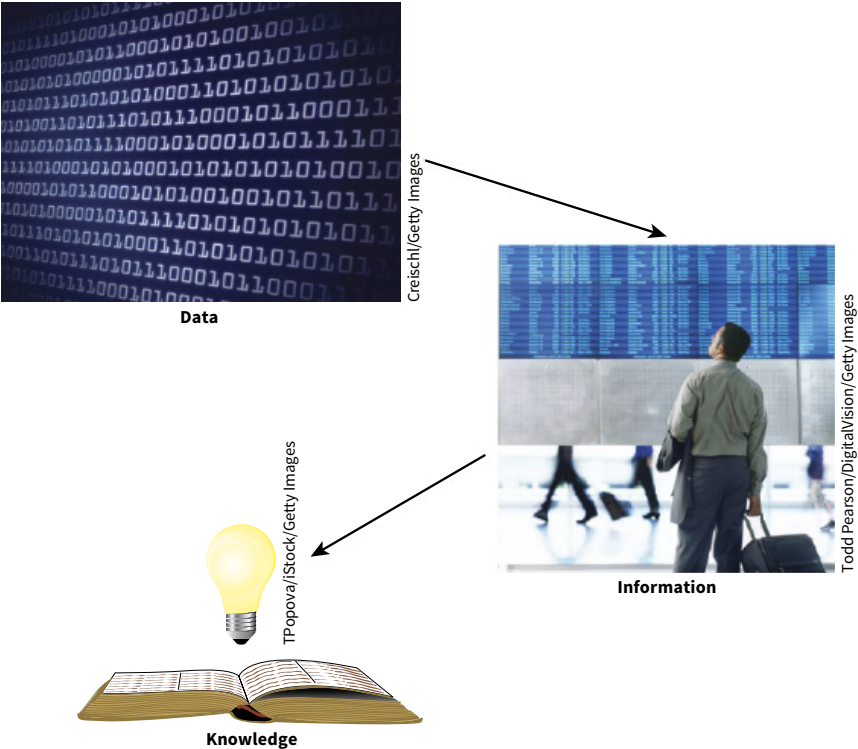


FIGURE 1.2 Data, information, and knowledge.

Data items refer to elementary descriptions of things, events, activities, and transactions that are recorded, classified, and stored but are not organized to convey any specific meaning. Data items can be numbers, letters, figures, sounds, and images. Examples of data items are collections of numbers (e.g., 3.11, 2.96, 3.95, 1.99, 2.08) and characters (e.g., B, A, C, A, B, D, F, C).

Information refers to data that have been organized so that they have meaning and value to the recipient. For example, a grade point average (GPA) by itself is data, but a student's name coupled with their GPA is information. The recipient interprets the meaning and draws conclusions and implications from the information. Consider the examples of data provided in the preceding paragraph. Within the context of a university, the numbers could be grade point averages, and the letters could be grades in an Introduction to MIS class.

Knowledge consists of data and/or information that have been organized and processed to convey understanding, experience, accumulated learning, and expertise as they apply to a current business problem. For example, suppose that a company recruiting at your school has found over time that students with grade point averages over 3.0 have experienced the greatest success in its management program. Based on this accumulated knowledge, that company may decide to interview only those students with GPAs over 3.0. This is an example of knowledge because the company utilizes information—GPAs—to address a business problem—hiring successful employees. As you can see from this example, organizational knowledge, which reflects the experience and expertise of many people, has great value to all employees.

Consider this example:

Data	Information	Knowledge
[No context]	[University context]	
3.16	3.16 + John Jones = GPA	* Job prospects
2.92	2.92 + Sue Smith = GPA	* Graduate school prospects
1.39	1.39 + Kyle Owens = GPA	* Scholarship prospects
3.95	3.95 + Tom Elias = GPA	

data items Elementary descriptions of things, events, activities, and transactions that are recorded, classified, and stored but are not organized to convey any specific meaning.

information Data that have been organized so that they have meaning and value to the recipient.

knowledge Data and/or information that have been organized and processed to convey understanding, experience, accumulated learning, and expertise as they apply to a current problem or activity.

Data	Information	Knowledge
[No context]	[Professional baseball pitcher context]	
3.16	3.16 + Corey Kluber = ERA	
2.92	2.92 + Chris Sale = ERA	* Keep pitcher, trade pitcher, or send pitcher to minor leagues
1.39	1.39 + Clayton Kershaw = ERA	* Salary/contract negotiations
3.95	3.95 + Shane Bieber = ERA	

computer-based information system (CBIS) An information system that uses computer technology to perform some or all of its intended tasks.

information technology components Hardware, software, databases, and networks.

hardware A device such as a processor, monitor, keyboard, or printer. Together, these devices accept, process, and display data and information.

software A program or collection of programs that enable the hardware to process data.

database A collection of related files or tables containing data.

GPA = Grade point average (higher is better)
ERA = Earned run average (lower is better); ERA is the number of runs per nine innings that a pitcher surrenders.

You see that the same data items with no context can have entirely different meanings in different contexts.

Now that you have a clearer understanding of data, information, and knowledge, let’s shift our focus to computer-based information systems. As you have seen, these systems process data into information and knowledge that you can use.

A **computer-based information system (CBIS)** is an information system that uses computer technology to perform some or all of its intended tasks. Although not all information systems are computerized, today most are. For this reason, the term “information system” is typically used synonymously with “computer-based information system.” The basic components of computer-based information systems are listed below. The first four are called **information technology components**. **Figure 1.3** illustrates how these four components interact to form a CBIS.

- **Hardware** consists of devices such as the processor, monitor, keyboard, and printer. Together, these devices accept, process, and display data and information.
- **Software** is a program or collection of programs that enable the hardware to process data.
- A **database** is a collection of related files or tables containing data.

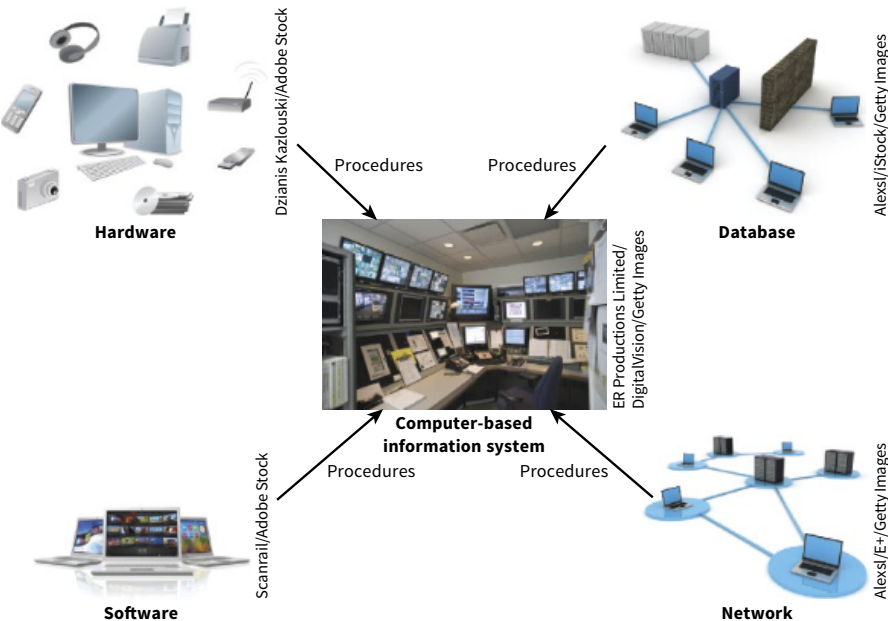


FIGURE 1.3 Computer-based information systems consist of hardware, software, databases, networks, procedures, and people.

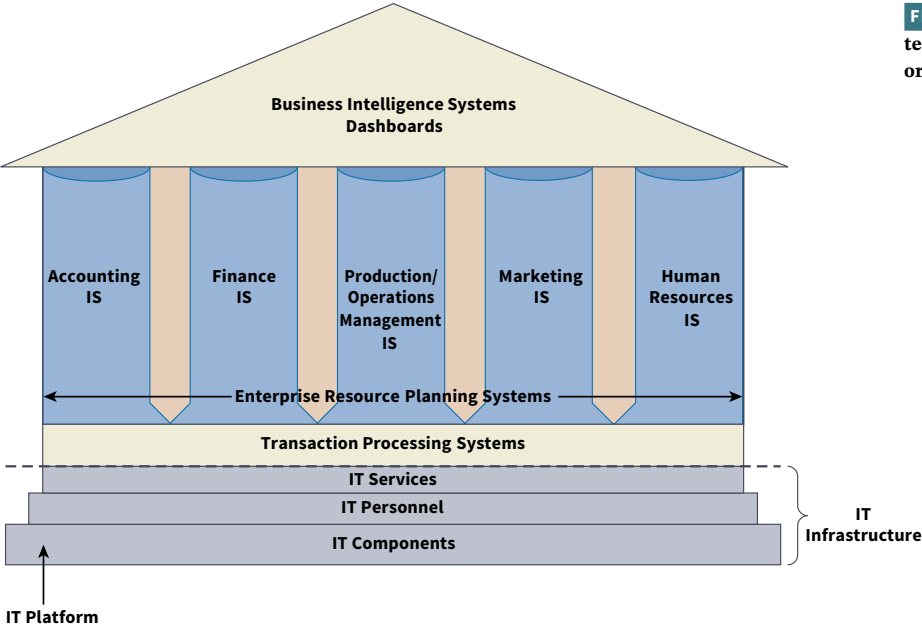


FIGURE 1.4 Information technology inside your organization.

- A **network** is a connecting system (wireline or wireless) that enables multiple computers to share resources.
- **Procedures** are the instructions for combining the above components to process information and generate the desired output.
- *People* use the hardware and software, interface with it, or utilize its output.

Figure 1.4 illustrates how these components are integrated to form the wide variety of information systems found within an organization. Starting at the bottom of the figure, you see that the IT components of hardware, software, networks (wireline and wireless), and databases form the **information technology platform**. IT personnel use these components to develop information systems, oversee security and risk, and manage data. These activities cumulatively are called **information technology services**. The IT components plus IT services comprise the organization’s **information technology infrastructure**. At the top of the pyramid are the various organizational information systems.

Computer-based information systems have many capabilities. Table 1.3 summarizes the most important ones.

Information systems perform these various tasks via a wide spectrum of applications. An **application (or app)** is a computer program designed to support a specific task or business process. (A synonymous term is *application program*.) Each functional area or department within a business organization uses dozens of application programs. For instance, the human resources department sometimes uses one application for screening job applicants and another for monitoring employee turnover. The collection of application programs in

network A connecting system (wireline or wireless) that enables multiple computers to share resources.

procedures The set of instructions for combining hardware, software, database, and network components in order to process information and generate the desired output.

information technology platform The name given to the combination of the IT components of hardware, software, networks (wireline and wireless), and databases.

information technology services Activities performed by IT personnel using IT components; specifically, developing information systems, overseeing security and risk, and managing data.

information technology infrastructure IT components plus IT services.

application (or app) A computer program designed to support a specific task or business process.

TABLE 1.3 Major Capabilities of Information Systems

Perform high-speed, high-volume numerical computations.
Provide fast, accurate communication and collaboration within and among organizations.
Store huge amounts of information in an easy-to-access yet small space.
Allow quick and inexpensive access to vast amounts of information worldwide.
Analyze and interpret vast amounts of data quickly and efficiently.
Automate both semiautomatic business processes and manual tasks.

departmental information system

The business strategy that leverages IT to dramatically improve employee, customer, and business partner relationships; support continuous improvement in business operations and business processes; and develop new business models and businesses.

a single department is usually referred to as a **departmental information system** (also known as a functional area information system (FAIS)). For example, the collection of application programs in the human resources area is called the human resources information system (HRIS). There are collections of application programs—that is, departmental information systems—in the other functional areas as well, such as accounting, finance, marketing, and production/operations.

Types of Computer-Based Information Systems

Modern organizations employ many different types of information systems. Figure 1.4 illustrates the different types of information systems that function within a single organization, and Figure 1.5 shows the different types of information systems that function *among* multiple organizations. You will study transaction processing systems, management information systems, and enterprise resource planning systems in Chapter 10. You will learn about both customer relationship management (CRM) systems and supply chain management (SCM) systems in Chapter 11.

In the next section, you will learn about the numerous and diverse types of information systems employed by modern organizations. You will also read about the types of support these systems provide.

Breadth of Support of Information Systems

Certain information systems support parts of organizations, others support entire organizations, and still others support groups of organizations. This section addresses all of these systems.

Recall that each department or functional area within an organization has its own collection of application programs, or information systems. These functional area information systems are the supporting pillars for the information systems located at the top of Figure 1.4, namely, business intelligence systems and dashboards. As the name suggests, each FAIS supports a particular functional area within the organization. Examples are accounting IS, finance IS, production/operations management (POM) IS, marketing IS, and human resources IS.

ACCT **FIN** Consider these examples of IT systems in the various functional areas of an organization. In *finance and accounting*, managers use IT systems to forecast revenues and business activity, to determine the best sources and uses of funds, and to perform audits to

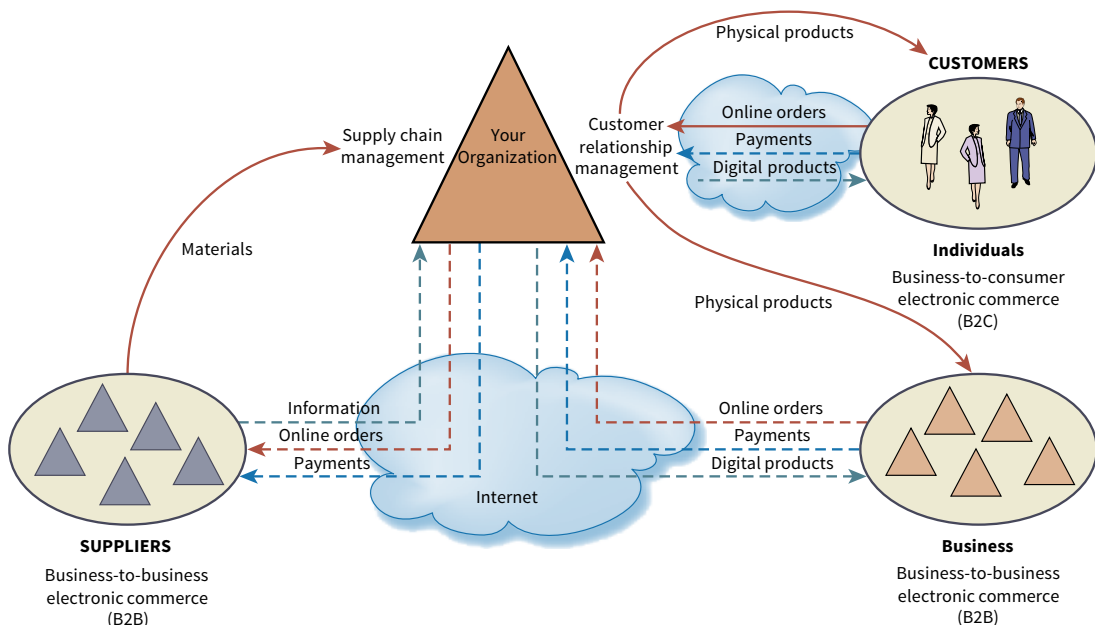


FIGURE 1.5 Information systems that function among multiple organizations.

ensure that the organization is fundamentally sound and that all financial reports and documents are accurate.

MKT In *sales and marketing*, managers use information technology to perform the following functions:

- *Product analysis*: Developing new goods and services
- *Site analysis*: Determining the best location for production and distribution facilities
- *Promotion analysis*: Identifying the best advertising channels
- *Price analysis*: Setting product prices to obtain the highest total revenues

Marketing managers also use IT to manage their relationships with their customers.

POM In *manufacturing*, managers use IT to process customer orders, develop production schedules, control inventory levels, and monitor product quality. They also use IT to design and manufacture products. These processes are called *computer-assisted design (CAD)* and *computer-assisted manufacturing (CAM)*.

HRM Managers in *human resources* use IT to manage the recruiting process, analyze and screen job applicants, and hire new employees. They also employ IT to help employees manage their careers, to administer performance tests to employees, and to monitor employee productivity. Finally, they rely on IT to manage compensation and benefits packages.

Two information systems that support the entire organization, enterprise resource planning (ERP) systems and transaction processing systems, are designed to correct a lack of communication among the functional area ISs. For this reason, Figure 1.4 shows ERP systems spanning the FAISs. ERP systems were an important innovation because organizations often developed the various functional area ISs as stand-alone systems that did not communicate effectively (if at all) with one another. ERP systems resolve this problem by tightly integrating the functional area ISs via a common database. In doing so, they enhance communications among the functional areas of an organization. For this reason, experts credit ERP systems with greatly increasing organizational productivity.

A transaction processing system (TPS) supports the monitoring, collection, storage, and processing of data from the organization's basic business transactions, each of which generates data. When you are checking out at Walmart, for example, a transaction occurs each time the cashier swipes an item across the bar code reader. Significantly, within an organization, different functions or departments can define a transaction differently. In accounting, for example, a transaction is anything that changes a firm's chart of accounts. The information system definition of a transaction is broader: a transaction is anything that changes the firm's database. The chart of accounts is only part of the firm's database. Consider a scenario in which a student transfers from one section of an Introduction to MIS course to another section. This move would be a transaction to the university's information system, but not to the university's accounting department (the tuition would not change).

The TPS collects data continuously, typically in *real time*—that is, as soon as the data are generated—and it provides the input data for the corporate databases. TPSs are considered critical to the success of any enterprise because they support core operations. Significantly, nearly all ERP systems are also TPSs, but not all TPSs are ERP systems. In fact, modern ERP systems incorporate many functions that previously were handled by the organization's functional area information systems. You will study both TPSs and ERP systems in detail in Chapter 10.

ERP systems and TPSs function primarily within a single organization. Information systems that connect two or more organizations are referred to as interorganizational information systems (IOSs). IOSs support many interorganizational operations, of which *supply chain management* is the best known. An organization's supply chain is the flow of materials, information, money, and services from suppliers of raw materials through factories and warehouses to the end customers.

Note that the supply chain in Figure 1.5 shows physical flows, information flows, and financial flows. Digitizable products are those that can be represented in electronic form, such as music and software. Information flows, financial flows, and digitizable products go through the internet, whereas physical products are shipped. For example, when you order a computer from www.dell.com, your information goes to Dell via the internet. When your transaction is completed (that is, your credit card is approved and your order is processed), Dell ships your computer to you. (We discuss supply chains in more detail in Chapter 11.)

Electronic commerce (e-commerce) systems

A type of interorganizational information system that enables organizations to conduct transactions, called business-to-business (B2B) electronic commerce, and customers to conduct transactions with businesses, called business-to-consumer (B2C) electronic commerce.

Electronic commerce (e-commerce) systems are another type of interorganizational information system. These systems enable organizations to conduct transactions, called business-to-business (B2B) electronic commerce, and customers to conduct transactions with businesses, called business-to-consumer (B2C) electronic commerce. Figure 1.5 illustrates B2B and B2C electronic commerce. Electronic commerce systems are so important that we discuss them in detail in Chapter 7, with additional examples interspersed throughout the text. IT's About Business 1.2 presents the case of lululemon, a pioneer in the athleisure industry, which turned the threat of the COVID-19 pandemic into an opportunity to grow and enhance its e-commerce strategies and channels.

Support for Organizational Employees So far, you have concentrated on information systems that support specific functional areas and operations. Now you will learn about information systems that typically support particular employees within the organization.

IT's About Business 1.2

MKT **MIS** lululemon's Success During and Despite the COVID-19 Pandemic

lululemon athletica, headquartered in Vancouver, BC, is a Canadian athletic apparel brand that has more than 490 stores worldwide. At first glance, Lululemon seemed like a business that would be especially vulnerable to the disruptions caused by the COVID-19 pandemic because not only was it forced to close its shops, like many other retail companies, but the brand is also tied to in-person fitness activities, which took a hit due to lockdowns and restrictions.

However, to many people's surprise, not only did lululemon manage to survive the pandemic but it actually prospered. The brand reported that its revenue for the second quarter of 2021 increased by 61 percent compared to the previous year. Overall, lululemon's annual revenue in 2020, 2021, and 2022 grew by 21 percent, 11 percent, and 42 percent, respectively. How did lululemon manage to achieve such astonishing results? Here we review some of the contributing success factors.

By March 2020, lululemon already had a strong online presence with its e-commerce website. Additionally, it had already invested in RFID technology (see Chapter 5). This combination enabled it to have accurate real-time store inventory visibility and thus to offer its customers the option to buy online, pick up in store (BOPIS). lululemon also invested in a new mobile point-of-sale system, which made it possible to conduct transactions like purchases of gift cards, returns, and exchanges just outside of the store.

In addition, in April 2020, lululemon introduced a unique feature for its customers, who were locked down at home at the time. The live video-chat shopping experience was a game-changer that enabled customers to schedule one-on-one video chats with lululemon experts to discuss sizing, recommendations, etc.

During the COVID-19 pandemic, although consumers were stuck at home, many wanted to keep fit and continue doing some physical activities. So, lululemon jumped on this trend and responded to the change in consumers' habits by introducing online sport challenges like "move and stay connected," which was based on spending 20 minutes a day, five days a week, moving. To further encourage its consumers, lululemon posted daily streams with its brand ambassadors via Instagram. These daily sessions not only increased consumers' engagement with the brand but also helped them build a new lifestyle in the new reality.

lululemon also invested in *paid search*, which is a type of digital marketing where search engines such as Google show ads on their results pages. Paid searches drive traffic to the advertised websites through ads that are relevant to the key terms used to search the web. Paid search helped lululemon to increase its brand awareness, generate extra sales, and attract a new audience.

During the pandemic, lululemon observed an unprecedented volume of sales through its online channels. To make this happen, according to its CEO, Calvin McDonald, lululemon "had to pull forward almost three years' worth of investments in capital expenditure to build upon its digital infrastructure—years ahead of schedule." As a result of its investments, efforts, and dedication, the brand managed to achieve its goal of doubling 2018 e-commerce revenue three years early.

Questions

1. What other digital initiatives could lululemon employ on its website to enhance its revenue from online sales?
2. How can lululemon better employ social media platforms to increase brand awareness and/or customer satisfaction?

Sources: Compiled from J. Park, "Leading in Crisis: How the Pandemic Shaped lululemon CEO Calvin McDonald's (Executive MBA '00) View on Leadership," *Rotman*, May 17, 2022; M. Fool, "Here's How Lululemon Plans to Double Revenue by 2026," *The Globe and Mail*, May 10, 2022; E. Mixon, "Lululemon Bet Big on Digital Technology and Won, Here's How," *Intelligent Automation Network*, January 4, 2022; Y. Pan, "Lululemon Provides Better Customer Services through Digital Ecosystem," *Highlights in Business, Economics and Management*, Volume 1, 2022; S. Kohan, "Lululemon Sales Surge Despite Supply Chain Issues," *Forbes*, September 8, 2021; S. Lauchlan, "Champagne for Lululemon! Athleisure Wear Retailer Reaps the Omni-Channel Benefits of a Locked Down Customer Base," *Diginomica*, April 1, 2021; L. Johnston, "Lululemon Will Open More Stores as Digital Investments Drive Growth," *RIS News*, March 30, 2021; V. Kurichenko, "How Lululemon Increased Their Brand Value by 40% in 2020," *Medium*, June 17, 2020; L. Dignan, "Lululemon Steps Up Digital Efforts, E-Commerce as Physical Stores Closed Due to COVID-19," *ZDNET*, March 30, 2020; "Lululemon Boosts Digital Sales 30% through Global Focus," *BrainStation*, December 16, 2019.

Clerical workers, who support managers at all levels of the organization, include bookkeepers, secretaries, electronic file clerks, and insurance claim processors. *Lower-level managers* handle the day-to-day operations of the organization, making routine decisions such as assigning tasks to employees and placing purchase orders. *Middle managers* make tactical decisions, which deal with activities such as short-term planning, organizing, and control.

Knowledge workers are professional employees such as financial and marketing analysts, engineers, lawyers, and accountants. All knowledge workers are experts in a particular subject area. They create information and knowledge, which they integrate into the business. Knowledge workers, in turn, act as advisers to middle managers and executives. Finally, *executives* make decisions that deal with situations that can significantly change the manner in which business is conducted. Examples of executive decisions are introducing a new product line, acquiring other businesses, and relocating operations to a foreign country.

Functional area information systems summarize data and prepare reports, primarily for middle managers, but sometimes for lower-level managers as well. Because these reports typically concern a specific functional area, report generators (RPGs) are an important type of functional area IS.

Business analytics (BA) systems (also known as **business intelligence (BI) systems**) provide computer-based support for complex, nonroutine decisions, primarily for middle managers and knowledge workers. (They also support lower-level managers, but to a lesser extent.) These systems are typically used with a data warehouse, and they enable users to perform their own data analysis. You will learn about BA systems in Chapter 12.

Expert systems (ESs) attempt to duplicate the work of human experts by applying reasoning capabilities, knowledge, and expertise within a specific domain. They have become valuable in many application areas, primarily but not exclusively areas involving decision making. For example, navigation systems use rules to select routes, but we do not typically think of these systems as expert systems. Significantly, expert systems can operate as stand-alone systems or be embedded in other applications. We examine ESs in greater detail in Chapter 14.

Dashboards (also called **digital dashboards**) are a special form of IS that support all managers of the organization. They provide rapid access to timely information and direct access to structured information in the form of reports. Dashboards that are tailored to the information needs of executives are called *executive dashboards*. Chapter 12 provides a thorough discussion of dashboards.

Table 1.4 provides an overview of the different types of information systems used by organizations.

knowledge workers

Professional employees such as financial and marketing analysts, engineers, lawyers, and accountants, who are experts in a particular subject area and who create information and knowledge, which they integrate into the business.

Business analytics (BA) systems See business intelligence systems.

business intelligence (BI) systems Systems that provide computer-based support for complex, nonroutine decisions, primarily for middle managers and knowledge workers.

Expert systems (ESs) Systems that attempt to duplicate the work of human experts by applying reasoning capabilities, knowledge, and expertise within a specific domain.

dashboard A business analytics presentation tool that provides rapid access to timely information and direct access to management reports.

TABLE 1.4 Types of Organizational Information Systems

Type of System	Function	Example
Transaction processing system	Processes transaction data from terminal	Walmart checkout point-of-sale business events
Enterprise resource planning	Integrates all functional areas of the organization	Oracle, SAP system
Functional area IS	Supports the activities within a specific functional area	System for processing payroll
Decision support system	Provides access to data and analysis tools	“What-if” analysis of changes in budget
Expert system	Mimics human expert in a particular area and makes decisions	Credit card approval analysis
Dashboards	Present structured, summarized information about aspects of business important to executives	Status of sales by product
Supply chain management system	Manages flows of products, services, and information among organizations	Walmart Retail Link system connecting suppliers to Walmart
Electronic commerce system	Enables transactions among organizations and between organizations and customers	www.dell.com

Before you go on...

1. What is a computer-based information system?
2. Describe the components of computer-based information systems.
3. What is an application program?
4. Explain how information systems provide support for knowledge workers.
5. As we move up the organization's hierarchy from clerical workers to executives, how does the type of support provided by information systems change?

1.3**How Does IT Impact Organizations?****LEARNING OBJECTIVE**

Discuss ways in which information technology can affect managers and non-managerial workers.

Throughout this text, you will encounter numerous examples of how IT affects various types of organizations. These examples will make you aware of just how important IT actually is to organizations. In fact, for the vast majority of organizations, if their information systems fail, then they cease operations until the problems are found and fixed. Consider the following examples.

On December 18, 2022, a leading Canadian pediatric hospital, Toronto-based SickKids, was hit by a cyberattack. The attack caused several network systems to go down. Specifically, SickKids' website, phone lines, and some clinical and corporate systems were affected by the attack for two weeks. According to the hospital, the medical equipment and services remained functional; however, clinical teams experienced delays in receiving lab and imaging results, which caused patients and families to suffer from longer than usual waiting times. The attack was executed by the LockBit ransomware group. The group made an official apology later for having attacked a health care organization.

This section provides an overview of the impact of IT on modern organizations. As you read it, you will learn how IT will affect you as well.

IT Impacts Entire Industries

As of mid-2022, the technology required to transform industries through software had been developed and integrated and could be delivered globally. In addition, software tools and internet-based services enabled companies in many industries to launch new software-powered start-ups without investing in new infrastructure or training new employees. For example, in 2000, operating a basic internet application cost businesses approximately CAD \$200,000 per month. By mid-2022, operating that same application in Amazon's cloud could cost as little as CAD \$140 per month, depending on the amount of data traffic to and from the website. (We discuss cloud computing in Technology Guide 3.)

In essence, software is impacting every industry, and every organization must prepare for these impacts. Let's examine a few examples of software disruption across several industries. Many of these examples focus on two scenarios: (1) industries where software disrupted the previous market-leading companies, and (2) industries where a new company (or companies) used software to achieve a competitive advantage.

The Book Industry In early-2023, the largest book bookseller in the world was Amazon, a software company. Amazon's core capability is its software engine, which can sell virtually

anything online without building or maintaining any retail stores. Now even books themselves have become software products, known as electronic (or digital) books, or e-books.

The revenue in the e-book segment of the worldwide book market is projected to reach US \$14.21 billion in 2023, while revenue for the physical books segment is projected to reach US \$68.08 billion. So, the revenue from the sales of e-books will account for more than 17 percent of total revenue from book sales. Given that the average revenue per user for e-books and physical books is estimated to be US \$14.46 and US \$37.41, respectively, the number of e-books expected to be sold in 2023 accounts for 35 percent of the total books sold in the market.

According to the 2018 Academic Student eBook Experience Survey, 74 percent of respondents said that they preferred print books when reading for pleasure. Furthermore, 68 percent said that they preferred print books for assigned readings. In 2022, e-book sales were down 12 percent compared to the previous year. While some of this is attributed to the world reopening after the COVID-19 pandemic, the future is unknown and continuous disruption is affecting the book industry.

The Music Industry Dramatic changes in the music industry resulted from the emergence of digital music-streaming platforms such as Spotify (www.spotify.com), Apple Music (www.apple.com/ca/apple-music/), and Amazon Prime (www.amazon.ca), which generally charge CAD \$9 to CAD \$12 per month for unlimited access to millions of songs. Even though the record labels receive only about 0.3–0.5 cents each time a song is streamed, these small amounts are significant. In 2021, the global record industry reported revenues of US \$25.9 billion (up from \$20.2 billion in 2019), with streaming generating US \$16.9 billion (up from \$11.4 billion in 2019).

The Video Industry Blockbuster—which rented and sold videos and ancillary products through its chain of stores—was the industry leader until it was disrupted by a software company, Netflix (www.netflix.com). By the first quarter, 2021, Netflix had the largest global subscriber base of any video service, with more than 200 million subscribers. Meanwhile, Blockbuster declared bankruptcy in February 2011 and was acquired by satellite television provider Dish Network (www.dish.com) a month later.

MIS The Software Industry Incumbent software companies such as Oracle and Microsoft are increasingly threatened by software-as-a-service (SaaS) products—for example, Salesforce (www.salesforce.com) and Android, an open-source operating system. (We discuss operating systems in [Technology Guide 2](#) and SaaS in [Technology Guide 3](#).)

The Video Game Industry Today, the fastest growing entertainment companies are video game makers—again, software. Examples are Zynga (www.zynga.com), the creator of FarmVille; Rovio (www.rovio.com), the maker of Angry Birds; and Minecraft (www.minecraft.net), now owned by Microsoft (www.microsoft.com).

The Photography Industry Software disrupted this industry years ago. Today, it is virtually impossible to buy a mobile phone that does not include a software-powered camera. In addition, people can upload photos automatically to the internet for permanent archiving and global sharing. Leading photography companies include Instagram (www.instagram.com), Shutterfly (www.shutterfly.com), Snapfish (www.snapfish.com), and Flickr (www.flickr.com). Meanwhile, Kodak, the long-time market leader—whose name was almost synonymous with cameras—declared bankruptcy in January 2012.

MKT The Marketing Industry Some of today's largest direct marketing companies include Facebook (www.facebook.com), Google (www.google.com), and Amazon (www.amazon.com). All of these companies are using software to disrupt the retail marketing industry.

HRM The Recruiting Industry LinkedIn (www.linkedin.com) is disrupting the traditional job-recruiting industry. For the first time, employees and job searchers can maintain their résumés on a publicly accessible website that interested parties can search in real time.

FIN The Financial Services Industry Software has transformed the financial services industry. Practically every financial transaction—for example, buying and selling stocks—is now performed by software. In fact, an entirely new name has been given to the merging of technology and financial services, FinTech (Financial Technologies). Also, many of the leading innovators in financial services are software companies. See our discussion of FinTech in Chapter 7.

The Motion Picture Industry The process of making feature-length computer-generated films has become incredibly IT-intensive. Studios require state-of-the-art information technologies, including massive numbers of servers, sophisticated software, and an enormous amount of storage (all described in **Technology Guide 1**).

Consider DreamWorks Animation (www.dreamworks.com), a motion picture studio that creates animated feature films, television programs, and online virtual worlds. For a single motion picture, the studio manages more than 500,000 files and 300 terabytes (a terabyte is 1 trillion bytes) of data, and it uses about 80 million central processing unit (CPU; described in **Technology Guide 1**) hours. As DreamWorks executives state, “In reality, our product is data that looks like a movie. We are a digital manufacturing company.”

Software is also disrupting industries that operate primarily in the physical world. Consider these examples:

- *The Automobile Industry:* In modern cars, software is responsible for running the engine, controlling safety features, entertaining passengers, guiding drivers (and in some cases, fully autonomous driving) to their destinations, and connecting the car to mobile, satellite, and GPS networks. Other software functions include Wi-Fi receivers, which turn your car into a mobile hot spot; software that helps maximize fuel efficiency; and ultrasonic sensors, which enable some models to parallel park automatically.

The next step is to network all vehicles together, a necessary step toward the next major breakthrough: driverless cars. Google, Tesla (www.tesla.com), Apple, and all of the major automobile companies are now developing driverless vehicles.

- *The Agriculture Industry:* Agriculture is increasingly powered by software, including satellite analysis of soils linked to per-acre seed-selection software algorithms. In addition, precision agriculture makes use of automated, driverless tractors controlled by global positioning systems (GPS) and software. *Precision agriculture* is an approach to farm management that uses information technology to ensure that crops receive exactly what they need—for example, water, fertilizer, and pesticides—for optimum health and productivity.
- *The Fashion Industry:* Women have long “borrowed” special-occasion dresses from department stores, buying them and then returning them after wearing them for one evening. Now, Rent the Runway (www.renttherunway.com) has redefined the fashion business, making expensive clothing available to more women than ever before. The firm is also disrupting traditional physical retailers. After all, why buy a dress when you can rent one for a very low price? Some department stores feel so threatened by Rent the Runway that they have reportedly told vendors that they will remove floor merchandise if it ever shows up on that company’s website.
- *The Legal Profession:* Today, electronic discovery (e-discovery) software applications can analyze documents in a fraction of the time that human lawyers would take, at a fraction of the cost. For example, Blackstone Discovery (www.blackstonediscovery.com) helped one company analyze 1.5 million documents for less than US \$100,000. That company estimated that the process would have cost US \$1.5 million had it been performed by lawyers.

Law firms are now also using new artificial intelligence software packages such as Casetext (www.casetext.com) that augment lawyers’ cognitive abilities.

IT Reduces the Number of Middle Managers

HRM IT makes managers more productive and increases the number of employees who can report to a single manager. Thus, IT ultimately decreases the number of managers and experts required. It is reasonable to assume, therefore, that in coming years organizations will have

fewer managerial levels and fewer staff and line managers. If this trend materializes, promotional opportunities will decrease, making promotions much more competitive. Bottom line: pay attention in school!

IT Changes the Manager's Job

One of the most important tasks of managers is making decisions. A major consequence of IT has been to change the manner in which they make their decisions. In this way, IT has ultimately changed managers' jobs.

IT often provides managers with near-real-time information, meaning that they have less time to make decisions, making their jobs even more stressful. Fortunately, IT also provides many tools—for example, business analytics applications such as dashboards, search engines, and intranets—to help managers handle the volumes of information they must deal with on an ongoing basis.

So far in this section, we have been focusing on managers in general. Now let's focus on you. Due to advances in IT, you will increasingly supervise employees and teams who are geographically dispersed. Employees can work from anywhere at any time, and teams can consist of employees who are literally dispersed throughout the world. Information technologies such as telepresence systems (discussed in Chapter 6) can help you manage these employees even though you do not often see them face to face. For these employees, electronic or “remote” supervision will become the norm. Remote supervision places greater emphasis on completed work and less emphasis on personal contacts and office politics. You will have to reassure your employees that they are valued members of the organization, thereby diminishing any feelings they might have of being isolated and “out of the loop.”

Will IT Eliminate Jobs?

One major concern of every employee, part-time or full-time, is job security. Relentless cost-cutting measures in modern organizations often lead to large-scale layoffs. Put simply, organizations are responding to today's highly competitive environment by doing more with less. Regardless of your position, then, you consistently will have to add value to your organization and make certain that your superiors are aware of this value.

Many companies have responded to difficult economic times, increased global competition, demands for customization, and increased consumer sophistication by increasing their investments in IT. In fact, as computers continue to advance in terms of intelligence and capabilities, the competitive advantage of replacing people with machines is increasing rapidly. This process frequently leads to layoffs. At the same time, however, IT creates entirely new categories of jobs, such as electronic medical record-keeping and nanotechnology.

HRM IT Impacts Employees at Work

Many people have experienced a loss of identity because of computerization. They feel like “just another number” because computers reduce or eliminate the human element present in noncomputerized systems.

The internet threatens to exert an even more isolating influence than computers and television. Encouraging people to work and shop from their living rooms could produce some unfortunate psychological effects, such as depression and loneliness.

HRM **IT Impacts Employees' Health and Safety** Although computers and information systems are generally regarded as agents of “progress,” they can adversely affect individuals' health and safety. In fact, the average Canadian worker spends 6 hours and 45 minutes per day in front of some type of screen (consider laptops, tablets, smartphones, computers, and televisions). Let's consider two issues associated with IT: job stress and long-term use of the keyboard.

An increase in an employee's workload and/or responsibilities can trigger *job stress*. Although computerization has benefited organizations by increasing productivity, it has

also created an ever-expanding workload for some employees. Some workers feel overwhelmed and have become increasingly anxious about their job performance. These feelings of stress and anxiety can actually diminish rather than improve workers' productivity while jeopardizing their physical and mental health. Management can help alleviate these problems by providing training, redistributing the workload among workers, and hiring more workers.

On a more specific level, the long-term use of keyboards can lead to *repetitive strain injuries* such as backaches and muscle tension in the wrists and fingers. *Carpal tunnel syndrome* is a particularly painful form of repetitive strain injury that affects the wrists and hands.

Designers are aware of the potential problems associated with the prolonged use of computers. To address these problems, they continually attempt to design a better computing environment. The science of designing machines and work settings that minimize injury and illness is called *ergonomics*. The goal of ergonomics is to create an environment that is safe, well lit, and comfortable. Examples of ergonomically designed products are antiglare screens that alleviate problems of fatigued or damaged eyesight and chairs that contour the human body to decrease backaches. [Figure 1.6](#) displays some sample ergonomic products.

HRM IT Provides Opportunities for People with Disabilities Computers can create new employment opportunities for people with disabilities by integrating speech-recognition and vision-recognition capabilities. For example, individuals who cannot type can use a voice-operated keyboard, and individuals who cannot travel can work at home.

Going further, adaptive equipment for computers enables people with disabilities to perform tasks they normally would not be able to do. For example, the Web and graphical user interfaces (GUIs; e.g., Windows) can be difficult for people with impaired vision to use. To address this problem, manufacturers have added audible screen tips and voice interfaces, which essentially restore computer functionality to the way it was before GUIs became standard.

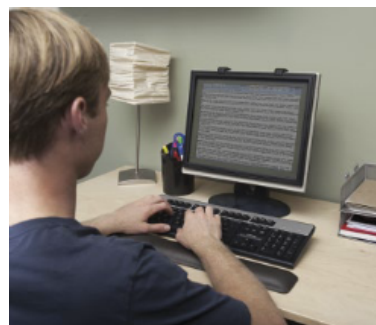
Other devices help improve the quality of life in more mundane, but useful, ways for people with disabilities. Examples are a two-way writing telephone, a robotic page turner, a hair brusher, and a hospital-bedside video trip to the zoo or the museum. Several organizations specialize in IT designed for people with disabilities.



Andrey Popov/Adobe Stock



Media Bakery



Media Bakery



Media Bakery

FIGURE 1.6 Ergonomic products protect computer users.

Before you go on...

1. Why should employees in all functional areas become knowledgeable about IT?
2. Describe how IT might change a manager's job.
3. Discuss several ways in which IT impacts employees at work.

1.4 Importance of Information Systems to Society

LEARNING OBJECTIVE

Identify positive and negative societal effects of the increased use of information technology.

This section explains in greater detail why IT is important to society as a whole. Other examples of the impact of IT on society appear throughout the text.

IT Affects Our Quality of Life

IT has significant implications for our quality of life. The workplace can be expanded from the traditional 9-to-5 job at a central location to 24 hours a day at any location. IT can provide employees with flexibility that can significantly improve the quality of leisure time, even if it doesn't increase the total amount of leisure time. Online meetings are now a fixture in our business life. These meetings have many advantages (easier to share documents, less travel, time savings). However, there are also many disadvantages when they are not coordinated properly. The Closing Case for this chapter discusses online and hybrid meetings and presents strategies to help them be successful.

While IT does make significant improvements to quality of life, it also can place employees on "constant call," which means they are never truly away from the office, even when they are on vacation. In fact, surveys reveal that the majority of respondents take their laptops and smartphones on their vacations. Going further, the majority of respondents did some work while vacationing, and almost all of them checked their email regularly. Boundaries are more important than ever because IT has made it easy to blur those lines.

The Robot Revolution Is Here Now

Once restricted largely to science fiction, robots that can perform practical tasks are now a reality. Two major types of robots are industrial robots and collaborative robots, or cobots.

An *industrial robot* is an automated, programmable machine used in manufacturing operations. Applications for industrial robots include welding, painting, assembly, disassembly, packaging and labelling, palletizing, and many others. *Collaborative robots*, or *cobots*, are machines designed to be used in collaborative applications where there are interactions with humans within a shared space. Applications for cobots include providing information in public spaces, transporting materials and products within a building, inspection of goods, patrolling perimeters, securing facilities, and many others. Now let's look at the differences between the two types.

POM **Industrial Robots versus Cobots** Cobots are designed to work alongside human employees, while industrial robots perform work in place of those employees. A cobot

can assist employees with work that may be too dangerous, strenuous, or tedious for them to accomplish on their own. This assistance can create a safer, more efficient workplace without eliminating factory jobs. In contrast, industrial robots are used to automate the manufacturing process almost entirely without human help on the manufacturing floor. This process can free employees for more meaningful tasks that are less mundane and less prone to repetitive-motion injuries.

Cobots are also more easily programmable than industrial robots because they are capable of “learning” on the job. A factory worker can reprogram a cobot simply by moving the cobot’s arms along a desired path. At that point, the cobot will “remember” the new movement and be able to repeat it on its own. Industrial robots cannot be so easily reprogrammed and require an engineer to write new software for any changes in the process that the robot is to perform.

Industrial robots are designed for heavy manufacturing, while cobots are designed for light manufacturing. Industrial robots require safety cages to keep humans out of the workspace, while cobots are safe enough to function around people and do not require the same type of safety infrastructure as industrial robots. Last but certainly not least, industrial robots are much more expensive (US \$100,000 to US \$150,000) than cobots (US \$35,000 to US \$50,000).

Cobots have become increasingly common on factory floors, in hospital corridors, and in farm fields. Amazon Robotics is an excellent example of cobots in a distribution centre. Traditionally, companies moved goods around their distribution centres with human-operated conveyors or with human-operated machines such as forklifts. That is, orders would enter the distribution centre and humans would locate, pick, and pack the items for shipment.

Amazon Robotics, formerly Kiva Systems, reversed the process with cobots. In the new approach, the company stores items on portable storage units. When an order enters the company database, software locates the closest cobot to the item and directs it to retrieve that item. The cobots navigate around the distribution centre by following bar code stickers on the floor. Each cobot has sensors that read the bar codes and prevent collisions. When the cobot reaches the correct storage unit, it slides underneath it and lifts it off the ground with a corkscrew action. The cobot then carries the storage unit to a human operator who picks the item(s).

The bottom line with this system is that, rather than humans going to the items, the cobots bring the items to the humans. The system is much more efficient and accurate than the traditional one.

Drones A *drone* is an unmanned aerial vehicle (UAV) (a flying robot, if you will) that either is controlled by pilots from the ground or autonomously follows a preprogrammed mission. Commercial drones function in a variety of business purposes, in contrast to drones used by hobbyists for recreational purposes.

An interesting use of drones is in the fight against deforestation. A good example of this process is in Yangon, Myanmar, where Dendra Systems (www.dendra.io) is working with a non-profit organization called Worldview International Foundation (<http://wif.foundation>) to plant mangrove saplings. Dendra, formerly BioCarbon Engineering, is a start-up company that makes drones to plant trees and grasses.

Drones first fly over the area to be planted, map it, and collect data about the topography and soil conditions. Dendra integrates these data with satellite data on the area and determines the best locations to plant seeds. Once the company analyzes the data, drones fire biodegradable pods filled with germinated seeds and nutrients into the ground at the preselected locations. Over the next months, drones fly over the planted areas and monitor how the mangroves are growing.

Autonomous Vehicles An autonomous, or self-driving, car (essentially a robot car) is a vehicle that is capable of sensing its environment and moving safely to its destination with little or no human input. When you think about autonomous vehicles, consider these statistics:

- Human error accounts for more than 90 percent of automobile accidents.
- Each year more than 6 million vehicle accidents are reported to law enforcement.
- In 2020, a total of 1,745 Canadians died in automobile accidents. According to the World Health Organization, each year, approximately 1.35 million people die worldwide in road accidents.

These statistics offer compelling reasons for autonomous vehicles, and the development of these vehicles is proceeding rapidly. Leading autonomous vehicle companies are Tesla (www.tesla.com), Waymo (www.waymo.com), GM Cruise (<https://getcruise.com>), and Ford Autonomous (www.ford.com).

There is some bad news, however. Several fatalities have been reported with Tesla automobiles on full autopilot (self-driving mode). Whether these deaths were caused by the automobiles is under investigation.

It probably will be a long time before we see robots making decisions by themselves, handling unfamiliar situations, and interacting with people. Nevertheless, robots are extremely helpful in various environments, particularly those that are repetitive, harsh, or dangerous to humans.

The Emergence of Cognitive Computing: IBM Watson

MIS IBM Watson (www.ibm.com/watson) is a suite of enterprise-ready artificial intelligence services, applications, and software tools. Watson integrates advanced natural language processing, information retrieval, knowledge representation and reasoning, and machine learning technologies in order to answer open-domain (general) questions. IBM has labelled the type of processing demonstrated by Watson as *cognitive computing*. Watson has four primary capabilities:

- The ability to understand human language, with all of its nuance and ambiguity;
- The ability to learn and absorb information;
- The ability to formulate hypotheses;
- The ability to understand the context of a question.

By mid-2022, organizations in at least 20 industries were using Watson in a variety of applications. Some of these applications end up being sold to firms who can take these technical capabilities and refine and develop them for a specific industry. For example, in June 2022, IBM sold Watson's health division to Francisco Partners, a firm that specializes in health care technology and plans to establish a new company, Merative, that will invest heavily in the continued development of this tool. Merative's products will be organized into six product families to provide a variety of artificial intelligence insights to physicians and health care administrators. The opening case for Chapter 5, Data and Knowledge Management, presents a more detailed overview of the story of Watson Health.

IT Impacts Health Care

IT has brought about major improvements in health care delivery. Medical personnel use IT to make better and faster diagnoses and to monitor critically ill patients more accurately. IT has also streamlined the process of researching and developing new drugs. Expert systems now help doctors diagnose diseases, and machine vision is enhancing the work of radiologists. Surgeons use virtual reality to plan complex surgeries. They also employ surgical robots to perform long-distance surgery. Finally, doctors discuss complex medical cases via videoconferencing. New computer simulations recreate the sense of touch, allowing doctors-in-training to perform virtual procedures without risking harm to an actual patient.

Information technology can be applied to improve the efficiency and effectiveness of health care. Among the thousands of other health care applications, administrative systems are critically important. These systems perform functions ranging from detecting insurance fraud to creating nursing schedules to performing financial and marketing management.

The internet contains vast amounts of useful medical information. However, even though this information exists on the internet, physicians caution against self-diagnosis. Rather, people should use diagnostic information obtained from Google and medical websites such as WebMD (www.webmd.com) only to ask questions of their physicians.

One of the earliest applications of IBM Watson was in the field of medicine. Watson is able to analyze vast amounts of medical data and provide insights.

Although some health data are structured—for example, blood pressure readings and cholesterol counts—the vast majority are unstructured. These data include textbooks, medical journals, patient records, and nurse and physician notes. In fact, modern medicine entails so much unstructured data that their rapid growth has surpassed the ability of health care practitioners to keep up. IBM emphasizes that Watson is *not* intended to replace health care professionals. Rather, its purpose is to assist them in avoiding medical errors and fine-tuning their medical diagnoses.

Before you go on...

1. What are some of the quality-of-life improvements made possible by IT? Has IT had any negative effects on our quality of life? If so, explain and provide examples.
2. Describe the robotic revolution, and consider its implications for humans. How do you think robotics will affect your life in the future?
3. Explain how IT has improved health care practices. Has the application of IT to health care created any problems or challenges? If so, explain and provide examples.

What's in IT for me?

In Section 1.2, we discussed how IT supports each of the functional areas of the organization. Here we examine the MIS function.

MIS For the MIS Major

The MIS function directly supports all other functional areas in an organization. That is, the MIS function is responsible for providing

the information that each functional area needs in order to make decisions. The overall objective of MIS personnel is to help users improve performance and solve business problems using IT. To accomplish this objective, MIS personnel must understand both the information requirements and the technology associated with each functional area. Given their position, however, they must think “business needs” first and “technology” second.

Summary

1.1 Identify the reasons why being an informed user of information systems is important in today's world.

The benefits of being an informed user of IT include the following:

- You will benefit more from your organization's IT applications because you will understand what is “behind” them.
- You will be able to provide input into your organization's IT applications, thus improving their quality.
- You will quickly be in a position to recommend or to participate in the selection of IT applications that your organization will use.
- You will be able to keep up with rapid developments in existing information technologies, as well as the introduction of new ones.
- You will understand the potential impacts that “new and improved” technologies will have on your organization. Consequently, you will be qualified to make recommendations concerning their adoption and use.

- You will play a key role in managing the information systems in your organization.
- You will be in a position to better employ IT if you decide to start your own business.

1.2 Describe the various types of computer-based information systems in an organization.

- Transaction processing systems (TPSs) support the monitoring, collection, storage, and processing of data from the organization's basic business transactions, each of which generates data.
- Functional area information systems (FAISs) support a particular functional area within the organization.
- Interorganizational information systems (IOSs) support many interorganizational operations, of which supply chain management is the best known.

- Enterprise resource planning (ERP) systems correct a lack of communication among the FAISs by tightly integrating the functional area ISs via a common database.
- Electronic commerce (e-commerce) systems enable organizations to conduct transactions with other organizations (called business-to-business (B2B) electronic commerce), and with customers (called business-to-consumer (B2C) electronic commerce).
- Business intelligence (BI) systems provide computer-based support for complex, nonroutine decisions, primarily for middle managers and knowledge workers.
- Expert systems (ESs) attempt to duplicate the work of human experts by applying reasoning capabilities, knowledge, and expertise within a specific domain.

1.3 Discuss ways in which information technology can affect managers and non-managerial workers.

Potential IT impacts on managers:

- IT may reduce the number of middle managers.
- IT will provide managers with real-time or near real-time information, meaning that they will have less time to make decisions.
- IT will increase the likelihood that managers will have to supervise geographically dispersed employees and teams.

Potential IT impacts on non-managerial workers:

- IT may eliminate jobs.
- IT may cause employees to experience a loss of identity.
- IT can cause job stress and physical problems, such as repetitive stress injury.

1.4 List positive and negative societal effects of the increased use of information technology.

Positive societal effects:

- IT can provide opportunities for people with disabilities.
- IT can provide people with flexibility in their work (e.g., work from anywhere, anytime).
- Robots will take over mundane chores.
- IT will enable improvements in health care.

Negative societal effects:

- IT can cause health problems for individuals.
- IT can place employees on constant call.
- IT can potentially misinform patients about their health problems.

Key Terms

application (or app) 13
 Business analytics (BA) systems 17
 business intelligence (BI) systems 17
 computer-based information system (CBIS) 12
 dashboard 17
 database 12
 data items 11
 departmental information system 14

digital transformation 6
 Electronic commerce (e-commerce) systems 16
 Expert systems (ESs) 17
 hardware 12
 information 11
 information system (IS) 10
 information technology components 12
 information technology infrastructure 13

information technology (IT) 10
 information technology platform 13
 information technology services 13
 informed user 4
 knowledge 11
 knowledge workers 17
 network 13
 procedures 13
 software 12

Discussion Questions

1. Would your university be a good candidate for digital transformation? Why or why not? Support your answer.
2. If you responded yes, then what types of digital initiatives should your university undertake to transform itself?
3. Describe a business that you would like to start. Discuss how information technology could: (a) help you find and research an idea for a business, (b) help you formulate your business plan, and (c) help you finance your business.
4. Your university wants to recruit high-quality high school students from your province. Provide examples of (a) the data that your

recruiters would gather in this process, (b) the information that your recruiters would process from these data, and (c) the types of knowledge that your recruiters would infer from this information.

5. Can the terms *data*, *information*, and *knowledge* have different meanings for different people? Support your answer with examples.

6. Information technology makes it possible to “never be out of touch.” Discuss the pros and cons of always being available to your employers and clients (regardless of where you are or what you are doing).

7. Robots have the positive impact of being able to relieve humans from working in dangerous conditions. What are some negative impacts of robots in the workplace?
8. Is it possible to endanger yourself by accessing too much medical information on the Web? Why or why not? Support your answer.
9. Describe other potential impacts of IT on societies as a whole.
10. What are the major reasons why it is important for employees in all functional areas to become familiar with IT?

11. Given that information technology is impacting every industry, what does this mean for a company's employees? Provide specific examples to support your answer.
12. Given that information technology is impacting every industry, what does this mean for students attending a business school? Provide specific examples to support your answer.
13. Is the vast amount of medical information on the Web a good thing? Answer from the standpoint of a patient and from the standpoint of a physician.

Problem-Solving Activities

1. Visit some websites that offer employment opportunities in IT. Prominent examples are: www.linkedin.com, www.dice.com, www.monster.ca, www.collegerecruiter.com, www.careerbuilder.ca, www.jobbank.gc.ca, www.simplyhired.ca, and www.indeed.ca. Compare IT salaries to salaries offered to accountants, marketing personnel, financial personnel, operations personnel, and human resources personnel. For other information on IT salaries, check *Computerworld's* annual salary survey.
2. Explore the role of the CIO in today's business world. Access www.cio.com and search through the resources listed under careers. What opportunities are available if you were graduating today?
3. Go to www.canadapost.ca.
 - a. Find out what information is available to customers before they send a package.
 - b. Find out about the "package tracking" system.
 - c. Compute the cost of delivering a 25 cm × 50 cm × 38 cm box, weighing 18 kg, from your hometown to Montreal, Quebec (or to Vancouver, British Columbia, if you live in or near Montreal). Compare the fastest delivery against the least cost. How long did this process take? Look into the business services offered by Canada Post. How do they make this process easier when you are a business customer?
4. Surf the internet for information about the federal government agency Public Safety Canada. Examine the available information and comment on the role of information technologies in the department.
5. Go to Twitter.com. Note the number of people on the platform daily and the number of tweets or posts in a 24-hour period. Check out your favorite clothing company and see how many of their customers are using the platform.
6. Access www.edu.irobot.com, and investigate the company's Education and Research Robots. Surf the Web for other companies that manufacture robots, and compare their products with those of iRobot.

Closing Case

MIS POM Hybrid Work Means Hybrid Meetings

In the early months of the pandemic, most business meetings were entirely virtual. This reality created a level playing field when it came to virtual meetings in that everyone had to contend with the same videoconferencing issues. But since everyone was online, each participant had a similar meeting experience.

As the world adjusts to a new normal after the pandemic, it is clear that many people prefer hybrid work structures. In a 2021 Accenture Future of Work Study that surveyed over 9,000 workers from 11 countries and 13 industries, 83 percent of respondents said that a hybrid set-up would be optimal for them. Hybrid work allows worker's flexibility in setting their in-person hours, leaving scheduled meetings with a mix of some participants who are attending in person while others are online, creating a hybrid meeting.

A *hybrid meeting* is an online meeting in which some participants attend from home and others from a conference room. This set-up introduces various issues. For example, participants who are not in the office will likely feel left out. In addition, organizations

need to ensure that their meetings are productive and beneficial for as many workers as possible, not just those in the office. Organizations want to empower staff to engage in every meeting. Yet, data show that roughly 70 percent of people who dial into meetings remotely feel disengaged.

Connected and Disconnected Participants

A 2022 study revealed that more than 50 percent of remote workers become distracted by emails or social media during meetings. Further, more than 20 percent have even brought virtual meetings to bed. Finally, 10 percent admitted to coming up with fake excuses to leave meetings early. Overall, remote participants seem disconnected despite being directly connected to the meeting.

The key issue appears to be a real human connection. When asked about building rapport, 54 percent of respondents claimed they had fewer opportunities when they attended a meeting virtually. An additional 39 percent felt that their input would have greater value if they had participated in person. Finally, roughly 70 percent of respondents stated that collaboration between in-office and remote workers is challenging. Significantly, current IT

tools—virtual meetings, group messaging, and file sharing—are intended to enhance productivity. However, these tools do not promote collaboration and connection.

In addition to these issues, there are the unintended consequences of hybrid meetings; for example, when people in the office focus on each other and fail to remember that there is an “invisible” person online, or the online person fails to mute their microphone, creating a feedback problem for everyone in person. As another example, if the in-office microphone isn’t sufficient to pick up everyone’s voice, then online participants will miss out.

Solutions

Given all of these problems, we might ask, can we make hybrid meetings work? Fortunately, the answer is yes. Below we present several recommendations on how to help make hybrid meetings successful.

Focus on collaboration, not just sharing. Although screen sharing is an effective strategy for conveying information, it does not promote knowledge sharing or collaboration. One study identified digital whiteboard tools as a potential solution that would be more collaborative and build team camaraderie.

Have everyone participate online through their laptop. To create equity, require that both in-person and remote participants use a computer with a webcam. Everyone is then visible through a webcam, everyone can chat, and everyone can contribute to the digital experience. This requirement effectively makes the hybrid meeting a “fully online” experience while enabling some participants to build face-to-face relationships. One key suggestion: In-person participants in the same room should join the meeting audio through a single connection. Otherwise, the feedback will be terrible for the online participants.

Install multiple cameras in the conference room. One problem with using your laptop’s webcam in the conference room is that you don’t know where to look. At the webcam? At your colleague across the table, which gives everyone at home a nice view of your nostrils? At the wall? Installing multiple cameras around the conference room can eliminate this problem. You can look at and speak directly to your colleagues, the screen, and your notes. Today, the most popular videoconferencing platforms, including Zoom, Google Meet, and Microsoft Teams, use artificial intelligence (AI, see Chapter 14) to identify who is speaking and change camera views accordingly. These systems are more costly, but they are effective.

Set up high-quality audio for the in-person room. Ensure that the in-person meeting room is equipped with enough high-quality microphones so remote participants can hear everyone in the room. One microphone—or one cellphone set to speakerphone—in the middle of the room is insufficient. Online participants will not be able to hear everyone. Also, remind all participants to be aware of unnecessary noises. Opening a soda, typing loudly on the computer, and opening a piece of candy all create unnecessary noises and the microphone hears everything.

Use extra-large screens to display online participants. An organization can set up a large screen in the middle of a room and then two additional large monitors on each side of the room to display near-life-sized views of the remote participants. This practice can help to give online participants equal status.

Go all virtual into the metaverse. Virtual reality is creating new possibilities. Companies like Spatial (www.spatial.io) offer software that enables users to develop near-real-life avatars. These

avatars, driven by participants, sit around virtual tables, sip virtual coffees, and share information on virtual whiteboards. Although metaverse meetings currently are highly technical, the possibilities are endless. Moreover, they can make the meeting less expensive because the meeting “hardware”—think whiteboard—is simply computer code. There is no need for expensive cameras, microphones, or physical spaces. Rather, everything is contained in a virtual space that leaders can modify without expensive renovation.

Make use of AI. Cisco’s Webex platform now uses AI to translate people’s natural and nonverbal gestures into animated images. This technology enables users to perform simple actions like raising their hands or giving a thumbs-up without clicking a button. In addition, Webex features real-time closed-captioning and translation capabilities in more than 100 languages. Advanced noise cancellation features can filter out distracting environmental noises, especially during calls in shared spaces or home offices.

Conclusion

Hybrid meetings will remain a part of the working environment for the foreseeable future. Therefore, companies must continue to invest in solutions that work for all staff—regardless of whether they are in the office or hundreds of kilometres away. Maintaining employee engagement involves making everyone feel seen and heard in meetings. To accomplish this goal, organizations must consider the combination of behaviours and technologies that will create a healthy hybrid environment. When employees are committed and connected, then the entire business will benefit.

Questions

1. What complications arise when some participants attend in person and others remotely?
2. What role might AI play in making meetings more productive?
3. How can you use your computer to be better prepared for online meetings?

Sources: Compiled from Staff Writer, “Cisco Tackles Video-Meeting Fatigue to Empower the Hybrid Work Model,” *Tech Financials*, October 3, 2022; E. Roethler, “Yes, the Hybrid Workplace Can Work,” *builtinchicago.com*, September 27, 2022; T. Bishop, “GeekWire Podcast: The New World of Hybrid Work, and the Next Generation of Smartphone Users,” *GeekWire*, September 24, 2022; K. Errick, “Collaborative Tools Are More Needed Than Performance Tech in Remote Work, Study Says,” *Nextgov.com*, September 23, 2022; J. McKendrick, “Remote and In-Person Work Balance Is Key, Even at the Most Virtual of Virtual Companies,” *Forbes*, September 23, 2022; G. Kyvik, “Tackling Inequity in Hybrid Meetings: How Can Remote Workers Feel Seen and Heard?” *Telecom Reseller*, September 22, 2022; D. Martinus, “Over 50 Percent of Remote Workers Get Distracted by Emails or Social Media during Meetings,” *Mashable SE Asia*, September 21, 2022; P. Goldstein, “How to Fine-Tune Meetings for Hybrid Work Settings,” *BizTech*, September 20, 2022; L. Kolondy, “Tesla Struggles with Elon Musk’s Strict Return-to-Office Policy,” *CNBC.com*, September 14, 2022; S. Stern, “Hybrid Working: Why the Office-Home Balance Is Still a Challenge,” *Financial Times*, September 4, 2022; B. Lovejoy, “Apple Return-to-Office Argument Rejected by Apple Together as It Petitions for Flexibility,” *9to5Mac.com*, August 22, 2022; J. Stern, “Hybrid Work Meetings Are Hell. Tech Is Trying to Fix Them,” *The Wall Street Journal*, June 15, 2022; <https://www.accenture.com/us-en/insightsnew/future-workforce-index>, accessed October 4, 2022.

Organizational Strategy, Competitive Advantage, and Information Systems

CHAPTER OUTLINE

LEARNING OBJECTIVES

2.1 Business Processes

2.1 Discuss ways in which information systems enable cross-functional business processes and business processes for a single functional area.

2.2 Business Process Reengineering, Business Process Improvement, and Business Process Management

2.2 Differentiate between business process reengineering, business process improvement, and business process management.

2.3 Business Pressures, Organizational Responses, and Information Technology Support

2.3 Identify effective IT responses to different kinds of business pressures.

2.4 Competitive Advantage and Strategic Information Systems

2.4 Describe the strategies that organizations typically adopt to counter Porter's five competitive forces.

Opening Case

MIS IKEA Reshapes Its Strategy with the Help of Digital Technologies

IKEA is the world's largest furniture retailer, operating 422 stores in more than 30 countries, 14 of them in Canada. Recently, the company has been facing financial challenges due to the sharp increase in the cost of materials and transportation within its global supply chain, mainly because of the war in Ukraine.

Against this backdrop of financial challenges, the company has been exploring new ways to serve the needs of its customers and to operate its business, mainly through the use of digital technologies. As one executive has put it, "in order to be successful, digital needs to be embedded in every aspect of IKEA. Digital is a way of working, making decisions, and managing the company."

IKEA's online journey started with a new and improved navigation and search function on its website and continued with the introduction of its online furniture planning tools. These online design tools allow customers to decorate their kitchen, bedroom,

or living room with IKEA's furniture using an embedded application on the website.

The "Shop & Go" feature in the IKEA mobile app is another example of how the company is trying to give customers a more immersive experience in its stores. This feature allows in-store customers to use their mobile device to scan items and pay for them without the need to take them out of their bags and rescan them at a checkout counter, thus saving time.

IKEA's latest digital addition is its Kreativ Scene Scanner app, a mobile virtual reality app to help customers visualize a 3D model of their home and replace their furniture with IKEA's. The new mobile app requires customers to enter the measurements of rooms and answer a few questions concerning their taste and life situations, then it builds a 3D model of the house with IKEA's furnishing products. Customers also have the option to place an order right from the app.

These changes have required a complete modernization of the business, from inventory management to logistics, fulfillment, and supply chain, with a renewed focus on the customer and embedding

data into every area of the company. The results have not taken long to appear: IKEA store sales grew by 6.5 percent for fiscal year 2022 to a total of \$63.3 billion and are expected to grow even further.

Questions

1. Is IKEA's use of information technology consistent with its overall strategy? Why or why not?
2. Browse the Web to find out IKEA's most recent information technology innovations. Are they consistent with the company's overall strategy? Why or why not?

Sources: Compiled from M. Meisenzahl, "Ikea Is Making It Easier to Buy Its Famous Budget-Friendly Furniture Online," *Business Insider*, May 9, 2022; I. Cameron, "Ikea Online Sales Double as Pandemic Resurgence Continues," *Charged Retail*, December 19, 2022; R. Catterson, "IKEA Launches New Digital Tools," *Power Retail*, December 1, 2022; "E-Commerce Net Sales from 1015 to 2022," *statista.com*; "IKEA Registers Total Sales Increase of 6.5% for Fiscal 2022," *Retail Insight Network*, October 14, 2022; T. Stackpole, "Inside IKEA's Digital Transformation," *Harvard Business Review*, June 4, 2021; "IKEA Canada 2021 Summary Report," *Ikea.com*, accessed April 14, 2023.

competitive advantage

An advantage over competitors in some measure such as cost, quality, or speed; leads to control of a market and to larger-than-average profits.

Introduction

Organizations operate in the incredible complexity of the modern high-tech world. As a result, they are subject to myriad business pressures. Information systems help organizations respond to business pressures and support their global strategies. As you study this chapter, you will see that any information system can be *strategic*, meaning it can provide a competitive advantage if it is employed properly. The chapter-opening case, as well as the other cases in this chapter, illustrate how information technology (IT) can give organizations a competitive advantage.

Competitive advantage refers to any assets that provide an organization with an edge against its competitors in some measure such as cost, quality, or speed. A competitive advantage helps an organization control a market and accrue larger-than-average profits. Significantly, both strategy and competitive advantage take many forms.

Although many companies use technology in very expensive ways, an entrepreneurial spirit coupled with a solid understanding of what IT can do for you will provide competitive advantages to entrepreneurs. As you study this chapter, think of the small businesses in your area that are utilizing popular technologies in interesting and novel ways. Have any of them found an innovative use for Twitter? Facebook? Amazon? PayPal? Square? Zoom? If not, then can you think of any businesses that would benefit from employing these technologies?

This chapter is important to you for several reasons. First, the business pressures we address in the chapter will affect your organization. Just as important, however, they also will affect *you*. Therefore, you must understand how information systems can help you—and eventually your organization—respond to these pressures.

Acquiring a competitive advantage is also essential for your organization's survival. Many organizations achieve a competitive advantage through the efforts of their employees. Therefore, becoming knowledgeable about strategy and how information systems affect strategy and competitive position will help you throughout your career.

This chapter encourages you to become familiar with your organization's strategy, mission, and goals and to understand its business problems and how it makes (or loses) money. It will help you understand how information technology contributes to organizational strategy. Furthermore, you likely will become a member of business or IT committees that decide (among many other things) how to use existing technologies more effectively and whether to adopt new ones. After studying this chapter, you will be able to make immediate contributions in these committees.

Essentially, organizations consist of a large number of diverse business processes. In this chapter, you will first learn about the different types of business processes and the support that information systems provide for all of them.

The need for organizations to optimize their business processes has led to efforts such as business process improvement (BPI), business process reengineering (BPR), and business process management (BPM). You will learn how organizations address these important efforts and the key role that information systems play in supporting and enabling them.

Next, you will see how information systems enable organizations to respond to business pressures. Finally, you will learn how information systems help organizations acquire competitive advantages in the marketplace.

2.1 Business Processes

LEARNING OBJECTIVE

Discuss ways in which information systems enable cross-functional business processes and business processes for a single functional area.

A **business process** is an ongoing collection of related activities that create a product or a service of value to the organization, its business partners, and its customers. The process involves three fundamental elements:

- **Inputs:** Materials, services, and information that flow through and are transformed as a result of process activities
- **Resources:** People and equipment that perform process activities
- **Outputs:** The product or a service created by the process

If the process involves a customer, then that customer can be either internal or external to the organization. A manager who is the recipient of an internal reporting process is an example of an internal customer. In contrast, an individual or a business that purchases the organization's products is the external customer of the fulfillment process.

Successful organizations measure their process activities to evaluate how well they are executing these processes. Two fundamental metrics that organizations employ in assessing their processes are efficiency and effectiveness. *Efficiency* focuses on doing things well without wasting resources in the process; for example, progressing from one process activity to another without delay or without wasting money or resources. *Effectiveness* focuses on doing the things that matter; that is, creating outputs of value to the process customer—for example, high-quality products.

Many processes cross functional areas in an organization. For example, product development involves research, design, engineering, manufacturing, marketing, and distribution. Other processes involve only a single functional area. **Table 2.1** identifies the fundamental business processes performed in an organization's functional areas.

business process A collection of related activities that create a product or a service of value to the organization, its business partners, and its customers.

Cross-Functional Processes

All the business processes in Table 2.1 fall within a single department or functional area of the company. However, many other business processes, such as procurement and fulfillment, cut across multiple functional areas; that is, they are cross-functional business processes, meaning that no single functional area is responsible for their execution. Rather, multiple functional areas collaborate to perform the process. For a cross-functional process to be successfully completed, each functional area must execute its specific process steps in a coordinated, collaborative way. To clarify this point, let's take a look at the procurement and fulfillment of **cross-functional processes**. We discuss these processes in greater detail in Chapter 10.

POM The *procurement process* includes all of the tasks involved in acquiring needed materials externally from a vendor. Procurement comprises five steps that are completed in three different functional areas of the firm: warehouse, purchasing, and accounting.

ACCT The process begins when the warehouse recognizes the need to procure materials, perhaps due to low inventory levels. The warehouse documents this need with a purchase requisition, which it sends to the purchasing department (step 1). In turn, the purchasing department identifies a suitable vendor, creates a purchase order based on the purchase requisition, and sends the order to the vendor (step 2). When the vendor receives the purchase order, it ships the materials, which are received in the warehouse (step 3). The vendor then sends an invoice, which is received by the accounting department (step 4). Accounting sends the payment to the vendor, thereby completing the procurement process (step 5).

cross-functional processes Processes for which no single functional area is responsible.

TABLE 2.1 Examples of Business Processes

ACCT Accounting Business Processes	
Managing accounts payable	Managing invoice billings
Managing accounts receivable	Managing petty cash
Reconciling bank accounts	Producing month-end close
Managing cash receipts	Producing virtual close
FIN Finance Business Processes	
Managing account collection	Producing property tax assessments
Managing bank loan applications	Managing stock transactions
Producing business forecasts	Generating financial cash-flow reports
Applying customer credit approval and credit terms	
MKT Marketing Business Processes	
Managing post-sale customer follow-up	Handling customer complaints
Collecting sales taxes	Handling returned goods from customers
Applying copyrights and trademarks	Producing sales leads
Using customer satisfaction surveys	Entering sales orders
Managing customer service	Training sales personnel
POM Production/Operations Management Business Processes	
Processing bills of materials	Managing quality control for finished goods
Processing manufacturing change orders	Auditing for quality assurance
Managing master parts list and files	Receiving, inspecting, and stocking parts and materials
Managing packing, storage, and distribution	Handling shipping and freight claims
Processing physical inventory	Handling vendor selection, files, and inspections
Managing purchasing	
HRM Human Resources Business Processes	
Applying disability policies	Producing performance appraisals and salary adjustments
Managing employee hiring	Managing resignations and terminations
Handling employee orientation	Applying training and tuition reimbursement
Managing files and records	Managing travel and entertainment
Applying health care benefits	Managing workplace rules and guidelines
Managing pay and payroll	Overseeing workplace safety
MIS Management Information Systems Business Processes	
Managing antivirus control	Applying electronic mail policy
Handling computer security issues incident reporting	Generating internet use policy
Training computer users and staff	Managing service agreements and emergency services
Applying disaster recovery procedures	Applying user workstation standards
	Managing the use of personal software

POM ACCT The *fulfillment process* is concerned with processing customer orders. Fulfillment is triggered by a customer purchase order that is received by the sales department. Sales then validates the purchase order and creates a sales order. The sales order communicates data related to the order to other functional areas within the organization and tracks the progress of the order. The warehouse prepares and sends the shipment to the customer. Once

accounting is notified of the shipment, it creates an invoice and sends it to the customer. The customer then makes a payment, which accounting records.

An organization's business processes can create a competitive advantage if they enable the company to innovate or to execute more effectively and efficiently than its competitors. They can also be liabilities, however, if they make the company less responsive and productive. Consider the airline industry. It has become a competitive necessity for all airlines to offer electronic ticket purchases through their websites. To provide competitive advantage, however, these sites must be highly responsive and they must provide both current and accurate information on flights and prices. An up-to-date, user-friendly site that provides fast answers to user queries will attract customers and increase revenues. In contrast, a site that provides outdated or inaccurate information, or has a slow response time, will hurt rather than improve business.

Clearly, good business processes are vital to organizational success. But how can organizations determine if their business processes are well designed? The first step is to document each process by describing its steps, its inputs and outputs, and its resources. The organization can then analyze the process and, if necessary, modify it to improve its performance.

To understand this point, let's consider the e-ticketing process. E-ticketing consists of four main process activities: searching for flights, reserving a seat, processing payment, and issuing an e-ticket. These activities can be broken down into more detailed process steps. The result may look like the process map in [Figure 2.1](#). Note that different symbols correspond

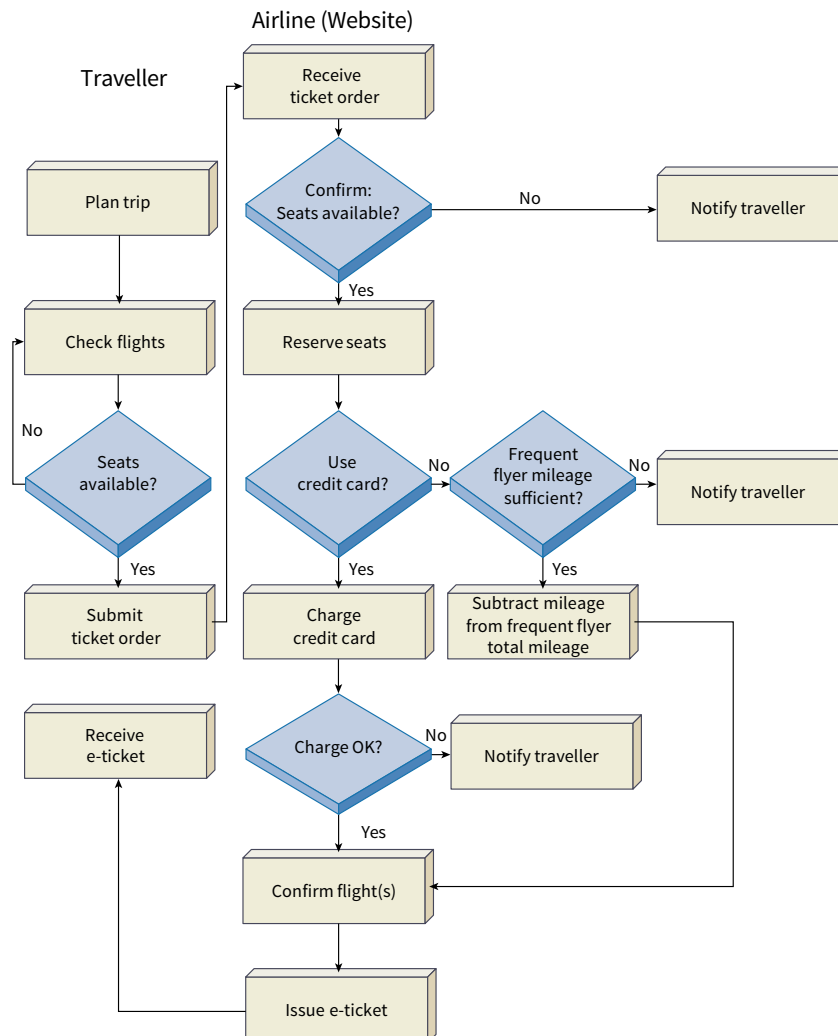


FIGURE 2.1 Business process for ordering an e-ticket from an airline website.

to different types of process steps. For example, rectangles (steps) are activities that are performed by process resources (reserve seats, issue e-ticket). Diamond-shaped boxes indicate decisions that need to be made (seats available?). Arrows are used as connectors between steps; they indicate the sequence of activities.

These symbols are important in the process flowchart (which is similar to a programming flowchart). Other symbols may be used to provide additional process details. For example, D-shaped boxes are used instead of rectangles when a waiting period is part of a process, ovals can show start and stop points, and process resources can be attached to activities with resource connector lines or included as an annotation or property for each activity box.

The customers of the process are travellers planning a trip, and the process output is an e-ticket. Travellers provide inputs to the process: the desired travel parameters to begin the search, the frequent flyer miles number, and their credit card information. Also, a computerized reservation system that stores information for many airlines provides some of the process inputs such as the seat availability and prices. The resources used in the process are the airline website, the computerized reservation system, and, if the customer calls the airline call centre at any time during the process, the call centre system and the human travel agents. The process creates customer value by efficiently generating an output that meets the customer search criteria—dates and prices. The performance of the process depends on efficiency metrics such as the time required to purchase an e-ticket, from the moment the customer initiates the ticket search until they receive the e-ticket. Effectiveness metrics include customer satisfaction with the airline website. Finally, the performance of the process may be affected if the quality or the timeliness of the inputs is low—for example, if the customer enters the wrong dates—or if the process resources are not available—for example, if the website crashes before the purchase is finalized.

Information Systems and Business Processes

MIS An information system (IS) is a critical enabler of an organization's business processes. Information systems facilitate communication and coordination among different functional areas, and allow easy exchange of, and access to, data across processes. Specifically, ISs play a vital role in three areas:

- Executing the process
- Capturing and storing process data
- Monitoring process performance

In this section, you will learn about each of these roles. In some cases, the role is fully automated—that is, it is performed entirely by the IS. In other cases, the IS must rely on the manager's judgement, expertise, and intuition.

MIS Executing the Process An IS helps organizations execute processes efficiently and effectively. ISs are typically embedded into the processes, and they play a critical role in executing them. In other words, an IS and processes are usually intertwined. If the IS does not work, the processes cannot be executed. An IS helps execute processes by informing people when it is time to complete a task, providing the necessary data to complete the task, and, in some cases, providing the means to complete the task.

In the fulfillment process, the IS will inform people in the warehouse that orders are ready for shipment. It also provides them with a listing of what materials must be included in the order and where to find those materials in the warehouse.

MIS Capturing and Storing Process Data Processes create data such as dates, times, product numbers, quantities, prices, and addresses, as well as who did what, when, and where. IS captures and stores these data, commonly referred to as *process data* or *transaction data*. Some of these data are generated and automatically captured by the IS. These are data related to who completes an activity, when, and where. Other data are generated outside the IS and must be entered into it. This data entry can occur in various ways, ranging from manual entry to automated methods involving data in forms such as bar codes and RFID tags that can be read by machines.

In the fulfillment process, for example, when a customer order is received by mail or over the phone, the person taking the order must enter data such as the customer's name, what the customer ordered, and how much they ordered. Significantly, when a customer order is received through the firm's website, then all customer details are captured by the IS. Data such as the name of the person entering the data (who), the location where the person is completing the task (where), and the date and time (when) are automatically included by the IS when it creates the order. The data are updated as the process steps are executed. When the order is shipped, the warehouse will provide data about which products were shipped and in what quantities, and the IS will automatically include data related to who, when, and where.

An important advantage of using an IS compared to a manual system or multiple functional area information systems is that the data need to be entered into the system only once. Furthermore, once they are entered, other people in the process can easily access them, and there is no need to reenter them in subsequent steps.

The data captured by the IS can provide immediate feedback. For example, the IS can use the data to create a receipt or to make recommendations for additional or alternative products.

MIS Monitoring Process Performance A third contribution of IS is to help monitor the state of the various business processes. That is, the IS indicates how well a process is executing. It performs this role by evaluating information about a process. This information can be created at either the *instance level* (i.e., a specific task or activity) or the *process level* (i.e., the process as a whole).

For example, a company might be interested in the status of a particular customer order. Where is the order within the fulfillment process? Was the complete order shipped? If so, when? If not, then when can we expect it to be shipped? Or, for the procurement process, when was the purchase order sent to the supplier? What will be the cost of acquiring the material? At the process level, the IS can evaluate how well the procurement process is being executed by calculating the lead time, or the time between sending the purchase order to a vendor and receiving the goods, for each order and each vendor over time.

Not only can the IS help monitor a process, but it can also detect problems with the process. The IS performs this role by comparing the information with a standard—that is, what the company expects or desires—to determine if the process is performing within expectations. Management establishes standards based on organizational goals.

If the information provided by the IS indicates that the process is not meeting the standards, then the company assumes that some type of problem exists. Some problems can be routinely and automatically detected by the IS, whereas others require a person to review the information and make judgements. For example, the IS can calculate the expected date that a specific order will be shipped and determine whether this date will meet the established standard. Or, the IS can calculate the average time taken to fill all orders over the past month and compare this information with the standard to determine if the process is working as expected.

POM Monitoring business processes, then, helps detect problems with these processes. Often, these problems are really symptoms of a more fundamental problem. In such cases, the IS can help diagnose the cause of the symptoms by providing managers with additional detailed information. For example, if the average time to process a customer order appears to have increased over the previous month, this problem could be a symptom of a more fundamental one.

HRM A manager can then drill down into the information to diagnose the underlying problem. To accomplish this task, the manager can request a breakdown of the information by type of product, customer, location, employees, day of the week, time of day, and so on. After reviewing this detailed information, the manager might determine that the warehouse has experienced an exceptionally high employee turnover rate over the last month and that the delays are occurring because new employees are not sufficiently familiar with the process. The manager might conclude that this problem will work itself out over time, in which case there is nothing more to be done. Alternatively, the manager could conclude that the new employees are not being adequately trained and supervised. In that case, the company must take actions to correct the problem. The following section discusses several methodologies that managers can use to take corrective action when process problems are identified.

Robotic Process Automation

Robotic process automation (RPA) is a system that enables enterprises to automate business processes and tasks that historically were carried out by employees. Companies that employ RPA develop software “robots”—known as bots—that automate the steps in a business process. Let’s consider a variety of RPA scenarios. One example of the use of robots to help automate business processes is Pizza Hut Canada’s use of bots, as described in IT’s About Business 2.1.

MKT *Customer service:* Modern customers are accustomed to quick responses that solve their problems. Automated customer care bots can examine queries and route them to the correct customer care agent. Bots can also offer initial responses to customers without human intervention.

POM *Invoice processing:* RPA bots can automate the entire process from receipt to payment. The bots can automate receiving the invoice from the supplier, entering the invoice data, checking the invoice for correctness, and generating payments, thus minimizing human involvement.

POM *Sales orders:* RPA bots can automate tasks such as generating sales quotes and sales orders, monitoring the status of the order, generating invoices, generating payment terms and methods, monitoring returns, and generating refunds. Interestingly, RPA bots can monitor returns and generate refunds very quickly, which improves the customer experience and positively impacts the company’s reputation.

HRM *Payroll:* RPA bots can verify that employee data are consistent across multiple systems, validate timesheets, load earnings and deductions in calculating the amount of payment, create the paycheck, administer benefits, and make any necessary reimbursements.

IT’s About Business 2.1

Pizza Hut to Use Robots to Deliver Pizzas in Vancouver

Pizza Hut Canada is one of Canada’s largest pizza restaurant chains with over 500 locations in the country. Because of the rising cost of fuel in recent years, the company is finding it more challenging to deliver orders to customers, especially for short-distance delivery orders such as those located within a few hundred metres from a Pizza Hut restaurant. Such deliveries tend to be located in busy city centres, making them more tedious to deliver and, with little money to be made, restaurants are finding it increasingly difficult to find bicycle or car couriers who want to take them.

To help solve this problem, Pizza Hut reengineered its pizza delivery business process with the help of robots. In September 2022, the company started using three robots that look like coolers on wheels—named Angie, Hugo, and Raja—to deliver pizzas to customers in Vancouver’s city centre. In this pilot test, the robots, which have four wheels and eyelike lights, travelled no more than 500 metres, although they are capable of travelling for several kilometres. Customers can track their orders using Pizza Hut’s delivery app and, once their orders arrive, customers use unique codes to open the lid of the robot and collect their food.

The company argues that the use of robots brings additional value, such as boosting local commerce, reducing traffic, and generating environmental benefits by reducing greenhouse gas emissions. However, not everyone is convinced of the benefits. For example, some accessibility advocates have argued that such robots cannot coexist with humans because they will always present a tripping hazard. At the time of writing this story, several cities in Canada, including Toronto and Ottawa, had banned the use of robots on their sidewalks and bicycle paths, arguing safety concerns.

Pizza Hut has announced that it is not yet ready to roll out robots permanently in all Canadian cities and there is still much work to be done. For example, how would weather conditions affect the use of robots in Saskatchewan winters? Or how would they operate in freezing rain in Quebec? In the meantime, Pizza Hut will continue with its pilot project in Vancouver to improve its pizza delivery business processes.

Sources: Compiled from R. Crawford and C. Carey, “The Future Is Here; Pizza Hut Deliver Pies by Robot,” *Vancouver CityNews*, September 23, 2022; T. Deschamps, “Food Delivery Robots Hit Canadian Sidewalks, but Many Challenges Delay Mass Adoption,” *The Canadian Press*, December 5, 2022; A. Harris, “A Robot Can Deliver Pizza Hut to You in Vancouver This Week & It’s the First of Its Kind,” *Narcity Vancouver*, September 26, 2022; H. Short, “Pizza Hut Canada and Serve Robotics Launching Robot Delivery Service,” *Daily Hive*, September 26, 2022; T. Aziz, “This Electric, Self-Driving Delivery Robot Can Bring Pizza to Your Door,” *CTV News Vancouver*, September 24, 2022; K. Connor, “Pizza Hut Canada Testing Robot Delivery Service,” *Toronto Sun*, September 26, 2022.

Questions

1. Describe the steps of a typical pizza delivery business process.
2. Describe the fundamental elements of Pizza Hut’s new delivery business process in terms of inputs, resources, and outputs.
3. Explain the use of robots, such as those used by Pizza Hut, in relation to the three roles of information systems: executing the process, capturing and storing data, and monitoring performance.

POM *Price comparison:* All businesses make purchases. In the purchasing process, companies do research about pricing in order to make informed decisions. RPA bots compare prices from different vendors, as well as product attributes and quality.

POM *Manage customer information:* In May 2020, Takeda Pharmaceuticals (www.takeda.com) was recruiting patients for a clinical trial of a COVID-19 treatment. It normally took the firm several weeks to collect the volunteers' information, determine who would be suitable for the trial, and prepare the paperwork. Takeda used RPA bots to create patient files, select data input fields, and cut and paste text. As a result, the firm finished each person's paperwork in days instead of weeks.

HRM *Processing HR information:* Businesses generate large amounts of employee data, which RPA bots can collect and organize. These data include employee history with the company, payroll, and level of training.

HRM *Recruitment:* RPA bots can source resumes from different platforms such as LinkedIn, assess candidate qualifications, and filter spam and unqualified applications.

Before you go on...

1. What is a business process?
2. Describe several business processes carried out at your university.
3. Define a cross-functional business process and provide several examples of such processes.
4. Pick one of the processes described in Table 2.1 and identify its inputs, outputs, customer(s), and resources.
5. What is robotic process automation? Provide examples of its use in organizations.

2.2 Business Process Reengineering, Business Process Improvement, and Business Process Management

LEARNING OBJECTIVE

Differentiate between business process reengineering, business process improvement, and business process management.

Excellence in executing business processes is widely recognized as the underlying basis for all significant measures of competitive performance in an organization. Consider the following measures, for example:

- *Customer satisfaction:* The result of optimizing and aligning business processes to fulfill customers' needs, wants, and desires
- *Cost reduction:* The result of optimizing operations and supplier processes
- *Cycle and fulfillment time reduction:* The result of optimizing the manufacturing and logistics processes
- *Quality:* The result of optimizing the design, development, and production processes
- *Differentiation:* The result of optimizing the marketing and innovation processes
- *Productivity:* The result of optimizing each individual's work processes

The question is: How does an organization ensure business process excellence?

business process

reengineering (BPR) A radical redesign of a business process that improves its efficiency and effectiveness, often by beginning with a “clean sheet” (i.e., from scratch).

In their book *Reengineering the Corporation*, first published in 1993, Michael Hammer and James Champy argued that, to become more competitive, businesses needed to radically redesign their business processes to reduce costs and increase quality. The authors further asserted that information technology is the key enabler of such change. This radical redesign, called **business process reengineering (BPR)**, is a strategy for making an organization's business processes more productive and profitable. The key to BPR is for enterprises to examine their business processes from a “clean sheet” perspective and then determine how they can best reconstruct those processes to improve their business functions. BPR's popularity was propelled by the unique capabilities of information technology, such as automation and standardization of many process steps and error reduction due to improved communication among organizational information silos.

Although some enterprises have successfully implemented BPR, many organizations found this strategy too difficult, too radical, too lengthy, and too comprehensive. The impact on employees, on facilities, on existing investments in information systems, and even on organizational culture was overwhelming. Despite the many failures in BPR implementation, however, businesses increasingly began to organize work around business processes rather than individual tasks. The result was a less radical, less disruptive, and more incremental approach, called *business process improvement (BPI)*.

BPI focuses on reducing variation in process outputs (e.g., the finished product) by searching for the root causes of the variation in the process itself (e.g., a broken machine on an assembly line) or among the process inputs (e.g., a decline in the quality of raw materials purchased from a certain supplier). BPI is usually performed by teams of employees that include a process expert—usually the process owner (the individual manager who oversees the process)—as well as other individuals who are involved in the process. These individuals can be involved directly; for example, the workers who actually perform process steps. Alternatively, they can be involved indirectly; for example, customers who purchase the outputs from the process.

Six Sigma is a popular methodology for BPI initiatives. Its goal is to ensure that the process has no more than 3.4 defects per million outputs by using statistical methods to analyze the process. (A defect is defined as a faulty product or unsatisfactory service.) Six Sigma was developed by Motorola in the 1980s, and it is now used by companies worldwide, thanks in part to promotional efforts by early adopters such as General Electric. Six Sigma is especially appropriate for manufacturing environments, in which product defects can be easily defined and measured. Over the years, the methodology has been modified so that it focuses less on defects and more on customer value. As a result, it can now be applied to services as well as to products. Today, Six Sigma tools are widely used in financial services and health care institutions as components of process-improvement initiatives.

Regardless of the specific methodology you use, a successful BPI project generally follows five basic phases: define, measure, analyze, improve, and control (DMAIC).

- In the *define phase*, the BPI team uses a graphical process diagram to document the existing “as is” process activities, process resources, and process inputs and outputs. The team also documents the customer requirements for the process output, together with a description of the problem to be addressed.
- In the *measure phase*, the BPI team identifies relevant process metrics, such as time and cost, to generate one output (product or service) and collects data to understand how metrics evolve over time. Sometimes the data already exist, in which case the team can extract them from the IS that supports the process. Other times, however, the BPI team must combine operational process data already stored in the company's IS systems with other data sources, such as customer and employee observations, interviews, and surveys.
- In the *analysis phase*, the BPI team examines the “as is” process diagram and the collected data to identify problems with the process (e.g., decreasing efficiency or effectiveness) and their root causes. If possible, the team should also benchmark the process; that is, compare its performance with that of similar processes in other companies, or other areas of the organization. The team can employ IT applications such as statistical analysis software or simulation packages in this phase.

Using process simulation software during the analysis phase provides two benefits. First, it enables a process manager to quickly simulate a real situation (e.g., with a certain

number of people undertaking activities) for a specific amount of time (e.g., a working day, a week, or a month). The manager can then estimate the process performance over time without having to observe the process in practice. Second, it allows the manager to create multiple scenarios; for example, using a different number of resources in the process or using a different configuration for the process steps. Process simulation software can also provide a number of outputs regarding a process, including the time used by all resources to execute specific activities, the overall cycle time, the identification of resources that are infrequently used, and the bottlenecks in the process. Simulating a process provides a risk-free, inexpensive test of an improvement solution that does not need to be conducted with real resources.

- In the *improve phase*, the BPI team identifies possible solutions for addressing the root causes of the problem, maps the resulting “to be” process alternatives, and selects and implements the most appropriate solution. Common ways to improve processes are eliminating process activities that do not add value to the output and rearranging activities in a way that reduces delays or improves resource use. The organization must be careful, however, not to eliminate internal *process controls*—those activities that safeguard company resources, guarantee the accuracy of its financial reporting, and ensure adherence to rules and regulations.
- In the *control phase*, the team establishes process metrics and monitors the improved process after the solution has been implemented to ensure the process performance remains stable. An IS system can be very useful for this purpose.

Although BPI initiatives do not deliver the huge performance gains promised by BPR, many organizations prefer them because they are less risky and less costly. BPI focuses on delivering quantifiable results—and if a business case cannot be made, the project is not continued. All employees can be trained to apply BPI techniques in their own work to identify opportunities for improvement. Thus, BPI projects tend to be performed more from the bottom up, in contrast to BPR projects, which involve top-down change mandates. BPI projects take less time overall, and even if they are unsuccessful, they consume fewer organizational resources than BPR projects. However, if incremental improvements through BPI are no longer possible, or if significant changes occur in the firm’s business environment, then the firm should consider BPR. One final consideration is that, over time, employees can become overstretched or lose interest if the company undertakes too many BPI projects and does not have an effective system to manage and focus the improvement efforts.

POM To sustain BPI efforts over time, organizations can adopt **business process management (BPM)**, a management system that includes methods and tools to support the design, analysis, implementation, management, and continuous optimization of core business processes throughout the organization. BPM integrates disparate BPI initiatives to ensure consistent strategy execution.

Important components of BPM are process modelling and business activity monitoring. BPM begins with *process modelling*, which is a graphical depiction of all of the steps in a process. Process modelling helps employees understand the interactions and dependencies among the people involved in the process, the information systems they rely on, and the information they require to optimally perform their tasks. Process modelling software can support this activity.

Business activity monitoring (BAM) is a real-time approach for measuring and managing business processes. Companies use BAM to monitor their business processes, identify failures or exceptions, and address these failures in real time. Furthermore, because BAM tracks process operations and indicates whether they succeed or fail, it creates valuable records of process behaviours that organizations can use to improve their processes.

BPM activities are often supported by *business process management suites (BPMS)*. A BPMS is an integrated set of applications that includes a repository of process information such as process maps and business rules, tools for process modelling, simulation, execution, coordination across functions, and reconfiguration in response to changing business needs as well as process-monitoring capabilities.

Gartner (www.gartner.com), a leading IT research and advisory firm, states that companies need to focus on developing and mastering BPM skills throughout the organization. Gartner notes that high-performing companies use BPM technologies such as real-time process

business process management (BPM) A management technique that includes methods and tools to support the design, analysis, implementation, management, and optimization of business processes.

monitoring, visualization, analytics, and intelligent automated decision making to support intelligent business operations.

Another promising emerging trend is *social BPM*. This technology enables employees to collaborate using social media tools on wired and mobile platforms, both internally across functions and externally with stakeholders (e.g., customers or subject-area experts), to exchange process knowledge and improve process execution.

BPM initially helps companies improve profitability by decreasing costs and increasing revenues. Over time, BPM can create a competitive advantage by improving organizational flexibility—making it easy to adapt to changing business conditions and to take advantage of new opportunities. BPM also increases customer satisfaction and ensures compliance with rules and regulations. In all cases, the company's strategy should drive the BPM effort.

Before you go on...

1. What is business process reengineering?
2. What is business process improvement?
3. What is business process management?

2.3 Business Pressures, Organizational Responses, and Information Technology Support

LEARNING OBJECTIVE

Identify effective IT responses to different kinds of business pressures.

Modern organizations compete in a challenging environment. To remain competitive, they must react rapidly to problems and opportunities that arise from extremely dynamic conditions. In this section, you examine some of the major pressures confronting modern organizations and the strategies that organizations employ to respond to these pressures.

Business Pressures

business environment The combination of social, legal, economic, physical, and political factors in which businesses conduct their operations.

The **business environment** is the combination of social, legal, economic, physical, and political factors in which businesses conduct their operations. Significant changes in any of these factors are likely to create business pressures on organizations. Organizations typically respond to these pressures with activities supported by IT. **Figure 2.2** illustrates the relationships among business pressures, organizational performance and responses, and IT support. You will learn about three major types of business pressures: market, technological, and societal pressures.

MKT Market Pressures Market pressures are generated by the global economy, intense competition, the changing nature of the workforce, and powerful customers. Let's look more closely at each of these factors.

globalization The integration and interdependence of economic, social, cultural, and ecological facets of life, enabled by rapid advances in information technology.

Globalization **Globalization** is the integration and interdependence of economic, social, cultural, and ecological facets of life, made possible by rapid advances in information technology. Today, individuals around the world are able to connect, compute, communicate,

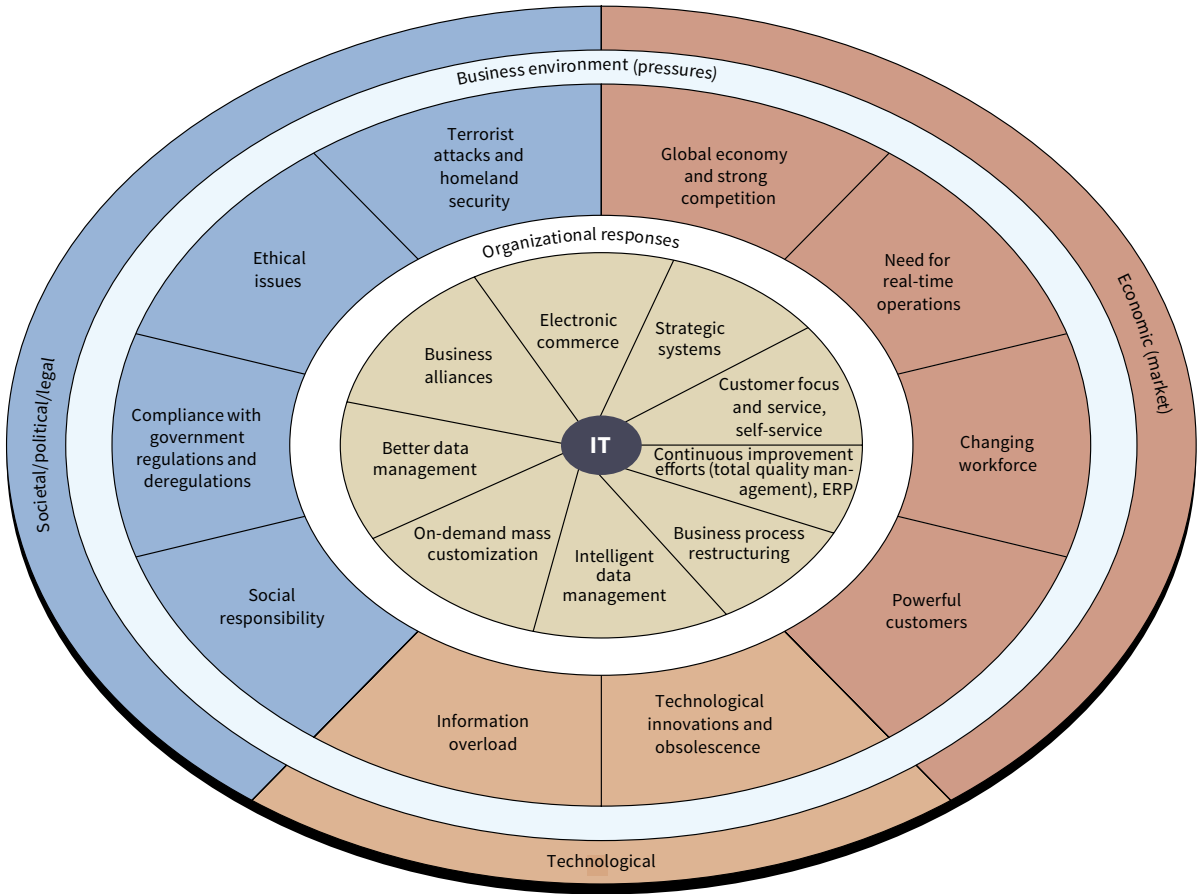


FIGURE 2.2 Business pressures, organizational performance and responses, and IT support.

collaborate, and compete everywhere and anywhere, anytime, and all the time; to access limitless amounts of information, services, and entertainment; to exchange knowledge; and to produce and sell goods and services. People and organizations can now operate without regard to geography, time, distance, or even language barriers. The bottom line? Globalization is markedly increasing competition.

These observations highlight the importance of market pressures for you. Simply put, you and the organizations you join will be competing with people and organizations from all over the world.

Let's consider some examples of globalization:

- Multinational corporations operate on a global scale, with offices and branches located worldwide.
- Many automobile manufacturers use parts from other countries, such as a car being assembled in the United States with parts coming from Japan, Germany, or Korea.
- The World Trade Organization (WTO; www.wto.org) supervises international trade.
- Regional agreements such as the Canada–United States–Mexico Agreement (CUSMA) have contributed to increased world trade and increased competition.
- The European Union (EU) is an economic and political union of 27 countries.
- The rise of India and China as economic powerhouses has increased global competition.

One important pressure that businesses in a global market must contend with is the cost of labour, which varies significantly among countries. In general, labour costs are higher in

developed countries such as Canada, the United States, and Japan than in developing countries such as Bangladesh and El Salvador. In addition, developed countries usually offer greater benefits, such as health care, to employees, driving the cost of doing business even higher. Therefore, many labour-intensive industries have moved their operations to countries with low labour costs. IT has made such moves much easier to implement.

HRM The Changing Nature of the Workforce The workforce, particularly in developed countries, is becoming more diversified. Increasing numbers of women, single parents, minorities, and persons with disabilities are now employed in all types of positions. IT is easing the integration of these employees into the traditional workforce. IT is also enabling people to work from home, which can be a major benefit for parents with young children and for people confronted with mobility or transportation issues.

Powerful Customers Consumer sophistication and expectations increase as customers become more knowledgeable about the products and services they acquire. Customers can use the internet to find detailed information about products and services, to compare prices, and to purchase items at electronic auctions.

Organizations recognize the importance of customers and have increased their efforts to acquire and retain them. Modern firms strive to learn as much as possible about their customers to better anticipate and address their needs. This process, called *customer intimacy*, is an important component of *customer relationship management (CRM)*, an organization-wide effort to maximize the customer experience. You will learn about CRM in Chapter 11.

MIS Technology Pressures The second category of business pressures consists of those pressures related to technology. Two major technology-related pressures are technological innovation and information overload.

Technological Innovation and Obsolescence New and improved technologies rapidly create or support substitutes for products, alternative service options, and superb quality. As a result, today's state-of-the-art products may be obsolete tomorrow. For example, how fast are new versions of your smartphone being released? How quickly are electronic versions of books, magazines, and newspapers replacing traditional hard copy versions? These changes force businesses to keep up with consumer demands.

Consider the rapid technological innovation of the Apple iPad (www.apple.com/ipad).

- Apple released its first iPad in April 2010.
- It released its iPad Mini in November 2012.
- In November 2013, Apple released its iPad Air.
- In November 2015, it released the iPad Pro.
- In 2021, it released the latest version of its iPad Mini (sixth generation).
- In 2022, it released the latest version of the iPad (tenth generation).
- In March 2022, Apple released the latest version of the iPad Air (fifth generation).
- In October 2022, it released the new iPad Pro (sixth generation).

One manifestation of technological innovation is “bring your own device (BYOD).” BYOD refers to the policy of permitting employees to bring personally owned mobile devices (laptops, tablet computers, and smartphones) to the workplace and to use those devices to connect to the corporate network as well as for personal use. The academic version of BYOD involves students using personally owned devices in educational settings to connect to their school's network.

MIS The rapid increase in BYOD represents a huge challenge for IT departments. Not only has IT lost the ability to fully control and manage these devices, but employees are now demanding that they be able to conduct company business from multiple personal devices.

The good news is that BYOD has increased worker productivity and satisfaction. In fact, some employees with BYOD privileges actually work longer hours with no additional pay. The bad news is security concerns. Many companies with BYOD policies have experienced an increase in *malware* (malicious software, discussed in Chapter 4). Furthermore, there is

an increased risk of losing sensitive proprietary information. Such information might not be securely stored on a personal mobile device, which can be lost or stolen.

Information Overload The amount of information available on the internet doubles approximately every year, and much of it is free. The internet and other telecommunications networks are bringing managers a flood of information. To make decisions effectively and efficiently, managers must be able to access, navigate, and use these vast stores of data, information, and knowledge. Information technologies such as search engines (discussed in Chapter 6) and data mining (Chapter 12) provide valuable support in these efforts.

Societal, Political, and Legal Pressures The third category of business pressures includes social responsibility, government regulation/deregulation, spending for social programs, spending to protect against terrorism, and ethics. This section will explain how all of these elements affect modern businesses. We start with social responsibility.

Social Responsibility Social issues that affect businesses and individuals range from the state of the physical environment, to company philanthropy, to education. Some corporations and individuals are willing to spend time and money to address various social problems. These efforts are known as **organizational social responsibility**.

One critical social problem is the state of the physical environment. A growing IT initiative, called *green IT*, addresses some of the most pressing environmental concerns. IT is instrumental in organizational efforts to “go green” in three areas:

1. **Facilities design and management.** Organizations are creating more environmentally sustainable work environments. Many organizations are pursuing Leadership in Energy and Environmental Design (LEED), which in Canada is managed by the Canada Green Building Council, a non-profit group that promotes the construction of environmentally friendly buildings. One impact of this movement toward environmentally friendly buildings is that IT professionals are expected to help create green facilities.
2. **Carbon management.** As companies try to reduce their carbon footprints, they are turning to IT executives to develop the systems needed to monitor carbon throughout the organization and its supply chain, which can be global in scope. Therefore, IT employees need to become knowledgeable about embedded carbon and how to measure it in the company’s products and processes.
3. **International and Canadian environmental laws.** IT executives must deal with federal and provincial laws and international regulations that impact everything from the IT products they buy, to how they dispose of them, to their company’s carbon footprint.

IT’s About Business 2.2 illustrates multiple ways in which various societal, economic, and technological pressures are affecting the rental car business. It then explores how Hertz has responded to these pressures to achieve a competitive advantage.

organizational social responsibility (also individual social responsibility) Efforts by organizations to solve various social problems.

IT’s About Business 2.2

MIS Renting Electric Vehicles for Competitive Advantage

Like many other industries, the rental car industry was hit hard by the COVID-19 pandemic. In fact, by May 2020, Hertz Global Holdings, Inc. (www.hertz.com), a global car rental company, which also owns Dollar and Thrifty rentals, had filed for bankruptcy. The bankruptcy deal required Hertz to sell 180,000 vehicles from its fleet. By June 2021, as the economy began to recover from the pandemic, Hertz emerged from bankruptcy, and the car rental market was ready to move forward. Hertz, however, was in a difficult position. With its fleet reduced by 180,000 vehicles and demand returning, it had to determine what types of vehicles it should purchase to rebuild capacity.

To complicate matters, another major shift was occurring at that time. By the first quarter of 2022, electric vehicle (EV) sales accounted for more than 5 percent of new car sales in at least 19 countries. In Canada, that percentage was even higher: 7.7 percent for a total of more than 26,000 EVs sold during this period. Many analysts believed this growth represented the “tipping point” for the EV industry. The *tipping point* is the point at which an evolving situation becomes irreversible. At this level of market saturation, EVs have shifted from a rarity to a daily sighting to “I think I might want one of those.”

The dramatic expansion of the EV market has created several market pressures on the car rental industry. Figure 2.2 presents three broad categories of outside forces and organizational responses: societal/political/legal, economic, and technological

pressures. Let's examine how these pressures impacted the rental car business.

Societal/Political/Legal Pressures

Reaching the tipping point doesn't immediately create customers. However, it highlights a moment when the general attitude toward a new development begins to swing toward broader acceptance. Turo (www.turo.com), a car-sharing marketplace that allows peer-to-peer car rentals (similar to Airbnb (www.airbnb.com) for living spaces) provides an excellent example of this societal change in attitude. The number of Teslas, a luxury EV manufactured by Tesla (www.tesla.com), listed for rent on Turo has exploded over the past few years. In 2014, Turo's marketplace listed fewer than 70 Teslas; by late 2021, that number exceeded 21,000. For all EVs, the number available to rent on Turo mushroomed from fewer than 200 to almost 27,000. Peer-to-peer rental is often considered a good measure of consumer interest due to its organic nature.

In a survey by Enterprise Holdings (www.enterpriseholdings.com), the parent company of Enterprise Rent-A-Car, National Car Rental, and Alamo Rent-A-Car, more than 60 percent of its clients stated that a positive rental experience with a specific model made them consider purchasing one themselves. Having EVs on the lot for people to rent for an extended period allows customers to take a more substantial test drive. These extended rentals help customers answer many of their questions: Will the range work for me? Will I be able to find chargers? Do I enjoy the driving experience? This is crucial as many consumers are now able to test an EV before making a purchase. Enterprise is not creating demand, but following market demand to allow for more robust, personal tests of the EV concept.

Further, the increased demand for EVs is not restricted to the consumer market. Many corporations face political and legal pressures in determining the types of vehicles they pay for their employees to rent.

Often, corporations are accused of making decisions based exclusively on the bottom line. As we discuss later, renting EVs can offer financial benefits. In addition, however, many companies view renting EVs as a step toward achieving their environmental goals. EVs provide a quantifiable way for companies to reduce greenhouse gas (GHG) emissions, meet net-zero goals (human-caused emissions of carbon dioxide), and highlight their environmental, social, and governance (ESG) activities for sustainability investors and advocacy groups. Companies can employ these data to illustrate progress in implementing their green initiatives.

In December 2023, the federal government issued a draft regulation that would prohibit the sale of new gasoline-powered cars after 2035, signalling a federally mandated shift toward EVs. This rule will be introduced gradually and will require 20 percent of cars sold in 2026 to be EVs, 60 percent of cars by 2030, and all car sales to be of electric vehicles by 2035. However, some critics question whether these targets will be met, considering the still high price tag of electric vehicles and the need for additional charging stations across the country to power an increasingly electrified vehicle fleet. The government is trying to respond to these challenges by providing sales incentives of up to \$5,000 for consumers who buy or lease an EV and by investing an additional \$400 million in EV infrastructure through to March 2027.

Politically, socially, and legally, the demand for EVs is growing across consumer, corporate, and political interests. Not surprisingly, this demand has encouraged Hertz to shift its fleet toward EVs.

Economic Pressures

The Canadian car rental industry was estimated to reach \$5.8 billion in 2022. In general, rental car companies tend to keep new cars for anywhere from two to four years; that means that they typically buy between 25 and 50 percent of their car fleet new each year. This number, however, has declined significantly due to persistent supply-chain disruptions, particularly the shortage of essential computer chips.

Given the economic pressures on Hertz, there are two primary reasons for it to shift its fleet to EVs: cost reduction and premium pricing. EVs will have a direct economic impact on Hertz's overall profitability. In its 2021 annual report, Hertz signalled to its investors that its EVs would enhance its bottom line. Electricity is less expensive than fuel, maintenance costs for EVs are lower, and customers are willing to pay a premium for the rental. All of these benefits will expand the company's profit margin.

Technological Pressures

Technologically, Hertz is experiencing multiple pressures, some of which it has no control over. The most significant is renters' ability to charge their vehicles. Consumers who purchase an EV typically elect to have a charger installed at home, so they do not need the public charging grid. Renters, however, do not have this luxury. They will require public charging access. This could be challenging for customers who rent an EV in a city they are unfamiliar with and have never charged or driven an EV before. As we saw previously, in the United States, the Bipartisan Infrastructure Law is allocating funds to increase the number of charging stations. Additionally, company agents and mechanics must be trained in EV technology. Currently, the industry has little standardization, so the learning curve is quite steep.

Hertz's Response

While Hertz was the first rental company to make a significant EV move, its two biggest rivals, Enterprise Holdings and Avis Budget Group, have since joined the race. Consumers benefit when more rental companies offer EVs as part of their fleet because increased supply decreases costs. Currently, however, supply is not outpacing demand. Just as the full-scale adoption of EVs among North American drivers will take years, the rental car shift will be a marathon, not a sprint.

Hertz has made the most significant movements of any rental company in adding EVs to its fleet. In 2021, the company announced an order of 100,000 Teslas. In March 2022, it agreed to purchase 65,000 Polestar sedans. (Polestar is an EV manufacturer based in Sweden (www.polestar.com)). Then, in September, it announced a deal to purchase 175,000 EVs from GMC (www.gmc.com).

These moves place Hertz far ahead of its competitors in the EV rental race. Several of its rivals have also made big EV plans, including players such as Enterprise, Avis, Toro, Vancouver-based car rental company Zerocar, and Quebec's car-sharing service Communauto; all of them have added a significant number of EV to their fleets.

Significantly, car rental companies have gambled on EVs in the past without success. For example, Hertz and Enterprise offered EVs from 2011 to 2017. Ultimately, however, they abandoned those efforts in the face of low gas prices and consumer confusion on the concept of the EV. Will this time be different? Maybe. The market seems to have reached the tipping point.

Questions

1. Describe the political/social/legal pressures on Hertz.
2. Describe the technological pressures on Hertz.
3. Describe the economic pressures on Hertz.
4. How will EVs create a competitive advantage for Hertz

Sources: Compiled from E. Newburger, “All 50 States Get Green Light to Build EV Charging Stations Covering 75,000 Miles of Highways,” *CNBC.com*, September 27, 2022; D. Ferris, “Hertz Places a Risky Wager on EVs,” *eenews.net*, September 21, 2022; R. Bellan, “Biden to Announce \$900M to Build EV Charging Stations,” *TechCrunch*, September 14, 2022; C. Davenport, L. Friedman, and B. Plumer, “California to Ban the Sale of New Gasoline Cars,” *New York Times*, August 24, 2022; S. Collie, “Hertz on Why Your Next Rental Car Might Be an EV,” *carexpert.com.au*, August 11, 2022; T. Randall, “US Crosses the Electric-Car Tipping Point for Mass Adoption,” *Bloomberg*, July 8, 2022; S. Segal, “Hertz Is Trying to Leave Gas Behind, But What’s Standing in the Way?” *PC Magazine*, June 21, 2022; B. Woods, “How the Massive EV Transition Is Starting in the Car Rental Industry,” *cncb.com*, June 18, 2022; D. Shepardson and

A. Sriram, “Hertz to Buy Up to 65,000 Electric Vehicles from Polestar,” *reuters.com*, April 4, 2022; N. Naughton, “Hertz-Tesla Deal Signals Broad Shift to EVs for Rental-Car Companies,” *Wall Street Journal*, November 27, 2021; L. Brown, “Hertz Buying 100,000 Teslas in \$4.2 Billion Deal, Making EVs 20 Percent of Its Fleet,” *Car and Driver*, November 2, 2021; A. Alamalhodaie, “Tesla’s Deal with Hertz Opens a New Frontier for the EV Maker,” *techcrunch.com*, October 29, 2021; N. Bomey, “Hertz to Buy 100,000 Tesla Cars as Rental Car Company Pivots toward Electric Vehicles,” *USA Today*, October 25, 2021; E. Schatzker, “Hertz Order for 100,000 EVs Sends Tesla Value to \$1 Trillion,” *Bloomberg*, October 25, 2021; M. Gladwell *The Tipping Point: How Little Things Can Make a Big Difference*, New York, Back Bay Books, 2002. “Market Snapshot: Record-High Electric Vehicle Sales in Canada,” *Canada Energy Regulator—Government of Canada*, October 26, 2022; E. Stober, “Is Canada Ready to Meet its ‘Aggressive’ Electric Vehicle Mandate by 2026?,” *Global News*, January 20, 2023; M. Guy, “Getting a Charge Out of It: EV Rebates for Canadians,” *Driving*, January 13, 2023; J. Dabrusin, “Reaching the Tipping Point on Electric Vehicles,” *Toronto Star*, August 13, 2022; M. Yakub, “Some Canadian Car Rental and Car-Sharing Companies Are Going to Great Lengths to Pivot to EVs,” *Electronic Autonomy Canada*, June 9, 2022.

Continuing our discussion of social responsibility, social problems all over the world may be addressed through corporate and individual philanthropy. In some cases, questions arise as to what percentage of contributions actually goes to the intended causes and recipients and what percentage goes to the charity’s overhead. Another problem that concerns contributors is that they often exert little influence over the selection of the projects their contributions will support. The internet can help address these concerns and facilitate generosity and connection. Consider the following examples:

- *PatientsLikeMe* (www.patientslikeme.com), or any of the thousands of message boards dedicated to infertility, cancer, and various other ailments. People use these sites and message boards to obtain information about health care decisions based on volunteered information, while also receiving much-needed emotional support from strangers.
- **FIN** *Kiva* (www.kiva.org): Kiva is a nonprofit enterprise that provides a link between lenders in developed countries and entrepreneurs in developing countries. Users pledge interest-free loans rather than tax-deductible donations. Kiva directs 100 percent of the loans to borrowers.
- *Canadian Red Cross* (www.redcross.ca): At this site, potential donors can decide where their money will be directed, choosing whether it goes to a particular disaster relief fund. Other large charities similarly allow their donors to decide where their money will be used.

Still another social problem that affects modern business is the digital divide. The **digital divide** refers to the wide gap between those individuals who have access to information and communications technologies and those who do not. This gap exists both within and among countries.

digital divide The gap between those who have access to information and communications technology and those who do not.

Compliance with Government Regulations Another major source of business pressures is government regulations regarding health, safety, environmental protection, and equal opportunity. Businesses tend to view government regulations as expensive constraints on their activities. In general, government deregulation intensifies competition. Organizations must comply with the regulations contained in government statutes. The process of becoming and remaining compliant is expensive and time-consuming. In almost all cases, organizations rely on IT support to provide the necessary controls and information for compliance.

Protection against Criminal Activities Computer systems can be used to create fraudulent or fictitious transactions that are used to steal funds from banks or other organizations, or to engage in identity theft—the use of another person’s identity for financial gain. Individuals and organizations need to protect their information to help prevent these actions.

You can learn more about fraud from organizations such as the Association of Certified Fraud Examiners (www.acfe.com).

Two examples of protection against terrorism are the U.S. Department of Homeland Security's (DHS) and the Canada Border Services Agency's biometric programs. (We discuss biometrics in Chapter 4.) Biometric screening systems can include the collection of fingerprints, photos, and iris and retina scans that ties into government databases and watch lists to check the identities of those entering the country. These systems are now operational at most Canada–U.S. border crossings and major international ports of entry by air, sea, and land.

Ethical Issues *Ethics* relates to general standards of right and wrong. *Information ethics* relates specifically to standards of right and wrong in information processing practices. Ethical issues are very important because, if handled poorly, they can damage an organization's image and destroy its employees' morale. The use of IT raises many ethical issues, ranging from monitoring email to invading the privacy of millions of customers whose data are stored in private and public databases. Chapter 3 covers ethical issues in detail.

Clearly, the pressures on organizations are increasing, and organizations must be prepared to take responsive actions if they are to succeed. You will learn about these organizational responses in the next section.

Organizational Responses

Organizations are responding to the various pressures just discussed by implementing IT in different ways such as strategic systems, customer focus, make-to-order and mass customization, and e-business. This section explores each of these responses.

Strategic Systems Strategic systems provide organizations with advantages that enable them to increase their market share and profits to better negotiate with suppliers and to prevent competitors from entering their markets. IT's About Business 2.3 provides an example of how strategically important information systems can be to an organization. As you will see, many information systems are so strategically important that, if they are inadequate or fail altogether, the organizations using them are at risk of failing as well.

IT's About Business 2.3

MIS **MKT** **MLSE Deploys Technology to Win Championships and Attract and Connect Fans**

While the Raptors plan for their future championships, Maple Leaf Sports & Entertainment (MLSE), the parent company that owns the Toronto Raptors, Toronto Maple Leafs, Toronto FC, and Toronto Argonauts, sees digital innovation as an integral part of the organization's strategy.

Mobile Apps. A recent example is the Scotiabank Arena app, which allows game goers to order food and beverages ahead of time without having to wait in line. Also, when the arena is used for major music concerts, spectators can preorder merchandise, pick it up from a designated location, and wear it for the entire concert without having to wait and miss the opening songs. More capabilities are in the works as the MLSE digital team updates them every two weeks, and similar apps are planned down the line for additional MLSE venues such as the BMO Field, home of the Toronto FC and Argos CFL games.

Advanced Analytics. Advanced analytics and data presentation technologies also help MLSE make the right decisions about players. With professional athletes making millions in annual salaries, teams need to make the right hiring decisions to ensure success both on and off the court, ice, diamond, or field. Making

wrong player decisions can cause a team owner's bank account to go from the black to red in the blink of an eye. For example, the Raptors developed an information system consisting of several wall-sized screens and touch screen tables in a specially prepared room the team calls the "War Room." The system is known as Sports Insights Central and makes use of several of IBM's famous Watson artificial intelligence (www.ibm.com/watson) functionalities. The Watson Tradeoff analytics function can assemble possible "dream team" player combinations. Watson Personality Insights gives management a better understanding of a player's personality and how he might fit with other team members and the team culture. AlchemyAPI mines news databases for intelligence on players of interest. The software can also crunch a player's potential athletic and financial performance to see what impact he might have on a team on and off the court. Sports Insights Central has a phone app so Raptors' management can have their own mobile version of the War Room.

Paperless Systems. IBM Sports Insights Central has dramatically reduced paperwork for the Toronto Raptors and has automated and digitized a lot of the manual steps in the process of hunting for new players and the analyses that precede such decisions. Things that used to be stored in binders, such as the team's scouting reports, trade scenarios, and player comparisons,

are simultaneously displayed on screens. With the new solution, managers now have a centralized place to discuss and visualize the data and information necessary for them to make informed player hiring decisions, without having to give up parts of the old system.

Cashless Transactions. In 2018, the Scotiabank Arena, home of the Raptors and Maple Leafs, introduced cashless technologies to allow fans to tap their credit cards and phone apps at food and refreshment stands and kiosks. Two in every three transactions are cashless, which on a typical night amounts to about 14,000 transactions. The widespread use of cashless payment methods has resulted in a 10-percent increase in the average amount of transactions in some cases, as well as in the amounts spent by fans.

Augmented Reality. MLSE will soon utilize augmented reality (AR) in its new “Game within the Game” digital experience. This online platform will allow fans to gamble, play games, and learn about their favourite players. This platform will allow fans in and outside of the stadium to have a more interactive and interesting experience. It allows those wearing the headsets to either immerse themselves directly in the action, or even receive real-time stats as part of their viewpoint while watching a game.

Extended Reality. MLSE has already begun tests, and demonstrations of its new extended reality (XR) technologies. Using chips in players’ jerseys and other tracking devices, fans will soon be able to use virtual reality (VR) headsets to watch games from home, and new AR glasses will give fans in the stadium the ability to track certain players and view player statistics. Amazon Web Services is helping MLSE to develop these XR headsets, and soon they will be released for public purchase and use.

MLSE is also one of the first sports organizations in the world to form its own digital lab. Future of Sport Lab (FSL) is an MLSE initiative in collaboration with Toronto Metropolitan University with the mission to drive digital innovation across the sports world. Some examples of recent innovations that have come out of FSL include Performance Phenomics, a brain imaging assessment company; Rival.ai, an e-sports company that provides AI-powered scouting reports for players; and SkillShark, a platform for coaches that helps to evaluate athletes’ performance. The 250-person

digital lab includes developers, data scientists, project managers, UI/UX designers, and more, and has the mission of driving innovation across the sports world.

Questions

1. Consider all the technologies discussed in this case. Taken together, are they strategically important to the MLSE’s Toronto Raptors team? Why or why not? Provide specific examples to support your answer.
2. Are they strategically important to MLSE’s Scotiabank Arena? Why or why not? Provide specific examples to support your answer.
3. Have you experienced any of the technologies discussed in the case? Do you feel your experience was improved with the use of technology?

Sources: Compiled from N. Westoll “Raptors Make NBA History by Defeating Warriors to Win Finals,” *Global News*, www.globalnews.ca, June 13, 2019; Canadian Press, “MLSE Digital Boss Taking Raptors, Leafs Fan Experience Global,” www.torontosun.com, December 27, 2018; B. Jackson, “New MLSE Digital Boss Seeks to Transform Raptors and Leafs Fan Experience from the Stadium to the Digital Realm,” www.itworldcanada.com, February 25, 2019; N. Davidson, Canadian Press “MLSE Digital Boss Looks to Expand Fan Experience in Arena and around the World,” *The Globe and Mail*, www.theglobeandmail.com, December 27, 2018; M. Greenwood, “MLSE Is Leading the Digital Revolution in Professional Sports,” *BrainStation*, March 26, 2019; “Toronto Raptors Use Data-Driven Command Center on Path to NBA Finals,” *IBM Think Blog*, June 9, 2019; M. Simpson, “Home of Toronto Maple Leafs & Raptors Making Move to Cashless Food and Beverage Stalls,” *itbusiness.ca*, November 8, 2018; A. Coop, “MLSE’s New ‘Digital Arena’ for Raptors and Leafs Fans Is the Future of Sports Viewing, Says CTO,” *itbusiness.ca*, April 1, 2021; B. Meler, “Glimpse into the Future”: MLSE, Amazon Bringing AR, VR to Sports Viewing,” *Yahoo.com*, January 24, 2023; J. Fleguel, “MLSE Aims to Bring Virtual Reality, Other Tech Innovations to Live Sports Viewing,” *CTV News*, January 24, 2023; N. Davidson, “MLSE Working on ‘Mixed Reality’ Tech to Enhance Fan Experience and Help Its Teams Win,” *The Globe and Mail*, January 25, 2023.

MKT Customer Focus Organizational attempts to provide superb customer service can make the difference between attracting and retaining customers versus losing them to competitors. Numerous IT tools and business processes have been designed to keep customers happy. Recall that a *business process* is a collection of related activities that produce a product or service of value to the organization, its business partners, and its customers. Consider Amazon, for example. When you visit Amazon’s website anytime after your first visit, the site welcomes you back by name and presents you with information about items that you might like, based on your previous purchases. In another example, Dell guides you through the process of purchasing a computer by providing information and choices that help you make an informed buying decision.

POM Make-to-Order and Mass Customization **Make-to-order** is a strategy of producing customized (made to individual specifications) products and services. The business problem is how to manufacture customized goods efficiently and at a reasonably low cost. Part of the solution is to change manufacturing processes from mass production to mass customization. In mass production, a company produces a large quantity of identical items. An early example of mass production was Henry Ford’s Model T, for which buyers could pick any colour they wanted—as long as it was black!

Ford’s policy of offering a single product for all of its customers eventually gave way to *consumer segmentation*, in which companies provide standard specifications for different consumer groups, or segments. Clothes manufacturers, for example, design their products in

make-to-order The strategy of producing customized products and services.

mass customization

A production process in which items are produced in large quantities but are customized to fit each customer's desires.

different sizes and colours to appeal to different customers. The next step was *configured mass customization*, in which companies offer features that allow each shopper to customize their product or service with a range of components. Examples are ordering a car, a computer, or a smartphone, for which the customer can specify which features they want.

In the current strategy, known as **mass customization**, a company produces a large quantity of items, but it customizes them to match the needs and preferences of individual customers. Mass customization is essentially an attempt to perform make-to-order on a large scale. Examples are:

- NikeiD (www.nikeid.com) allows customers to design their footwear.
- M&M candies: My M&M (www.mms.com) allows customers to add photos, art, and messages to candy.
- Dell (www.dell.com) and HP (www.hp.com) allow customers to exactly specify the computer they want.

E-Business and E-Commerce Conducting business electronically is an essential strategy for companies that are competing in today's business environment. *Electronic commerce (EC or e-commerce)* describes the process of buying, selling, transferring, or exchanging products, services, or information through computer networks, including the internet. *E-business* is a somewhat broader concept. In addition to the buying and selling of goods and services, e-business also refers to servicing customers, collaborating with business partners, and performing electronic transactions within an organization. Chapter 7 focuses extensively on this topic. In addition, e-commerce applications are discussed throughout the text.

You now have a general overview of the pressures that affect companies in today's business environment and the responses that companies choose to manage these pressures. To plan for the most effective responses, companies formulate strategies. In the new digital economy, these strategies rely heavily on information technology, especially strategic information systems. You examine these topics in the next section.

Before you go on...

1. What are the characteristics of the modern business environment?
2. Discuss some of the pressures that characterize the modern global business environment.
3. Identify some of the organizational responses to these pressures. Are any of these responses specific to a particular pressure? If so, then which ones?

2.4 Competitive Advantage and Strategic Information Systems

LEARNING OBJECTIVE

Describe the strategies that organizations typically adopt to counter Porter's five competitive forces.

A *competitive strategy* is a statement that identifies a business's approach to compete, its goals, and the plans and policies that will be required to carry out those goals (Porter, 1985).¹ A strategy, in general, can apply to a desired outcome, such as gaining market share. A competitive

¹Porter, M.E. (1985) *Competitive Advantage*, Free Press, New York.

strategy focuses on achieving a desired outcome when competitors want to prevent you from reaching your goal. Therefore, when you create a competitive strategy, you must plan your own moves, but you must also anticipate and counter your competitors' moves.

Through its competitive strategy, an organization seeks a competitive advantage in an industry. That is, it seeks to outperform its competitors on a critical measure such as cost, quality, and time-to-market. Competitive advantage helps a company function profitably within a market and generate higher-than-average profits.

Competitive advantage is increasingly important in today's business environment, as you will note throughout the text. In general, companies' *core business* has remained the same. That is, information technologies simply offer tools that can enhance an organization's success through its traditional sources of competitive advantage, such as low cost, excellent customer service, and superior supply chain management. **Strategic information systems (SISs)** provide a competitive advantage by helping an organization to implement its strategic goals and improve its performance and productivity. Any information system that helps an organization either achieve a competitive advantage or reduce a competitive disadvantage qualifies as a strategic information system.

strategic information systems (SISs) Systems that help an organization gain a competitive advantage by supporting its strategic goals and increasing performance and productivity.

Porter's Competitive Forces Model

The best-known framework for analyzing competitiveness is Michael Porter's **competitive forces model** (Porter, 1985). Companies use Porter's model to develop strategies to increase their competitive edge. The model also demonstrates how IT can make a company more competitive.

Porter's model identifies five major forces that can endanger or enhance a company's position in a given industry. **Figure 2.3** highlights these forces. Although the Web has changed the nature of competition, it has not changed Porter's five fundamental forces. In fact, what makes these forces so valuable as analytical tools is that they have not changed for centuries. Every competitive organization, no matter how large or small, or which business it is in, is driven by these forces. This observation applies even to organizations that you might not consider competitive, such as local governments. Although local governments are not for-profit enterprises, they compete for businesses to locate in their districts, for funding from higher levels of government, for employees, and for many other things.

Significantly, Porter (2001)² concludes that the *overall* impact of the Web is to increase competition, which generally diminishes a firm's profitability. Let's examine Porter's five forces and how the Web influences them.

competitive forces model

A business framework devised by Michael Porter that analyzes competitiveness by recognizing five major forces that could endanger a company's position.

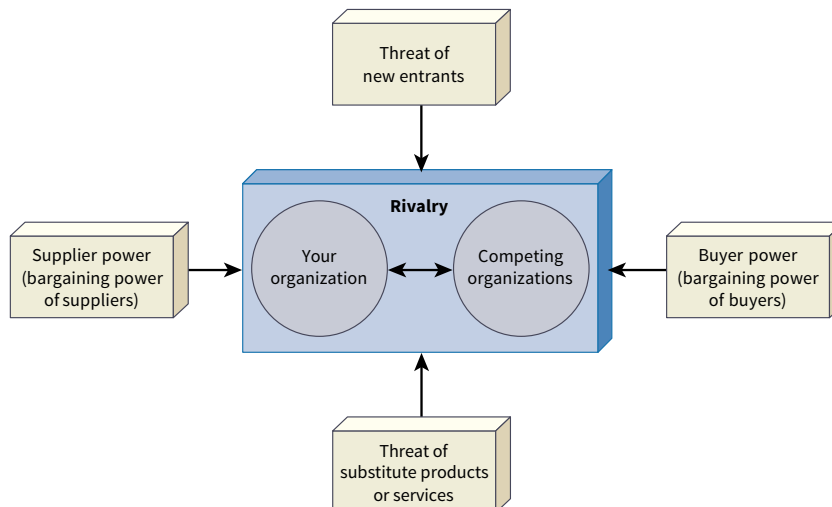


FIGURE 2.3 Porter's competitive forces model.

²Porter, M.E. (2001) "Strategy and the Internet," *Harvard Business Review*, March.

entry barrier Product or service feature that customers expect from organizations in a certain industry; an organization trying to enter this market must provide this product or service at a minimum to be able to compete.

1. *The threat of entry of new competitors.* The threat that new competitors will enter your market is high when entry is easy and low when there are significant barriers to entry. An **entry barrier** is a product or service feature that customers have learned to expect from organizations in a certain industry. An organization that seeks to enter the industry must offer this feature to survive in the marketplace. There are many types of entry barriers. Consider, for example, legal requirements such as admission to the bar to practise law or obtaining a licence to serve liquor, where only a certain number of licences are available.

Suppose you want to open a gasoline station. To compete in that industry, you would have to offer pay-at-the-pump service to your customers. Pay-at-the-pump is an IT-based barrier to entering this market because you must offer it for free. The first gas station that offered this service gained first-mover advantage and established barriers to entry. This advantage did not last, however, because competitors quickly offered the same service and thus overcame the entry barrier.

For most firms, the Web *increases* the threat that new competitors will enter the market because it sharply reduces traditional barriers to entry, such as the need for a sales force or a physical storefront. Today, competitors frequently need only to set up a website. This threat of increased competition is particularly acute in industries that perform an *intermediation role*, which is a link between buyers and sellers (e.g., stock brokers and travel agents), as well as in industries in which the primary product or service is digital (e.g., the music industry). The geographical reach of the Web also enables distant competitors to compete more directly with an existing firm.

In some cases, however, the Web increases barriers to entry. This scenario occurs primarily when customers have come to expect a nontrivial capability from their suppliers. For example, the first company to offer Web-based package tracking gained a competitive advantage from that service. Competitors were forced to follow suit.

2. *The bargaining power of suppliers.* Supplier power is high when buyers have few choices about whom to buy from and low when buyers have many choices. Therefore, organizations would rather have more potential suppliers so that they will be in a stronger position to negotiate price, quality, and delivery terms.

The internet's impact on suppliers is mixed. On the one hand, it enables buyers to find alternative suppliers and to compare prices more easily, thereby reducing the supplier's bargaining power. On the other hand, as companies use the internet to integrate their supply chains, participating suppliers prosper by locking in customers.

3. *The bargaining power of customers (buyers).* Buyer power is high when buyers have many choices about whom to buy from and low when buyers have few choices. For example, in the past, there were few locations where students could purchase textbooks (typically, one or two campus bookstores). In this situation, students had low buyer power. Today, the Web provides students with access to a multitude of potential suppliers as well as detailed information about textbooks. As a result, student buyer power has increased dramatically.

In contrast, *loyalty programs* reduce buyer power. As their name suggests, loyalty programs reward customers based on the amount of business they conduct with a particular organization (e.g., airlines, hotels, car rental companies). Information technology enables companies to track the activities and accounts of millions of customers, thereby reducing buyer power. That is, customers who receive perks from loyalty programs are less likely to do business with competitors. (Loyalty programs are associated with customer relationship management, which you will study in Chapter 11.)

4. *The threat of substitute products or services.* If there are many alternatives to an organization's products or services, then the threat of substitutes is high. Conversely, if there are few alternatives, then the threat is low. Today, new technologies create substitute products very rapidly. For example, customers can purchase wireless telephones instead of land line telephones, internet music services instead of traditional CDs, and ethanol instead of gasoline for their cars.

Information-based industries experience the greatest threat from substitutes. Any industry in which digitized information can replace material goods (e.g., music, books, software) must view the internet as a threat because the internet can convey this information efficiently and at low cost and high quality.

Even when there are many substitutes for their products, however, companies can create a competitive advantage by increasing switching costs. *Switching costs* are the costs, in money and time, imposed by a decision to buy elsewhere. For example, contracts with smartphone providers typically include a substantial penalty for switching to another provider until the term of the contract expires (quite often, two years). This switching cost is monetary.

As another example, when you buy products from Amazon, the company develops a profile of your shopping habits and recommends products targeted to your preferences. If you switch to another online vendor, then that company will need time to develop a profile of your wants and needs. In this case, the switching cost involves time rather than money.

5. *The rivalry among existing firms in the industry.* The threat from rivalry is high when there is intense competition among many firms in an industry. The threat is low when the competition involves fewer firms and is not as intense.

In the past, proprietary information systems—systems that belong exclusively to a single organization—have provided a strategic advantage to firms in highly competitive industries. Today, however, the visibility of internet applications on the Web makes proprietary systems more difficult to keep secret. In simple terms, when I see my competitor's new system online, I will rapidly match its features to remain competitive. The result is fewer differences among competitors, which leads to more intense competition in an industry.

To understand this concept, consider the highly competitive grocery industry, in which Loblaw's, Metro, Sobeys, and other companies compete essentially on price. Some of these companies have IT-enabled loyalty programs in which customers receive discounts and the store gains valuable business intelligence on customers' buying preferences. Stores use this business intelligence in their marketing and promotional campaigns. (You will learn about business intelligence in Chapter 12.)

Grocery stores are also experimenting with RFID to speed up the checkout process, track customers through the store, and notify customers of discounts as they pass by certain products. Grocery companies also use IT to tightly integrate their supply chains for maximum efficiency and thus reduce prices for shoppers.

Established companies can also gain a competitive advantage by allowing customers to use data from the company's products to improve their own performance. For example, Babolat (www.babolat.ca), a manufacturer of sports equipment, has developed its Babolat Play Pure Drive racquets. These racquets have sensors embedded into the handle and a smartphone app uses the data from the sensors to monitor and evaluate ball speed, spin, and impact location to give tennis players valuable feedback.

Competition is also being affected by the extremely low variable cost of digital products. That is, once a digital product has been developed, the cost of producing additional units approaches zero. Consider the music industry as an example. When artists record music, their songs are captured in digital format. Physical products, such as CDs or DVDs of the songs for sale in music stores, involve costs. The costs of a physical distribution channel are much higher than those involved in delivering the songs digitally over the internet.

In fact, in the future, companies might give away some products for free. For example, some analysts predict that commissions on online stock trading will approach zero because investors can search the internet for information to make their own decisions regarding buying and selling stocks. At that point, consumers will no longer need brokers to give them information that they can obtain themselves, virtually for free.

Porter's Value Chain Model

Organizations use Porter's competitive forces model to design general strategies. To identify specific activities in which they can use competitive strategies for greatest impact, they use his value chain model (1985). A **value chain** is a sequence of activities through which the organization's inputs, whatever they are, are transformed into more valuable outputs, whatever they are. The **value chain model** identifies points at which an organization can use information technology to achieve a competitive advantage (see **Figure 2.4**).

value chain A sequence of activities through which the organization's inputs, whatever they are, are transformed into more valuable outputs, whatever they are.

value chain model Model that shows the primary activities that sequentially add value to the profit margin; also shows the support activities.

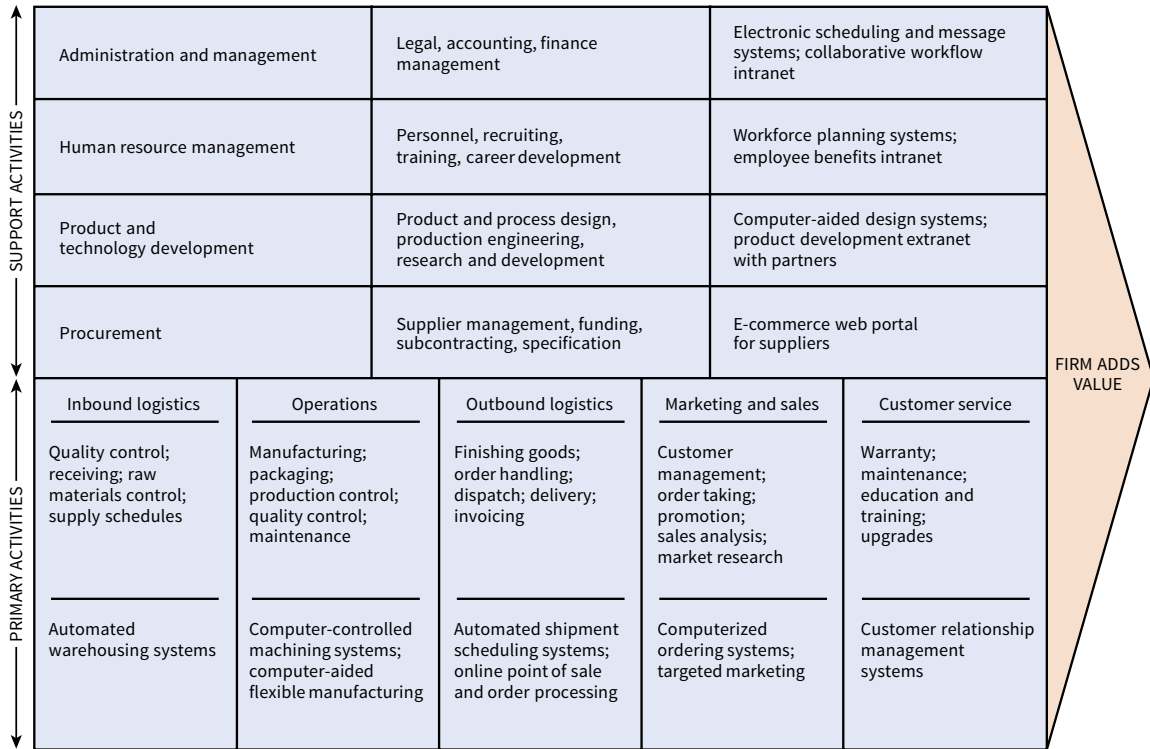


FIGURE 2.4 Porter's value chain model.

primary activities Those business activities related to the production and distribution of the firm's products and services, thus creating value.

support activities Business activities that do not add value directly to a firm's product or service under consideration but support the primary activities that do add value.

According to Porter's value chain model, the activities conducted in any organization can be divided into two categories: primary activities and support activities. **Primary activities** relate to the production and distribution of the firm's products and services. These activities create value for which customers are willing to pay. The primary activities are buttressed by **support activities**. Unlike primary activities, support activities do not add value directly to the firm's products or services. Rather, as their name suggests, they contribute to the firm's competitive advantage by supporting the primary activities.

Next, you will see examples of primary and support activities in the value chain of a manufacturing company. Keep in mind that other types of firms, such as transportation, health care, education, retail, and others, have different value chains. The key point is that *every* organization has a value chain.

In a manufacturing company, primary activities involve purchasing materials, processing the materials into products, and delivering the products to customers. Manufacturing companies typically perform five primary activities in the following sequence:

1. Inbound logistics (inputs)
2. Operations (manufacturing and testing)
3. Outbound logistics (storage and distribution)
4. Marketing and sales
5. Services

As work progresses in this sequence, value is added to the product in each activity. Specifically, the following steps occur:

1. The incoming materials are processed (in receiving, storage, and so on) in activities called *inbound logistics*.
2. The materials are used in operations, in which value is added by turning raw materials into products.

3. These products are prepared for delivery (packaging, storing, and shipping) in the out-bound logistics activities.
4. Marketing and sales sell the products to customers, increasing product value by creating demand for the company's products.
5. Finally, the company performs after-sales service for the customer, such as warranty service or upgrade notification, adding further value.

As noted earlier, these primary activities are buttressed by support activities. Support activities consist of the following:

1. The firm's infrastructure (accounting, finance, and management)
2. Human resources management
3. Product and technology development (R&D)
4. Procurement

Each support activity can be applied to any or all of the primary activities. The support activities can also support one another.

A firm's value chain is part of a larger stream of activities, which Porter calls a **value system**. A value system, or an *industry value chain*, includes the suppliers that provide the inputs necessary to the firm along with their value chains. After the firm creates products, these products pass through the value chains of distributors (which also have their own value chains), all the way to the customers. All parts of these chains are included in the value system. To achieve and sustain a competitive advantage, and to support that advantage with information technologies, a firm must understand every component of this value system.

value system A stream of activities that includes the producers, suppliers, distributors, and buyers, all of whom have their own value chains.

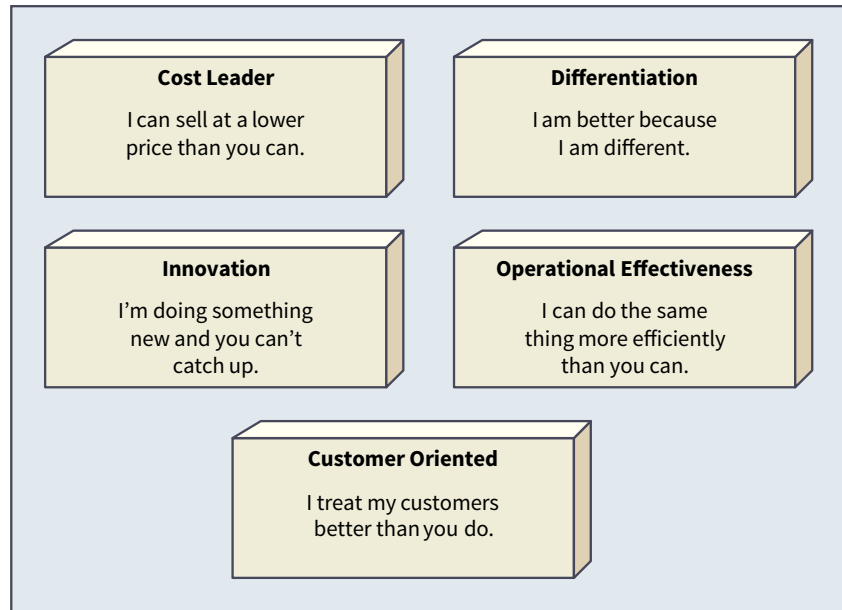
Strategies for Competitive Advantage

Organizations continually try to develop strategies to counter the five competitive forces identified by Porter. You will learn about five of those strategies here. Before we go into specifics, however, it is important to note that an organization's choice of strategy involves trade-offs. For example, a firm that concentrates only on cost leadership might not have the resources available for research and development, leaving it unable to innovate. As another example, a company that invests in customer happiness (customer orientation strategy) will experience increased costs.

Companies must select a strategy and then stay with it, because a confused strategy cannot succeed. This selection, in turn, decides how a company will use its information systems. A new information system that can improve customer service but will increase costs slightly will be welcomed at a high-end retailer such as Nordstrom's, but not at a discount store such as Walmart. The following list presents the most commonly used strategies. **Figure 2.5** provides an overview of these strategies.

1. **Cost leadership strategy.** Produce products and services at the lowest cost in the industry. An example is Walmart's automatic inventory replenishment system, which enables the company to reduce inventory storage requirements. As a result, Walmart stores use floor space only to sell products and not to store them, thereby reducing inventory costs.
2. **Differentiation strategy.** Offer different products, services, or product features than your competitors. Southwest Airlines, for example, has differentiated itself as a low-cost, short-haul express airline. This has proved to be a winning strategy for competing in the highly competitive airline industry.
3. **Innovation strategy.** Introduce new products and services, add new features to existing products and services, or develop new ways to produce them. A classic example is the introduction of automated teller machines (ATMs) by Citibank. The convenience and cost-cutting features of this innovation gave Citibank a huge advantage over its competitors. Like many innovative products, the ATM changed the nature of competition in the banking industry. Today, an ATM is a competitive *necessity* for any bank. Another excellent example is Apple's rapid introduction of innovative products.

FIGURE 2.5 Strategies for competitive advantage.



4. *Operational effectiveness strategy.* Improve the manner in which a firm executes its internal business processes so that it performs these activities more effectively than its rivals. Such improvements increase quality, productivity, and employee and customer satisfaction while decreasing time to market.
5. *Customer orientation strategy.* Concentrate on making customers happy. Web-based systems are particularly effective in this area because they can create a personalized, one-to-one relationship with each customer. Amazon (www.amazon.com), Apple (www.apple.com), and Starbucks (www.starbucks.com) are classic examples of companies devoted to customer satisfaction.

Business–Information Technology Alignment

business–information technology alignment The tight integration of the IT function with the strategy, mission, and goals of the organization.

The best way for organizations to maximize the strategic value of IT is to achieve the “holy grail” of organizations: business–information technology alignment, or strategic alignment (which we will call simply *alignment*). **Business–information technology alignment (business–IT alignment)** is the tight integration of the IT function with the organization’s strategy, mission, and goals. That is, the IT function directly supports the organization’s business objectives. There are six characteristics of excellent alignment:

1. Organizations view IT as an engine of innovation that continually transforms the business, often creating new revenue streams.
2. Organizations view their internal and external customers and their customer service function as supremely important.
3. Organizations rotate business and IT professionals across departments and job functions.
4. Organizations provide overarching goals that are completely clear to each IT and business employee.
5. Organizations ensure that IT employees understand how the company makes (or loses) money.
6. Organizations create a vibrant and inclusive company culture.

Unfortunately, many organizations fail to achieve this type of close alignment. In fact, according to a McKinsey and Company survey on IT strategy and spending, approximately

27 percent of the IT and business executives who participated agreed that their organization had adequate alignment between IT and the business. Given the importance of business and IT alignment, why do so many organizations fail to implement this policy? The major reasons are:

- Business managers and IT managers have different objectives
- The business and IT departments are ignorant of the other group's expertise
- There is a lack of communication

Put simply, business executives often know little about information technology, and IT executives understand the technology but may not understand the real needs of the business. One solution to this problem is to foster a collaborative environment in organizations so that business and IT executives can communicate freely and learn from each other.

The good news is that some organizations get it right. It is IT governance that helps organizations effectively manage their IT operations so that IT aligns with their business strategies.

Organizational strategies take account of risks or potential problems that could occur and the opportunities that organizations have to serve their customers better or create more value for their stakeholders. In large organizations, the board of directors and executives are expected to effectively manage the organization, which is called corporate governance.

According to *CIO Magazine*, IT governance is part of an organization's overall corporate governance and is defined as "a formal framework that provides a structure for organizations to ensure that IT investments support business objectives." An IT governance framework should answer questions related to business-IT alignment such as, What are the key objectives of the IT department? And what are the key metrics to measure the performance of the IT department?³ IT governance is about managing IT throughout the organization. This includes planning, acquisition, implementation, and ongoing support, as well as monitoring and evaluation so that decisions can be made about potential changes.

Without effective IT governance, there are many things that could go wrong. Information systems might not meet organizational business objectives, or systems could be error-prone, over budget, or hard to use. If security was poor, data and programs could be damaged or copied by unauthorized individuals.

Smaller businesses implement IT governance by having an aware and knowledgeable owner-manager who actively selects business practices and software.

Businesses can also use enterprise architecture to foster alignment. Originally developed as a tool to organize a company's IT initiatives, the enterprise architecture concept has evolved to encompass both a technical specification (the information and communication technologies and the information systems used in an organization) and a business specification (a collection of core business processes and management activities).

Before you go on...

1. What are strategic information systems?
2. According to Porter, what are the five forces that could endanger a firm's position in its industry or marketplaces?
3. Describe Porter's value chain model. Differentiate between Porter's competitive forces model and his value chain model.
4. What strategies can companies use to achieve competitive advantage?
5. What is business-IT alignment?
6. Provide examples of business-IT alignment at your university, regarding student systems. (*Hint: What are the "business" goals of your university with regard to student registration, fee payment, grade posting, and so on?*)

³K. Lindros, "What is IT governance? A formal way to align IT & business strategy," *CIO Magazine*, July 31, 2017.

What's in IT for me?

For All Business Majors

All of the functional areas of any organization are literally composed of a variety of business processes, as we can see from the examples discussed in this chapter. Regardless of your major, you will be involved in a variety of business processes from your first day on the job. Some of these processes you will perform by yourself; some will involve only your group, team, or department; and some will involve several (or all) functional areas of your organization.

It is important for you to be able to visualize processes, understand each process's inputs and outputs, and know the "customer" of each one. If you can accomplish these things, then you will contribute to making processes more efficient and effective. This often means incorporating information technology in the process. It is also important for you to understand how each process fits into your organization's strategy.

In addition, all functional areas in any organization must work together in an integrated fashion for the firm to respond adequately to business pressures. These responses typically require each functional area to employ a variety of information systems to support, document, and manage cross-functional business processes. In today's competitive global marketplace, it is more critical than ever that these responses be timely and accurate.

It is also essential that all functional areas work together for the organization to achieve a competitive advantage in its marketplace.

Again, the functional areas use a variety of strategic information systems to achieve this goal.

You have seen why companies must be concerned with strategic advantage. But why is this chapter so important for you? There are several reasons. First, the business pressures you have learned about have an impact on your organization, but they also affect you as an individual. So, it is critical that you understand how information systems can help you, and eventually your organization, to respond to these pressures.

Achieving a competitive advantage is also essential for your organization's survival. In many cases, you, your team, and all your colleagues will be responsible for creating a competitive advantage. Therefore, having general knowledge about strategy and about how information systems affect the organization's strategy and competitive position will help you in your career.

You also need a basic knowledge of your organization's strategy, mission, and goals, as well as its business problems and how it makes (or loses) money. You now know how to analyze your organization's strategy and value chain, as well as your competitors' strategies and value chains. You have also acquired a general knowledge of how information technology contributes to organizational strategy. This knowledge will help you to do your job more effectively, be promoted more quickly, and contribute significantly to the success of your organization.

Summary

2.1 Discuss ways in which information systems enable cross-functional business processes and business processes for a single functional area.

A business process is an ongoing collection of related activities that produce a product or a service of value to the organization, its business partners, and its customers. Examples of business processes in the functional areas are managing accounts payable, managing accounts receivable, managing after-sale customer follow-up, managing bills of materials, managing manufacturing change orders, applying disability policies, employee hiring, computer user and staff training, and applying internet use policy. The procurement and fulfillment processes are examples of cross-functional business processes.

2.2 Differentiate between business process reengineering, business process improvement, and business process management.

Business process reengineering (BPR) is a radical redesign of an organization's business processes that is intended to improve their efficiency and effectiveness. The key to BPR is for enterprises to examine their business processes from a "clean sheet" perspective and then determine how they can best reconstruct those processes to improve

their business functions. Because BPR proved difficult to implement, organizations have turned to the less radical alternatives: business process improvement (BPI) and business process management (BPM). BPI is less radical than BPR and it focuses on reducing variation in the process outputs (e.g., finished product) by searching for root causes of the variation in the process itself or among the process inputs. Business process management is a management technique that includes methods and tools to support the design, analysis, implementation, management, and optimization of business processes.

2.3 Identify effective IT responses to different kinds of business pressures.

- *Market pressures:* An example of a market pressure is powerful customers. Customer relationship management is an effective IT response that helps companies achieve customer intimacy.
- *Technology pressures:* An example of a technology pressure is information overload. Search engines and business intelligence applications enable managers to access, navigate, and use vast amounts of information.
- *Societal, political, and legal pressures:* An example of a societal, political, or legal pressure is social responsibility, such as the state of the physical environment. Green IT is one response that is intended to improve the environment.

2.4 Describe the strategies that organizations typically adopt to counter Porter's five competitive forces.

Porter's five competitive forces:

1. *The threat of entry of new competitors:* For most firms, the Web increases the threat that new competitors will enter the market by reducing traditional barriers to entry. Frequently, competitors need only set up a website to enter a market. The Web can also increase barriers to entry, as when customers come to expect a nontrivial capability from their suppliers.
2. *The bargaining power of suppliers:* The Web enables buyers to find alternative suppliers and to compare prices more easily, thereby reducing suppliers' bargaining power. From a different perspective, as companies use the Web to integrate their supply chains, participating suppliers can lock in customers, thereby increasing suppliers' bargaining power.
3. *The bargaining power of customers (buyers):* The Web provides customers with incredible amounts of choices for products, as well as information about those choices. As a result, the Web increases buyer power. However, companies can implement loyalty programs in which they use the Web to monitor the activities of millions of customers. Such programs reduce buyer power.
4. *The threat of substitute products or services:* New technologies create substitute products very rapidly, and the Web makes information about these products available almost instantly. As

a result, industries (particularly information-based industries) are in great danger from substitutes (e.g., music, books, newspapers, magazines, software). However, the Web also can enable a company to build in switching costs, so that it will cost customers time or money to switch from your company to that of a competitor.

5. *The rivalry among existing firms in the industry:* In the past, proprietary information systems provided a strategic advantage for firms in highly competitive industries. The visibility of Internet applications on the Web makes proprietary systems more difficult to keep secret. Therefore, the Web makes strategic advantage more short-lived.

The five strategies are as follows:

1. *Cost leadership strategy*—Produce products and services at the lowest cost in the industry
2. *Differentiation strategy*—Offer different products, services, or product features
3. *Innovation strategy*—Introduce new products and services, add new features to existing products and services, or develop new ways to produce them
4. *Operational effectiveness strategy*—Improve the manner in which internal business processes are executed so that a firm performs similar activities better than its rivals
5. *Customer orientation strategy*—Concentrate on making customers happy

Key Terms

business environment 42
business-information technology alignment 56
business process 33
business process management (BPM) 41
business process reengineering (BPR) 40

competitive advantage 32
competitive forces model 51
cross-functional processes 33
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mass customization 50

organizational social responsibility (also individual social responsibility) 45
primary activities 54
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Discussion Questions

1. Consider the student registration process at your university:
 - a. Describe the steps necessary for you to register for your classes each semester.
 - b. Describe how information technology is used (or is not used) in each step of the process.
2. Why is it so difficult for an organization to actually implement business process reengineering?
3. Explain why IT is both a business pressure and an enabler of response activities that counter business pressures.
4. What does globalization mean to you in your choice of a major? In your choice of a career? Will you have to be a "lifelong learner"? Why or why not?
5. What might the impact of globalization be on your standard of living?
6. Is IT a strategic weapon or a survival tool? Discuss.
7. Why might it be difficult to justify a strategic information system?
8. Describe the five forces in Porter's competitive forces model and explain how increased access to high-speed internet has affected each one.
9. Describe Porter's value chain model. What is the relationship between the competitive forces model and the value chain model?
10. Describe how IT can be used to support different value chains for different companies.
11. Discuss the idea that an information system by itself can rarely provide a sustainable competitive advantage.

Problem-Solving Activities

1. Surf the internet for information about the Canada Border Services Agency. Examine the available information, and comment on the role of information technologies in the agency.
2. Experience mass customization by designing your own shoes at www.nike.com, your car at www.jaguar.com, your business card at www.vistaprint.ca, and your diamond ring at www.bluenile.com. Summarize your experiences.
3. Access www.go4customer.com. What does this company do, and where is it located? Who are its customers? Provide examples of how a Canadian company would use its services.
4. Access the website of Walmart China (<https://en.walmart.cn/>). How does Walmart China differ from your local Walmart (consider products, prices, services, and so on)? Describe these differences.
5. Apply Porter's value chain model to Costco (www.costco.ca). What is Costco's competitive strategy? Who are its major competitors? Describe Costco's business model. Describe the tasks that Costco must accomplish for each primary value chain activity. How would Costco's information systems contribute to its competitive strategy, given the nature of its business?
6. Apply Porter's value chain model to Dell (www.dell.com). What is Dell's competitive strategy? Who are its major competitors? Describe Dell's business model. Describe the tasks that Dell must accomplish for each primary value chain activity. How would Dell's information systems contribute to its competitive strategy, given the nature of its business?

Closing Case

MIS POM MKT Pick n Pay Creates an Operational and Customer-Oriented Advantage with the Cloud

The Pick n Pay Group is a retail business in the consumer goods industry that is headquartered in Cape Town, South Africa. In 1967, Raymond Ackerman purchased four Pick n Pay (www.pnp.co.za) stores in Cape Town. Today, there are more than 2,000 stores in the Pick n Pay Group in eight countries across southern Africa. In addition, the company owns a 49-percent investment in TM Supermarkets in Zimbabwe. There are now many store formats under three brands: Pick n Pay, Boxer, and TM Supermarkets. Pick n Pay operates one of the largest online grocery platforms in sub-Saharan Africa. According to its mission, it serves customers to create an excellent place to shop. Customers inform everything from the range of products offered to how they design their stores. To keep customers first, the company needs to understand their diverse and changing needs.

A huge organization like Pick n Pay stores terabytes (TB) of data in multiple locations. Sharing data and analytics quickly and efficiently is crucial to running an organization in such a way as to be able to quickly respond to the market. Pick n Pay needed a modernized enterprise resource planning (ERP) solution to enhance communication across the supply chain, divisions, and geographical and political boundaries. Pick n Pay already used SAP (www.sap.com), but it was locally installed and operated. A true enterprise version that would connect and share data across the company's numerous locations would need to be moved into the cloud (see **Technology Guide 3**).

Additionally, at the time of writing, in 2023, SAP is planning to terminate support for its on-premise solutions by 2027, effectively forcing customers to migrate to the cloud. For Pick n Pay, upgrading to SAP S/4HANA and the cloud was the logical, strategic choice to create a competitive advantage.

Pick n Pay chose to implement SAP S/4HANA, installed on the Amazon Web Services (AWS) platform. To assist with the

installation, it selected Lemongrass as its partner. Let's take a look at each piece of this solution.

SAP. SAP has been a household name in ERP for years. There are many known benefits to implementing SAP. Among the most important are:

Adaptability. A cloud-based solution can more easily adapt to changing business needs. As one example, it is more robust at supporting a hybrid workforce.

Collaborations are easier. A cloud-based solution makes it easier to collaborate with business partners and suppliers. It even simplifies the acquisition of new businesses by making it simpler to bring them into the environment.

Lower ownership costs. Because the company's resources are stored in a central location and are often hosted by a third party, the overall ownership costs are lower.

Faster analytics insights. S/4HANA runs on the HANA in-memory database, which dramatically increases performance. It no longer stores data in a data warehouse and waits for it to load. Instead, the core ERP system provides analytics and insights, which it can share faster.

More accurate forecasting. AI and machine learning applications in S/4HANA are constantly evolving to improve modeling, forecasting, and predictive outcomes.

AWS. As mentioned above, SAP is often installed on a third-party solution. For more than 15 years, AWS has been the world's most comprehensive and widely used cloud offering. The company constantly expands its services to support multiple cloud workloads. It now offers more than 200 services supporting many basic operations such as computing, storage, databases, and networking, as well as more advanced functions such as analytics, machine learning and artificial intelligence (AI), Internet of Things (IoT), and virtual and augmented reality (VR and AR).

In 2004, AWS established a presence in Cape Town to pioneer technologies focused on networking, next-generation software for customer support, and software programs used by AWS, among

other technologies. This proximity to a cloud provider was a key reason why Pick n Pay selected AWS as its provider. While SAP S/4HANA functions without regard to geographic location, the implementation process benefits from a provider who operates in the same time zone, the same language, and within the same economic structure.

Lemongrass. Lemongrass (lemongrasscloud.com) is a software-enabled service provider focused on delivering superior, highly automated managed services to enterprise-level customers. It is a premier consulting partner that enables customers like Pick n Pay to migrate their mission-critical SAP—including SAP S/4HANA—and non-SAP workloads to AWS while also managing these workloads with a high level of automation and agility. It specializes in providing the experience, expertise, and best practices to assist its customers with an SAP transformation. Lemongrass helps engineer strategies and services that enable its customers to enjoy the benefits of scale and agility while controlling risks and uncertainties. It has also demonstrated the ability to migrate SAP systems to the cloud with almost no downtime. Pick n Pay found that SAP S/4HANA, running on AWS servers, with a migration led by Lemongrass, was the optimal solution for its needs.

The solution Lemongrass designed for Pick n Pay used its templates and patterns to migrate, operate, and automate SAP workloads. Lemongrass supported moving the entire range of SAP and non-SAP workloads to the cloud.

Using AWS enabled Pick n Pay to connect operations, sales, customer surveys, and loyalty data throughout all of its component parts. With the new configuration, SAP running on AWS supports Pick n Pay's sales (both online and physical), streamlines its supply chain network, forecasts its inventory, and does detailed market analysis to create the right mix of merchandise.

AWS lets Pick n Pay dynamically scale its operations to meet business demand during peak retail seasons. Pick n Pay's online shopping services, which run on AWS, can serve thousands of South African customers during the busiest shopping periods and holidays. Additionally, SAP running on the AWS platform has enabled Pick n Pay to perform market testing and develop

viable products quickly and cost-effectively. This ability has helped the company remain at the forefront of retail innovation on the African continent.

Based on its collaborations with past clients, Lemongrass expects Pick n Pay to realize cost savings of 45 to 75 percent with the new cloud-based strategy. Operating on the cloud will enable Pick n Pay to operate more efficiently and modernize its stores' supply chain network, create digital experiences for grocery shoppers, and expand into new business areas.

Questions

1. Why did Pick n Pay want to upgrade its enterprise solution to one hosted in the cloud?
2. Why did Pick n Pay make use of Lemongrass's services for this project?
3. How do AWS and SAP provide a competitive advantage for Pick n Pay and other retailers who use their products?

Sources: Compiled from L. Monzon, "AWS Opens New Offices in Johannesburg, South Africa," *IT News Africa*, September 1, 2022; A. Payne, "Three Ideas to Challenge Your Thinking About Digital Procurement," *SupplyChainBrain*, September 1, 2022; M. Evatt, "AWS Streamlines Operations for Pick n Pay," *ERP Today*, August 26, 2022; Staff Writer, "The Six Biggest Retail Technology News Stories of the Week," *Retail Technology Innovation Hub*, August 26, 2022; M. Wheatley, "South African Retailer Pick n Pay Migrates Its Entire IT Infrastructure to Amazon's Cloud," *SiliconANGLE*, August 25, 2022; P. Saunders, "Are ERP Projects Really the Stuff of Nightmares?" *Forbes*, June 28, 2022; C. Parizo, "9 Top SAP S/4HANA Benefits for Businesses," *TechTarget*, March 1, 2022; P. Rutten, F. Rosa, and R. Villars, "The Mighty Struggle to Migrate SAP to the Cloud May Be Over," *IDC White Paper*, February, 2022; P. Farbinger, "ERP Is Dead," *E-3 Magazine*, January 17, 2022; Lemongrass [Press release], "Fender Chooses Lemongrass to Lead its SAP-to-Cloud Growth Initiative," *GlobeNewswire*, January 12, 2022; J. O'Donnell, "Google-Lemongrass Partnership Boosts SAP on GCP," *TechTarget*, October 4, 2021; <https://lemongrasscloud.com/>, accessed 9/2/2022.

Ethics and Privacy

CHAPTER OUTLINE

3.1 Ethical Issues

3.2 Privacy

LEARNING OBJECTIVES

3.1 Describe ethics and explain its three fundamental tenets and the four categories of ethical issues related to information technology.

3.2 Discuss at least one potential threat to the privacy of the data stored in each of three places that store personal data.

Opening Case

MIS Facial Recognition in India Raises Concerns

The city of Hyderabad, India, experienced terror attacks in 2007 and 2013 when it was part of the state of Andhra Pradesh. The 2007 bomb blast killed at least 42 people, and the 2013 blast killed 18 people and injured 119 more. Pervasive police surveillance began after the blasts when authorities passed an amendment to the *Public Safety Act* that required all establishments where more than 100 people might gather to install closed-circuit television (CCTV) cameras. Moreover, if the police asked for CCTV footage, the venues were required to provide it.

In 2014, India created Telangana as a separate state from Andhra Pradesh with Hyderabad as its capital. By 2022, Telangana had installed 830,000 CCTV cameras. In fact, according to the Indian Ministry of Home Affairs, that state accounts for more than 60 percent of all police CCTV cameras in the country.

Using footage from the city's CCTV cameras, the Hyderabad Police Department has deployed facial recognition software. *Facial recognition systems* employ machine learning algorithms (see Chapter 14) to record specific, distinctive details of a person's face. These details, such as the distance between the eyes or the shape of the chin, are converted into a mathematical representation and compared to data on other faces in a facial recognition database. The state's facial recognition-capable cameras are monitored in real time at a new Command and Control Centre.

Privacy advocates allege that the Hyderabad police department uses facial recognition for many questionable objectives, including cordon-and-search operations, profiling random people for narcotics, and unlawful phone-searching activities. In a cordon-and-search operation, a neighbourhood is sealed off; then police conduct door-to-door searches and take fingerprint scans and photographs of residents. Activists contend that authorities usually carry out these operations in communities where Muslims and other socio-economically marginalized populations live.

Police officers may also randomly stop and search commuters and pedestrians, take photos, and collect biometric data (see Chapter 4). Police use an app on their smartphones called TSCOP, which contains facial recognition technology linked to national law enforcement databases and systems. Checks can be run in real time.

Telangana authorities are integrating numerous facial recognition data sets into a "smart governance program," called Samagram. This program provides the state government with a 360-degree digital profile of every resident's life, including their name, address, phone number, marital status, children, birth and death details, and employment status. The profile also includes data from police records, as well as utility service data, tax payments, passports, and voter identification.

Telangana authorities claim that, when given a resident's name, their software can provide access to his or her entire digital footprint in seconds. The software is also useful in *family tree forensics*; that is, the use of DNA and family tree data to learn the identity of criminals.

Privacy advocates are protesting police use of facial recognition in Telangana. Amnesty International has called Hyderabad a "total surveillance city." Activists argue that taking photographs of random civilians violates their right to privacy. Furthermore, there are no safeguards for the public. Specifically, civilians are not notified as to how the photographs are used, how long they are stored, or where they are stored and by whom. Further, they have no official redress mechanism. There is still no legal framework governing privacy-related issues, even though India's Supreme Court recognized privacy as a fundamental right in 2017.

The Hyderabad Police Department responds that using technology for police work has lowered the crime rate and has also helped in tracing missing children. They further maintain that they are now able to apprehend 99 percent of suspects within 24 hours.

As a final note, it is actually against Indian law for police to photograph and fingerprint people for a criminal database. Under an act dating back to 1920, the *Identification of Prisoners*

Act, police are not allowed to photograph people who have not been arrested or convicted. Nor can such photographs be shared with other law enforcement agencies. The practice continues despite the 1920 law because authorities are not enforcing that law.

Questions

1. Discuss the ethics and legality of the Telangana authorities' capture and use of personal data, including photos and biometric data.
2. Discuss the ethics and legality of the Telangana authorities' use of facial recognition software.
3. The Telangana police maintain that the department's use of technology has reduced the crime rate, enabled the police to quickly apprehend suspects, and helped find missing children. Discuss the ethics of the trade-off between these advantages and the loss of privacy for citizens.

Sources: Compiled from Q. Inzamam and H. Qadri, "This Part of India Is on the Verge of Becoming a Complete Surveillance State," *Slate.com*, July 13, 2022; A. Ghosh, "Facial Recognition Is out of Control in India," *Motherboard*, June 13, 2022; "Hyderabad: Command and Control Centre to Be Inaugurated by July," *India Today*, May 11, 2022; R. Sabha, "The Criminal Procedure (Identification) Bill," *PRS Legislative Research*, April 2022; R. Chandran, "India's Surveillance Hotspot, Facial Recognition Taken to Court," *Reuters*, January 19, 2022; H. Suresh, "Why Hyderabad Became India's Surveillance Capital," *The News Minute*, December 7, 2021; "India: Hyderabad 'on the Brink of Becoming a Total Surveillance City'," *Amnesty International*, November 9, 2021; A. Bokil et al., "Settled Habits, New Tricks: Casteist Policing Meets Big Tech in India," *tmi.org*, May, 2021; V. Bansal, "The Hyderabad Model of CCTV Surveillance," *Livemint News*, November 10, 2020; J. Umanadh, "Telangana Cops Can Now Recognize an Offender in Real-Time," *Deccan Herald*, July 25, 2019; "A Centralized Database of Citizens in the State of Telangana Is under Consideration," *FirstPost Tech2*, January 31, 2017; D. Mathew, "Hyderabad Citizens under 360 Degree Police Scanner," *Telangana Today*, January 28, 2017; "Hyderabad Blasts: 16 Killed, 119 Injured," *The Indian Express*, February 24, 2013.

Introduction

You will encounter numerous ethical and privacy issues in your career, many of which will involve IT in some manner. Ethics and privacy are closely related to each other and also to IT, and both types of issues raise significant questions involving access to information in the digital age. The answers to these questions are not straightforward. In fact, IT has made finding answers to these questions even more difficult.

Consider facial recognition apps in the chapter-opening case. Are these apps legal? Are they ethical? In a further example, suppose your organization decides to adopt social computing technologies (which you will study in Chapter 9) to include business partners and customers in new product development. You will be able to analyze the potential privacy and ethical implications of implementing these technologies.

This chapter provides insights into how to respond to ethical and privacy issues. Further, it will help you to make immediate contributions to your company's code of ethics and its privacy policies. You will also be able to provide meaningful input concerning the potential ethical and privacy impacts of your organization's information systems on people within and outside the organization.

All organizations, large and small, must be concerned with ethics. In particular, small business (or start-up) owners face a very difficult situation when their employees have access to sensitive customer information. There is a delicate balance between access to information and the appropriate use of that information. This balance is best maintained by hiring honest and trustworthy employees who abide by the organization's code of ethics. Ultimately, this issue leads to another question: Does the small business, or a start-up, even have a code of ethics to fall back on in this type of situation?

3.1 Ethical Issues

LEARNING OBJECTIVE

Describe ethics and explain its three fundamental tenets, and the four categories of ethical issues related to information technology.

ethics The principles of right and wrong that individuals use to make choices to guide their behaviours.

Ethics refers to the principles of right and wrong that individuals use to make choices that guide their behaviour. Deciding what is right or wrong is not always easy or clear-cut. Fortunately, there are many frameworks that can help us make ethical decisions.

Ethical Frameworks

There are many sources for ethical standards. Searches on the internet for “ethical standards” will result in thousands of hits. For examples of some used in Canada, look at the Canadian Standards Association (www.csa.ca). Here we consider five widely used standards: the utilitarian approach, the rights approach, the fairness approach, the common good approach, and the deontology approach. There are many other sources, but these five are representative.

The *utilitarian approach* states that an ethical action is the one that provides the most good or does the least harm. The ethical corporate action would be the one that produces the greatest good and does the least harm for all affected parties—customers, employees, shareholders, the community, and the physical environment.

The *rights approach* maintains that an ethical action is the one that best protects and respects the moral rights of the affected parties. Moral rights can include the rights to make one’s own choices about what kind of life to lead, to be told the truth, not to be injured, and to enjoy a degree of privacy. Which of these rights people are actually entitled to—and under what circumstances—is widely debated. Nevertheless, most people acknowledge that individuals are entitled to some moral rights. An ethical organizational action would be one that protects and respects the moral rights of customers, employees, shareholders, business partners, and even competitors.

The *fairness approach* posits that ethical actions treat all human beings equally, or, if unequally, then fairly, based on some defensible standard. For example, most people might believe it is fair to pay people higher salaries if they work harder or if they contribute more to the firm. However, there is less certainty regarding CEO salaries that are hundreds or thousands of times larger than those of other employees. Many people question whether this huge disparity is based on a defensible standard or whether it is the result of an imbalance of power and hence is unfair.

The *common good approach* highlights the interlocking relationships that underlie all societies. This approach argues that respect and compassion for all others are the basis for ethical actions. It emphasizes the common conditions that are important to the welfare of everyone. These conditions can include a system of laws, effective police and fire departments, health care, a public educational system, and even public recreation areas.

Finally, the *deontology approach* states that the morality of an action is based on whether that action itself is right or wrong under a series of rules rather than on the consequences of that action. An example of deontology is the belief that killing someone is wrong, even if it was in self-defence.

These five standards are used to develop a general framework for ethics (or ethical decision making). Two such frameworks are shown in [Table 3.1](#): a generic “traditional” approach, and the GVV (Giving Voice to Values) approach.

The traditional ethical approach provides a tool for deciding on the nature of an action response that you can take. The GVV approach provides tools for dealing with the ethical issue co-operatively. We now focus specifically on ethics in the corporate environment.

Ethics in the Corporate Environment

Many companies and professional organizations develop their own codes of ethics. A **code of ethics** is a collection of principles intended to guide decision making by members of the organization. For example, the Association for Computing Machinery (www.acm.org), an organization of computing professionals, has a thoughtful code of ethics for its members (see www.acm.org/code-of-ethics).

Keep in mind that different codes of ethics are not always consistent with one another. Therefore, an individual might be expected to conform to multiple codes. For example, a person who is a member of two large professional computing-related organizations may be simultaneously required by one organization to comply with all applicable laws and by the other organization to refuse to obey unjust laws.

code of ethics A collection of principles intended to guide decision making by members of an organization.

TABLE 3.1 Traditional and GVV Approaches to Resolving Ethical Issues

Traditional Approach	Giving Voice to Values (GVV) Approach
1. Recognize an ethical issue • Could this decision or situation damage someone or some group? • Does this decision involve a choice between a good and a bad alternative? • Does this issue involve more than simply legal considerations? If so, then in what way?	1. Identify an ethical issue • What are the different issues that give rise to this ethical issue? • What are the values of the individuals or organizations underlying this ethical issue? • Is there a possibility of action to resolve the ethical issue?
2. Get the facts • What are the relevant facts of the situation? • Do I have sufficient information to make a decision? • Which individuals or groups have an important stake in the outcome? • Have I consulted all relevant persons and groups?	2. Purpose and choice • What personal choices do you have in reacting to this ethical issue? • What is your most appropriate professional choice, being guided by professional rules, and what would be a “good” choice?
3. Evaluate alternative actions • Which option will produce the most good and do the least harm? (the utilitarian approach) • Which option best respects the rights of all stakeholders? (the rights approach) • Which option treats people equally or proportionately? (the fairness approach) • Which option best serves the community as a whole, and not just some members? (the common good approach)	3. Stakeholder analysis • Who is affected by the ethical issue? • How are they affected if I do give voice to resolving the issue? • How are they affected if I do not give voice to resolving the issue? • How can I connect with the stakeholders to best deal with the ethical issue?
4. Make a decision and test it • Considering all the approaches, which option best addresses the situation?	4. Powerful response • Who is my audience? • What types of things could I say to provide a response to the ethical issue? • What are some <i>inhibiting arguments</i> that would prevent me from acting? • What could I say in response to the inhibiting arguments (called an <i>enabling argument</i>)? • What external arguments (called <i>levers</i>) support my enabling arguments? • What external research supports or refutes my arguments?
5. Act and reflect on the outcome of your decision • How can I implement my decision with the greatest care and attention to the concerns of all stakeholders? • How did my decision turn out, and what did I learn from this specific situation?	5. Scripting and coaching • What words (script) could I use when talking about the ethical issue? (consider both positive and negative responses) • Who can I practise with? • How would I approach my audience to provide the best opportunity for discussing the ethical issue?

Fundamental tenets of ethics include:

- **Responsibility** means that you can recognize, interpret, and act upon multiple principles and values according to ethical standards.
- **Accountability** is an acknowledgment of responsibility and the acceptance of being answerable for the results (or actions) of a system or behaviour and its potential impacts.
- **Liability** is a legal concept that gives individuals the right to recover the damages done to them by other individuals, organizations, or systems.

Before you go any further, it is critical that you realize that what is *unethical* is not necessarily *illegal*. For example, a bank's decision to foreclose on a home can be technically legal, but it can raise many ethical questions. In many instances, then, an individual or organization faced with an ethical decision is not considering whether to break the law. As the foreclosure example illustrates, however, ethical decisions can have serious consequences for individuals, organizations, and society at large.

ACCT **FIN** Unfortunately, we have seen numerous extremely poor ethical decisions, not to mention outright criminal behaviour. Three of the most highly publicized fiascos in the United States occurred at Enron Corporation (now Enron Creditors Recovery Corporation), WorldCom (now MCI Inc.), and Tyco International. At each company, executives were convicted of various types of fraud using illegal accounting practices. These illegal acts were responsible, at least in part, for the passage of the *Sarbanes-Oxley Act* in 2002. This U.S. law requires that public companies implement financial controls and that, to ensure accountability, executives must personally certify financial reports. Similar problems occurred in Canada at companies like Nortel and Southam. In Canada, Bill 198, the *Budget Measures Act*, imposes similar requirements on management.

Canada was a leader in regulating cryptocurrency and cryptocurrency exchanges, discussed further in the closing case of Chapter 4. Sadly, ethical problems often arise at the chief executive level. FTX, a large cryptocurrency exchange founded in the Bahamas in 2018, declared bankruptcy in 2022. In December 2022, its former founder and CEO was indicted for money laundering, fraud, and other offences. FTX had attempted to operate in Canada in June 2022, but was prevented from doing so by Canadian regulations.

FIN Ethical misbehaviour has continued around the world. In the United States, consider Wells Fargo bank (www.wellsfargo.com). In 2016, authorities found that bank employees had created approximately 2 million fake customer chequing and credit card accounts without their knowledge. Bank employees had created the accounts under pressure from supervisors to meet daily account quotas. The bank then charged customers at least \$1.5 million in fees for the fake accounts. Not only were the bank's victims charged overdraft and maintenance fees, but their credit scores were lowered for not staying current on accounts that they did not even know about.

Wells Fargo fired some 5,300 employees. The bank was also ordered to pay \$185 million in fines, which is a very small amount compared to the \$5.6 billion that the bank earned in the second quarter of 2016. Furthermore, in October 2016, Wells Fargo CEO John Stumpf stepped down from his position.

MIS Avast (www.avast.com) is a computer-security company based in the Czech Republic. Some 400 million people around the world use the firm's software. In 2019, researchers found that the company used browser extensions (small software programs that customize the browsing experience) to watch everything their customers did online. Avast then sold those data to corporate customers as "insights." Clients included Google, Microsoft, PepsiCo, and McKinsey.

In October 2021, Meta Platforms whistle-blower Frances Haugen went public after sharing sensitive internal documents about Facebook with regulators and journalists. According to those documents, Meta knowingly valued money more than people, stirred up social discord with its algorithms, and allowed criminals, including drug smugglers and human traffickers to do business unhindered on its platform.

On top of Meta's questionable ethical practices, Haugen's ability to get hold of the documents showed that it had poor internal controls. Haugen said that, for months, she had accessed internal documents that were completely unrelated to her professional functions.

Clearly, Meta did not have an effective system to notify the relevant administrators if unauthorized persons accessed sensitive documents. This was a serious problem for a company that had already been fined \$5 billion by the Federal Trade Commission in 2019 for privacy violations.

responsibility A tenet of ethics in which you are able to recognize and act upon principles based on ethical standards.

accountability A tenet of ethics that refers to the act of accepting responsibility for your actions.

liability A legal concept that gives individuals the right to recover the damages done to them by other individuals, organizations, or systems.

Meta hired its first-ever chief compliance officer in January 2022. However, it is still unclear whether the CCO will be given the necessary authority and autonomy to act.

Advancements in information technologies have generated a new set of ethical problems. Computer processing power doubles roughly every 18 months, meaning that organizations are more dependent than ever on their information systems. Organizations can store increasing amounts of data at decreasing costs. As a result, they can maintain more data on individuals for longer periods of time. Going further, computer networks, particularly the internet, enable organizations to collect, integrate, and distribute enormous amounts of information on individuals, groups, and institutions. These developments have created numerous ethical problems concerning the appropriate collection and use of customer information, personal privacy, and the protection of intellectual property.

Ethics and Information Technology

All employees have a responsibility to encourage ethical uses of information and information technology. This may mean a new way of doing business to ensure respect for users and of private data within information technology. As IT's About Business 3.1 illustrates, considering training in cultural diversity and including Indigenous viewpoints may help lead the way.

IT's About Business 3.1

MIS Driving Change through Technology, the Indigenous Way

Bell (BCE Inc.) is a large Canadian company whose mission, set out on its home page, is “to advance how Canadians connect with each other and the world, enabled by a strategy that builds on our competitive strengths and embraces the new opportunities of the integrated digital future.” Bell has a publicly available business ethics document where it reiterates this mission and states that it intends to provide services to customers in alignment with its mission while engaging in the “highest” ethical standards of professional performance. The business ethics document goes on to explain that ethical risks occur not only for legal reasons but when employee behaviour does not match expected conduct. Readers are referred to the Bell Code of Business Conduct for further information.

The Bell Code of Business Conduct is a 39-page document that starts by stating that the document applies to employees, management, and directors of the BCE group of companies. The objectives of the code list eight core principles that cover performance of work including values such as integrity, respect, safety, ethical conduct, and avoiding conflicts of interest. The table of contents of this code has three items that have some relationship to the protection of corporate and customer information technology (in part 2, items 2.7 to 2.9). These sections explain who approves corporate information for release, that access to customer information is on a “need-to-know” basis (also discussed in Chapter 4), and that customers must provide explicit consent to have their information disclosed, unless requested by a legal authority (known as an opt-in process).

The Code goes into substantial detail about the nature of privacy and why it is important, and states that disciplinary action will be taken if employees deliberately violate privacy. The Code provides examples: for instance, a customer service

representative asks if they are permitted to release billing details to a customer's spouse. The response from the Code is a definite “no” if the spouse is not listed as an authorized person on the account. Privacy also covers employee data, but not employee communications. Then the Code provides a list of employee responsibilities and actions with respect to protecting confidential information.

Bell has used its resources to manage data in alignment with its objectives and in compliance with privacy (and other) legislation.

On its home page, Animikii, an information technology company, describes its mission as “social innovation through Indigenous technology.” The company was founded in 2003 by Jeff Ward, who is both Ojibwa and Métis. For his work in starting this first Indigenous business in Canada, the City of Vancouver awarded him a Forty under 40 winner designation in 2019. Technology can be used for many purposes, and Ward stated that what was different about this company was the “worldview” through which “the technology and solutions are created.”

On the company home page, Animikii emphasizes that its principles include being values-based. It has a values page that shows the Grandfather teachings of the Anishinaabe culture. The seven values listed and described are humility, truth, honesty, wisdom, respect, courage, and love. The page explains how these values relate to the company's provision of information technology services. For example, humility involves asking clients to bring their strengths, experience, and wisdom into a project so that the company can provide expertise in delivering the service. It explains that love connects (binds) the other values and is only understood when the other values exist. Love is the enabler of effective team collaboration both within the company and when working with their “broader partners and collaborators.”

An internal response to the pandemic illustrates Animikii's reliance on these principles. The company provided flexible

remote work hours, created support sharing circles, and facilitated working at home.

Animikii has both Indigenous and non-Indigenous employees, and states that “every ... team member has completed accredited Indigenous Cultural Safety training.” Such training is beyond the scope of this case, but you can find out more about its purpose from organizations such as San’yas, which provides national online anti-racism Indigenous cultural safety training (<https://sanyas.ca/>).

There is no privacy statement on Animikii’s website. However, the company would likely not be storing consumer data since it is a developer of sites and systems for others. Instead, it has initiated a project to “recognize and reclaim Indigenous data sovereignty,” posted in the news section of its website. Data ownership and its value are important ethical issues in information technology. The project was started in response to a lack of respect around copyright of traditional stories that were recorded from tribal elders. A non-profit organization recorded the stories, then would not provide the material to the source tribes, instead copyrighting the material and attempting to sell it back through literature such as textbooks.

Think about the many types of data that are available about you. Do any of those data have a cultural impact? Yes, if the data about you and others are aggregated and used to make decisions about funding, benefits, or tax law, in other words, if they drive policy decisions. Historical data, such as tracking traditions and language, are crucial to the recovery and continuity of Indigenous culture.

A quote on the Animikii news site is a rallying cry about Indigenous data rights and ownership: “Nothing about us without us.”

Questions

1. How would Bell’s values of integrity, respect, safety, ethical conduct, and avoiding conflicts of interest relate to data privacy and disclosure?
2. How would Animikii’s seven values of humility, truth, honesty, wisdom, respect, courage, and love relate to data privacy and disclosure?
3. How could the concept of cultural safety be used in data privacy?

Sources: Compiled from “#DataBack | Recognize and Reclaim Indigenous Data Sovereignty,” Animikii Inc., January 13, 2023, <https://animikii.com/news/databack-recognize-and-reclaim-indigenous-data-sovereignty>; “Animikii Indigenous Innovation,” Animikii Inc., March 11, 2023, <https://animikii.com/home>; “Values,” Animikii Inc., March 11, 2023, <https://animikii.com/about/values>; “Bell Code of Business Conduct,” BCE Inc., March 11, 2023, <https://www.bce.ca/governance/code-of-business-conduct/2022-august-code-of-business-conduct.pdf>; “Business Ethics,” BCE Inc., March 11, 2023, <https://www.bce.ca/responsibility/key-documents/2021-business-ethics.pdf>; “Jeff Ward,” Business Intelligence for B.C., December 3, 2019, <https://biv.com/article/2019/12/jeff-ward>; Karl Moore and Wáhiakatste Diome-Deer, “Jeff Ward on Driving change for Indigenous peoples through technology,” The Globe and Mail, February 6, 2022, <https://www.theglobeandmail.com/business/commentary/article-jeff-ward-on-driving-change-for-indigenous-peoples-through-technology/>; Graham Lee Brewer, “Lakota Elders Helped a White Man Preserve Their Language. Then He Tried to Sell It Back to Them,” NBC Universal, June 3, 2022, <https://www.nbcnews.com/news/us-news/native-american-language-preservation-rcna31396>; “Our Strategy,” BCE Inc., March 11, 2023, <https://www.bce.ca/about-bce/our-strategy>; “San’Yas Anti-Racism Indigenous Cultural Safety Training,” San’Yas Anti-Racism Indigenous Cultural Safety Education, March 22, 2023, <https://sanyas.ca/>.

Many of the business decisions you will face at work will have an ethical dimension. Consider the following decisions that you might have to make:

- **HRM** Should organizations monitor employees’ Web surfing and email?
- **MKT** Should organizations sell customer information to other companies?
- **HRM** Should organizations audit employees’ computers for unauthorized software or illegally downloaded music or video files?

The diversity and ever-expanding use of IT applications have created a variety of ethical issues. These issues fall into four general categories: privacy, accuracy, property, and accessibility.

1. *Privacy issues* involve collecting, storing, and disseminating information about individuals.
2. *Accuracy issues* involve the authenticity, fidelity, and correctness of information that is collected and processed.
3. *Property issues* involve the ownership and value of information.
4. *Accessibility issues* revolve around who should have access to information and whether they should pay a fee for this access.

Table 3.2 lists representative questions and issues for each of these categories.

Many of the issues and scenarios discussed in this chapter involve privacy as well as ethics. In the next section, you will learn about privacy issues in more detail.

TABLE 3.2
A Framework for Ethical Issues

Privacy Issues

- What information about oneself should an individual be required to reveal to others?
- What kinds of surveillance can an employer use on its employees?
- What types of personal information can people keep to themselves and not be forced to reveal to others?
- What information about individuals should be kept in databases, and how secure is the information there?

Accuracy Issues

- Who is responsible for the authenticity, fidelity, and accuracy of the information collected?
- How can we ensure that the information will be processed properly and presented accurately to users?
- How can we ensure that errors in databases, data transmissions, and data processing are accidental and not intentional?
- Who is to be held accountable for errors in information, and how should the injured parties be compensated?

Property Issues

- Who owns the information?
- What are just and fair prices for its exchange?
- How should we handle software piracy (illegally copying copyrighted software)?
- Under what circumstances can one use proprietary databases?
- Can corporate computers be used for private purposes?
- How should experts who contribute their knowledge to create expert systems be compensated?
- How should access to information channels be allocated?

Accessibility Issues

- Who is allowed to access information?
- How much should companies charge for permitting access to information?
- How can access to computers be provided for employees with disabilities?
- Who will be provided with the equipment needed for accessing information?
- What information does a person or an organization have a right to obtain, under what conditions, and with what safeguards?

Before you go on...

1. What does a code of ethics contain?
2. Identify and discuss the fundamental tenets of ethics.

3.2
Privacy

privacy The right to be left alone and to be free of unreasonable personal intrusions.

information privacy The right to determine when, and to what extent, personal information can be gathered by or communicated to others.

LEARNING OBJECTIVE

Discuss at least one potential threat to the privacy of the data stored in each of three places that store personal data.

In general, **privacy** is the right to be left alone and to be free of unreasonable personal intrusions. **Information privacy** is the right to determine when, and to what extent, information about you can be gathered or communicated to others. Privacy rights apply to individuals,

groups, and institutions. The right to privacy is recognized today in all Canadian provinces, the U.S. states, and by both federal governments, either by statute or in common law. Most countries around the world also have privacy rights laws or regulations.

Privacy can be interpreted quite broadly. However, court decisions in many countries have followed two rules fairly closely:

1. The right of privacy is not absolute. Privacy must be balanced against the needs of society.
2. The public's right to know supersedes the individual's right of privacy.

These two rules illustrate why determining and enforcing privacy regulations can be difficult.

As we discussed earlier, rapid advances in information technologies have made it much easier to collect, store, and integrate vast amounts of data on individuals in large databases. On an average day, data about you are generated in many ways: surveillance cameras located on toll roads, on other roadways, in busy intersections, in public places, and at work; credit card transactions; telephone calls (land line and cellular); banking transactions; queries to search engines; and government records (including police records). These data can be integrated to produce a **digital dossier**, which is an electronic profile of you and your habits. The process of forming a digital dossier is called **profiling**.

Data aggregators in the United States, such as LexisNexis (<https://risk.lexisnexis.com/>) and Acxiom (<https://www.acxiom.com/>), are prominent examples of profilers. These companies collect public data such as real estate records and published telephone numbers, in addition to nonpublic information such as social security numbers (and social insurance numbers in Canada); financial data; and police, criminal, and motor vehicle records. They then integrate these data to form digital dossiers. Statistics Canada (<https://www.statcan.gc.ca/>), Canada's national statistics agency, also provides aggregated information about businesses and individuals.

The problem with data aggregators, social media sites, marketing firms, and others is the methods they use to gather data on all of us. They ultimately sell their dossiers to law enforcement agencies and companies that conduct background checks on potential employees. They also sell them to companies that want to know their customers better, a process called *customer intimacy*. IT's About Business 3.2 discusses some of these methods and then looks at how DuckDuckGo (<https://duckduckgo.com/>) helps users avoid the most intrusive methods.

digital dossier An electronic description of an individual and their habits.

profiling The process of forming a digital dossier.

IT's About Business 3.2

MIS MKT Data Tracking Methods on the Web and DuckDuckGo

Today, you are tracked in many ways as you navigate the Web. We will first briefly survey some of the most common data-tracking methods. We will then take a look at how DuckDuckGo helps limit such tracking and the resulting loss of privacy.

Data Tracking Methods

Cookies are small files containing text and computer code stored on your computer or phone that the websites you visit send to your browser. These files track and monitor your login information, the sites you visit, the items you click on these pages, and your location. Advertisers and data brokers use cookies to create a digital profile of each user in order to target advertisements to that user. There are several kinds of cookies.

First-party cookies, or persistent cookies, are stored on the websites you visit so that, when you revisit the sites, they can remember your information and settings. These cookies do not track your activities on other websites; they work only on the original site where they were placed.

Third-party cookies, on the other hand, are placed on a website by someone other than the website's owner to collect user data for that third party. Companies such as marketers, social media websites, and data brokers use these cookies to track users visits to different websites and display relevant ads to them.

Web beacons, also known as web bugs or tracking beacons, are very small, often transparent graphic images that are placed on websites or in emails to monitor the behaviour of the user visiting the website or sending the email. They are typically used by a third party to monitor the activity on a website.

IP addresses uniquely identify all internet-connected devices. Websites you visit often record and store your IP address, using it to track your activity. IP addresses provide the city, postal code, or area code of your ISP, as well as your ISP's name.

Session replay scripts record all of your activity on a website: whenever you move your mouse, whenever you click, and whenever you scroll. Session replay scripts can even record how long you hover over a clickable link, even if you do not click on it.

Favicons are small icons (16 × 16 pixels) that serve as branding for your website. They are found next to bookmarks, tabs, toolbar apps, history results, and search bars—whatever identifies your website. The main function of a favicon is to help visitors identify your page more easily when they have many tabs open. The problem is that favicons can be used to track users because they can store a unique identifier for a user that is readable in a browser's incognito mode. Furthermore, users cannot remove the identifier by closing the browser, restarting the system, using a virtual private network (VPN), or installing AdBlockers.

Browser fingerprinting integrates information about your device—such as your operating system, language preferences, and time zone—to create a unique identifier that is used to trace what you do online.

DuckDuckGo

Founded in 2008, DuckDuckGo's mission was to be an internet search engine that would protect searchers' privacy and not produce personalized, precisely targeted search results. Simply put, DuckDuckGo guarantees its users that it does not track them at all.

According to DuckDuckGo's marketing research, the vast majority of people using the Web want more privacy. Users are clearly concerned about their lack of privacy. Apple's new App Tracking Transparency system, for instance, prompts iOS users not to provide their data to third-party apps by default, but to deliberately make a decision on whether they want to opt in. Significantly, only 13 percent of users do choose to allow tracking.

Like Google Search, DuckDuckGo earns its revenue by selling ads based on users' search results. The difference is that the ads you see on Google are generally targeted specifically to you based on your own past and present searches plus what Google already knows about your behaviour, a process called *behavioural targeting or advertising*. DuckDuckGo's ads are based only on your current search term, because the search engine never knows anything about you. You are not given an identifier, and your search history is not tracked to personalize your results. Therefore, DuckDuckGo employs *contextual targeting or advertising*, a unique identifier that is used to trace your online activity.

DuckDuckGo's tracker prevention works differently from most similar products. As soon as a tracker loads, it can gather very specific data about you, including your IP address. However, most websites will not function at all if you block all cookies, since they are designed to track users. For that reason, DuckDuckGo prevents cookies from loading, but to avoid the broken-site problem, it replaces some trackers with dummies that trick websites into thinking that their cookies have loaded.

DuckDuckGo has enhanced its original search engine with free privacy-centric tools, including a browser extension, its Email Protection feature, a tool within its Android app that blocks third parties from tracking you through any other app on your phone, and DuckDuckGo's privacy browser.

Browser extension. In 2019, DuckDuckGo added a feature to its browser extension that calls up encrypted versions of websites whenever these exist, so hackers and ISPs cannot track you.

Email Protection feature. DuckDuckGo researchers found that roughly 70 percent of emails contain embedded trackers. In more than 30 percent of those cases, the trackers send plaintext email addresses over the internet, where marketers, data brokers, and hackers can potentially get hold of them.

In 2021, DuckDuckGo launched its Email Protection feature. This feature gives users a free "@duck.com" email address. The tool forwards messages through a DuckDuckGo email address, which looks for and removes trackers before sending the email to recipients' inboxes. The company is also extending this feature by providing unique, disposable forwarding email addresses, which can be easily generated in DuckDuckGo's mobile browser or its desktop browser extension.

The personal DuckDuckGo email is meant to be given out to friends and contacts you know, while the disposable email addresses should be used when signing up for free trials, newsletters, or any source you suspect might sell your address. If the disposable email address is compromised, you can easily deactivate it and obtain another one.

Third-party blocking feature in Android mobile app. This new feature runs in the background, even when you are not using the app, to block tracking through any of the other apps on your phone. It routes all traffic through DuckDuckGo, using the phone's VPN permission. It

can then block requests from entities on its tracker list before they are able to gather any user data. This feature does not stop first-party data collection: the app you are using can still collect your data. However, it will not be able to give your data to other companies, including Facebook, which uses many unrelated apps to track people.

Privacy browser. In April 2022, DuckDuckGo launched a new privacy browser, which defaults to the private search engine, blocks ad trackers on all websites, and then shows you how many trackers it has blocked. The browser can also save passwords; it includes DuckDuckGo's Email Protection feature as well.

The new browser also addresses cookie consent pop-ups. The first time you use it, it will ask you if you want it to manage pop-ups. If you say "yes," it will automatically pick the option to "maximize privacy" in websites' cookie preferences. You will be able to use websites without seeing cookie pop-ups.

Questions

1. Discuss the ethics and legality of the use of each tracking method.
2. The fundamental tenets of ethics include responsibility, accountability, and liability. Discuss each of these tenets with respect to the use of each tracking method.
3. Advertising companies defend tracking users on websites and across the Web because they enable advertisers to produce highly targeted ads. These companies maintain that targeted ads feel less "in your face" than traditional ads and are more personalized based on each user's specific interests. The problem with this type of marketing is that users surrender their privacy. Are you willing to give up some of your privacy to be tracked and then shown personalized ads? Why or why not?

Sources: Compiled from Z. McAuliffe, "Forget Google Search: Here's Why You Should Switch to DuckDuckGo," *CNET*, July 31, 2022; C. Rao, "Data Privacy Concerns Trigger Restrictions on Google Chrome in Dutch Schools," *Android Police*, July 24, 2022; M. Burgess, "DuckDuckGo's Privacy Browser Finally Lands on Desktop," *Wired*, April 12, 2022; M. Burgess, "The Quiet Way Advertisers Are Tracking Your Browsing," *Wired*, February 26, 2022; C. Pilette, "Internet Tracking: How and Why We're Followed Online," *NortonLifeLock*, August 23, 2021; D. Gershgorin, "DuckDuckGo Launches New Email Protection Service to Remove Trackers," *The Verge*, July 20, 2021; G. Edelman, "DuckDuckGo's Quest to Prove Online Privacy Is Possible," *Wired*, June 16, 2021; C. Thompson, "Tech Companies Don't Need to Be Creepy to Make Money," *Wired*, May 14, 2021; D. Nielo, "What's Google FLoC? And How Does It Affect Your Privacy?" *Wired*, May 9, 2021; A. Barbaschow, "User 'Opt-In' Rate for Tracking across iOS Sitting at 13% Globally," *ZDNet*, May 9, 2021; "EFF Partners with DuckDuckGo to Enhance Secure Browsing and Protect User Information on the Web," *Electronic Frontier Foundation*, April 15, 2021; "1 in 5 Consumers Has Avoided Buying a Brand over Its Data Practices: Survey Finds Widespread Skepticism over How Companies Collect and Use Personal Data," *The Conference Board*, November 17, 2020; N. Perrin, "Search Marketing 2020," *eMarketer*, November 2, 2020; A. Sankin, "I Scanned the Websites I Visit with Blacklight, and It's Horrifying. Now What?" *The Markup*, September 22, 2020; D. Nielo, "All the Ways Facebook Tracks You—and How to Limit It," *Wired*, January 12, 2020; L. Newman, "DuckDuckGo Will Automatically Encrypt More Sites You Visit," *Wired*, November 19, 2019; D. Nielo, "All the Ways Google Tracks You—and How to Stop It," *Wired*, May 27, 2019; R. Nakashima, "Google Tracks Your Movements, Like It or Not," *AP News*, August 13, 2018; D. Goodin, "New Sites Can Fingerprint You Online Even When You Use Multiple Browsers," *Ars Technica*, February 13, 2017; www.duckduckgo.com, accessed August 5, 2022.

Electronic Surveillance

Electronic surveillance is rapidly increasing, particularly with the emergence of new technologies. Electronic surveillance is conducted by employers, the government, and other institutions.

Canadians today live with a degree of surveillance that would have been unimaginable just a few years ago. For example, surveillance cameras track you at airports, subways, banks, and other public venues. Inexpensive digital sensors are also now everywhere. They are incorporated into laptop webcams, video-game motion sensors, smartphone cameras, utility meters, passports, and employee ID cards. Step out your front door and you could be captured in a high-resolution photograph taken from the air or from the street by Google or Microsoft as they update their mapping services. Drive down a city street, cross a toll bridge, or park at a shopping mall, and your licence plate can be recorded and time-stamped.

Technologies such as low-cost digital cameras, motion sensors, and biometric readers are helping to increase the monitoring of human activity. The costs of storing and using digital data are also rapidly decreasing. The result is an explosion of sensor data collection and storage.

A special problem arises with smartphones that are equipped with global positioning system (GPS) sensors. These sensors routinely *geotag* photos and videos, embedding images with the longitude and latitude of the location shown in the image. Thus, you could be inadvertently supplying criminals with useful intelligence by posting personal images on social networks or photo-sharing websites. These actions would show the criminals exactly where you live and when you are there. You could be providing government agencies with useful information as well.

MIS Another example of how new devices can contribute to electronic surveillance is facial recognition technology. Just a few years ago, this software worked only in very controlled settings such as passport checkpoints. However, this technology can now match faces even in regular snapshots and online images. This chapter's opening case provides an example of how advances in facial recognition technologies can negatively impact privacy.

Photo tagging is the process of assigning names to images of people. Facial recognition software then indexes facial features. Once an individual in a photo is tagged, the software searches for similar facial features in untagged photos. This process allows the user to quickly group photos in which the tagged person appears. Significantly, the tagged individual is not aware of this process.

Why is tagging important? The reason is that, once you are tagged in a photo, that photo can be used to search for matches across the entire internet or in private databases, including databases fed by surveillance cameras. How could this type of surveillance affect you? As one example, a car dealer can take a picture of you when you step onto the car lot. They could then quickly profile you (find out information about where you live or your employment details) on the Web to achieve a competitive edge in making a sale. Even worse, a stranger in a restaurant could photograph you with a smartphone and then go online to profile you for reasons of their own. One privacy attorney has asserted that losing your right to anonymity would have a chilling effect on where you go, whom you meet, and how you live your life.

Drones are presenting additional surveillance concerns. Low-cost drones with high-performance cameras can be used for persistent aerial surveillance. Since the beginning of modern aviation, landowners have had rights to the airspace above their property up to 500 feet. However, to regulate small, low-flying drones, aviation authorities in some countries have assumed authority all the way down to the ground.

HRM The scenarios we just considered deal primarily with your personal life. However, electronic surveillance has become a reality in the workplace as well. In general, employees have very limited legal protection against surveillance by employers. The law supports the right of employers to read their employees' email and other electronic documents and to monitor their employees' internet use. Today, more than three-fourths of organizations routinely monitor their employees' internet usage. Two-thirds of them also use software to block connections to inappropriate websites, a practice called *URL filtering*. Furthermore, organizations are installing monitoring and filtering software to enhance security by blocking malicious software and to increase productivity by discouraging employees from wasting time.

MIS In one organization, the chief information officer (CIO) monitored roughly 13,000 employees for three months to determine the type of traffic they engaged in on the network. He then forwarded the data to the chief executive officer (CEO) and the heads of the human

electronic surveillance
Tracking people's activities with the aid of computers.

resources and legal departments. These executives were shocked at the questionable websites the employees were visiting, as well as the amount of time they were spending on those sites. The executives quickly decided to implement a URL filtering product.

In general, surveillance is a concern for private individuals regardless of whether it is conducted by corporations, government bodies, or criminals. As a nation, Canada (like many other countries) is still struggling to define the appropriate balance between personal privacy and electronic surveillance, especially in situations that involve threats to national security.

Personal Information in Databases

Information about individuals is kept in many databases. Perhaps the most visible locations of such records are credit-reporting agencies. Other institutions that store personal information include banks and financial institutions; cable TV, telephone, and utility companies; employers; mortgage companies; hospitals; schools and universities; retail establishments; government agencies (Canada Revenue Agency, your province, your municipality); and many others.

There are several concerns about the information you provide to these record keepers. Some of the major concerns are as follows:

- Do you know where the records are?
- Are the records accurate?
- Can you change inaccurate data?
- How long will it take to make a change?
- Under what circumstances will the personal data be released?
- How are the data used?
- To whom are the data given or sold?
- How secure are the data against access by unauthorized people?

Information on Internet Bulletin Boards, Newsgroups, and Social Networking Sites

Every day we see more and more *electronic bulletin boards*, *newsgroups*, and *electronic discussions* such as chat rooms and *social networking sites* (discussed in Chapter 9). These sites appear on the internet, within corporate intranets, and on blogs. A *blog*, short for “weblog,” is an informal, personal journal that is frequently updated and is intended for general public reading. How does society keep owners of bulletin boards from disseminating information that may be offensive to readers or simply untrue? This is a difficult problem because it involves the conflict between freedom of speech on the one hand and privacy on the other. This conflict is a fundamental and continuing ethical issue in Canada and throughout the world.

There is no better illustration of the conflict between free speech and privacy than the internet. Many websites contain anonymous, derogatory information on individuals, who typically have little recourse in the matter. The vast majority of Canadian firms use the internet in examining job applications, including searching on Google and on social networking sites. Consequently, derogatory information contained on the internet can harm a person’s chances of being hired.

privacy policies (or privacy codes) An organization’s guidelines for protecting the privacy of customers, clients, and employees.

opt-out model A model of informed consent that permits a company to collect personal information until the customer specifically requests that the data not be collected.

Privacy Codes and Policies

Privacy policies (or privacy codes) are an organization’s guidelines for protecting the privacy of its customers, clients, and employees. In many corporations, senior management has begun to understand that when they collect vast amounts of personal information, they must protect it. Many organizations also give their customers some voice in how their information is used by providing them with opt-out choices. The **opt-out model** of informed consent permits the company to collect personal information until the customer specifically requests that

the data not be collected. You can see an example of this by looking at the global American Express online privacy statement (from www.americanexpress.com). The statement, effective September 22, 2022, has a section titled “What are your choices?” There, the company states that, if you do not want information to be collected, you can disable collection by working with the cookie settings in your browser.

Privacy advocates prefer the **opt-in model** of informed consent, which prohibits an organization from collecting any personal information unless the customer specifically authorizes it. Although the opt-out model is a common approach, Canada’s privacy commissioner (see <https://www.priv.gc.ca/en/>) states that consent should be sought, which is the opt-in model. *Canada’s Anti-Spam Legislation* (CASL), Bill C-28, requires that organizations use the opt-in model for the sending of emails. This means that organizations need to have data collection processes so that they can keep records of which customers have agreed to receiving emails, and which ones have not. Details about the requirements of the law are available at www.fightspam.gc.ca.

One privacy tool available to consumers is the *Platform for Privacy Preferences* (P3P), a protocol that automatically communicates privacy policies between an electronic commerce website and visitors to that site. P3P enables visitors to determine the types of personal data that can be extracted by the sites they visit. It also allows visitors to compare a site’s privacy policy to the visitors’ preferences or to other standards, such as the Federal Trade Commission’s (FTC) Fair Information Practices Standard or the European Directive on Data Protection.

Table 3.3 provides a sampling of privacy policy guidelines. The last section, “Data Confidentiality,” refers to security, which we consider in Chapter 4. All of the good privacy intentions in the world are useless unless they are supported and enforced by effective security measures.

opt-in model A model of informed consent in which a business is prohibited from collecting any personal information unless the customer specifically authorizes it.

TABLE 3.3 Privacy Policy Guidelines: A Sampler

Data Collection

- Data should be collected on individuals only for the purpose of accomplishing a legitimate business objective.
- Data should be adequate, relevant, and not excessive in relation to the business objective.
- Individuals must give their consent before data pertaining to them can be gathered. Such consent may be implied from the individual’s actions (e.g., applications for credit, insurance, or employment).

Data Accuracy

- Sensitive data gathered on individuals should be verified before they are entered into the database.
- Data should be kept current, where and when necessary.
- Personal data should be made available so that the individual can ensure that the data are correct.
- In any disagreement about the accuracy of the data, the individual’s version should be noted and included with any disclosure of the file.

Data Confidentiality

- Computer security procedures should be implemented to ensure against unauthorized disclosure of data. These procedures should include physical, technical, and administrative security measures.
- Third parties should not be given access to data without the individual’s knowledge or permission, except as required by law.
- Records of disclosures of data, other than the most routine, should be prepared and maintained for as long as the data are kept.
- Data should not be disclosed for reasons incompatible with the business objective for which they are collected.

Despite privacy codes and policies, and despite opt-out and opt-in models, guarding whatever is left of your privacy is becoming increasingly difficult. This problem is illustrated in IT's About Business 3.2 as well as this chapter's opening and closing cases.

International Aspects of Privacy

As the number of online users has increased globally, governments throughout the world have enacted a large number of inconsistent privacy and security laws. This highly complex global legal framework is creating regulatory problems for companies. Approximately 50 countries have some form of data protection laws. Many of these laws conflict with those of other countries, or they require specific security measures. Other countries have no privacy laws at all.

For example, on June 16, 2022, Canada introduced Bill C-27, the *Digital Charter Implementation Act*. Bill C-27 proposed three new pieces of legislation. A new *Consumer Privacy and Protection Act* would result in the replacement of PIPEDA (*Personal Information Protection and Electronic Documents Act*). The purpose of the newer act is to ensure better personal control over information (e.g., by moving it from one organization to another securely); it specifically talks about increased standards for dealing with data about children. The second piece of legislation, a *Data Protection Tribunal Act*, would work with the Office of the Privacy Commissioner of Canada (which would still exist under the proposed legislation) and could charge higher penalties or even order a company to stop collecting personal data. The third part is a new *Artificial Intelligence and Data Act*. The concept of high-impact AI was introduced (although it was not defined in the legislation), requiring organizations with such types of AI to deal with potential harm and bias. A new AI and Data Commissioner would be set up to monitor compliance with the AI legislation. As of June 13, 2022, Bill C-27 had completed second reading in Canada's House of Commons. To pass, the legislation also requires consideration in a committee, third reading, and three readings at the Senate. During that process, the bill could be amended or even abolished.

The absence of consistent or uniform standards for privacy and security obstructs the flow of information among countries (*transborder data flows*). The European Union (EU), for one, has taken steps to not only overcome this problem but also to protect the rights of individuals. The EU data protection laws, like the Canadian ones, are stricter than the U.S. laws and therefore could create problems for U.S.-based multinational corporations, which could face lawsuits for privacy violations.

On May 25, 2018, the *General Data Protection Regulation* (GDPR), the world's strongest data protection laws, went into effect in the European Union. The GDPR modernized laws that protect the personal information of individuals because previous data protection laws across Europe could not keep pace with rapid technological changes. The GDPR changed how businesses and public sector organizations manage their customers' information. The regulation also increased the rights of individuals and gave them more control over their own information.

The GDPR covers both personal data and sensitive personal data. *Personal data* include information that can be used to identify a person, such as a name, address, Internet Protocol (IP) address, and many other pieces of information. *Sensitive personal data* encompass genetic data, racial information, information about religious and political views, sexual orientation, and trade union membership, among others.

The GDPR applies to *data controllers*, which are organizations that have relationships with data subjects, and *data processors*, which are organizations that work for data controllers and process personal data on the controllers' behalf. The GDPR defines a *natural person* as a living human being and a *data subject* as a human being whose data an organization has or processes.

The GDPR states that data controllers and data processors should keep minimal data on each data subject, secure them properly, ensure that they are accurate, and retain the data for only as long as they are needed. The GDPR also covers individuals' rights, which include:

- The right to know what organizations are doing with their data
- The right to ask, at any time, for copies of all the data that organizations have about them

- The right to know an organization's justification about why it has their data and how long it is planning to keep them
- The right to have their data corrected, if needed
- The right to have their data deleted. This provision is called the “right to be forgotten”

The GDPR provides the ability for regulators to fine businesses that do not comply with the regulation. Specifically, regulators can fine an organization:

- If it does not correctly process an individual's data
- If it experiences a security breach
- If it is required to have, but does not have, a data protection officer

The transfer of data into and out of a nation without the knowledge of either the authorities or the individuals involved raises several privacy issues. Whose laws have jurisdiction when records are stored in a different country for reprocessing or retransmission purposes? For example, if data are transmitted by a Polish company through a Canadian satellite to a British corporation, which country's privacy laws control the data, and at what points in the transmission? Questions like these will become more complicated and frequent as time goes on. Governments must try to develop laws and standards to cope with rapidly changing information technologies to solve some of these privacy issues.

Privacy legislation anywhere shares the goal of protecting citizens' privacy. Canada's PIPEDA privacy legislation discusses and requires the use of 10 principles:

1. accountability,
2. identifying purposes,
3. consent,
4. limiting collection,
5. limiting use, disclosure, and retention,
6. accuracy,
7. safeguards,
8. openness,
9. individual access, and
10. challenging compliance.

The following list of benefits of high-quality information privacy takes a business perspective:

- To protect the organization's public image or brand images;
- To maintain or enhance trust and promote continued consumer confidence in the organization and promote goodwill;
- To achieve a competitive advantage in the marketplace by maintaining high-quality, accurate customer information;
- To meet legal requirements of industry associations or organizations (e.g., e-payment and credit card processors); and
- To efficiently manage personal information, reducing administration or data handling costs and avoiding additional financial costs, such as the need to modify information systems to meet legal requirements.

Before you go on...

1. Describe the issue of privacy as it is affected by IT.
2. Discuss how privacy issues can impact transborder data flows.

What's in IT for me?

ACCT For the Accounting Major

Public companies, their accountants, and their auditors have significant ethical responsibilities. Accountants are now being held professionally and personally responsible for increasing the transparency of transactions and assuring compliance with Canadian and international accounting standards and with Canadian Privacy Principles. In fact, regulatory agencies require all accountants, whether they work as auditors, in accounting departments, or elsewhere, to adhere to strict ethical principles.

FIN For the Finance Major

As a result of global regulatory requirements, financial managers must follow strict ethical guidelines. They are responsible for full, fair, accurate, timely, and understandable disclosure in all financial reports and documents that their companies submit to regulatory agencies and provide in all other public financial reports. Furthermore, financial managers are responsible for compliance with all applicable governmental laws, rules, and regulations.

MKT For the Marketing Major

Marketing professionals have new opportunities to collect data on their customers; for example, through business-to-consumer electronic commerce (discussed in Chapter 7). Business ethics clearly mandate that these data should be used only within the company and should not be sold to anyone else. Marketers do not want to be sued for invasion of privacy over data collected for their marketing database.

Customers expect their data to be properly secured. However, profit-motivated criminals want that data. Therefore, marketing managers must analyze the risks of their operations. Failure to protect corporate and customer data will cause significant public relations

problems and outrage customers. Customer relationship management (discussed in Chapter 11) operations and tracking customers' online buying habits can expose unencrypted data to misuse or result in privacy violations.

POM For the Production/Operations Management Major

POM professionals decide whether to outsource (or offshore) manufacturing operations. In some cases, these operations are sent overseas to countries that do not have strict labour laws. This situation raises serious ethical questions. For example: Is it ethical to hire employees in countries with poor working conditions to reduce labour costs?

HRM For the Human Resource Management Major

Ethics is critically important to HR managers. HR policies define the appropriate use of information technologies in the workplace. Questions such as the following can arise: Can employees use the internet, email, or chat systems for personal purposes while at work? Is it ethical to monitor employees? If so, then how, how much, and how often? HR managers must formulate and enforce such policies while at the same time maintaining trusting relationships between employees and management.

MIS For the MIS Major

Ethics might be more important for MIS personnel than for anyone else in the organization because these individuals have control of the organization's information assets. They also have control over a huge amount of employees' personal information. As a result, the MIS function must be held to the highest ethical standards.

Summary

3.1 Describe ethics and explain its three fundamental tenets, and the four categories of ethical issues related to information technology.

Ethics refers to the principles of right and wrong that individuals use to make choices that guide their behaviour.

Fundamental tenets of ethics include responsibility, accountability, and liability. Responsibility means that you accept the consequences of your decisions and actions. Accountability refers to determining who is responsible for actions that were taken. Liability is a legal concept that gives individuals the right to recover the damages done to them by other individuals, organizations, or systems.

The major ethical issues related to IT are privacy, accuracy, property (including intellectual property), and access to information.

Privacy may be violated when data are held in databases or transmitted over networks. Privacy policies that address issues of data collection, data accuracy, and data confidentiality can help organizations avoid legal problems.

3.2 Discuss at least one potential threat to the privacy of the data stored in each of three places that store personal data.

Privacy is the right to be left alone and to be free of unreasonable personal intrusions. Threats to privacy include advances in information technologies, electronic surveillance, personal information in databases, internet bulletin boards, newsgroups, and social networking sites. The privacy threat in internet bulletin boards, newsgroups, and social networking sites is that you might post too much personal information that many unknown people can see.

Key Terms

accountability 67
code of ethics 65
digital dossier 71
electronic surveillance 73
information privacy 70

ethics 64
liability 67
opt-in model 75
opt-out model 74
privacy 70

privacy codes 70
privacy policies (or privacy codes) 74
profiling 71
responsibility 67

Discussion Questions

1. A Transportation Authority (TA) in the United States obtained a temporary restraining order barring three local university students from publicly displaying what they claimed to be a way to get “free subway rides for life.” Specifically, the 10-day injunction prohibited the students from revealing vulnerabilities of the TA’s fare card. The students were scheduled to present their findings in Las Vegas at the DEFCON computer hacking conference. Were the students’ actions legal? Were their actions ethical? Discuss your answer from the students’ perspective and then from the perspective of the TA.
2. Frank Abagnale, the criminal played by Leonardo DiCaprio in the motion picture *Catch Me If You Can*, ended up in prison. After he left prison, however, he worked as a consultant to many companies on matters of fraud.
 - a. Why do these companies hire the perpetrators (if caught) as consultants? Is this a good idea?
 - b. You are the CEO of a company. Discuss the ethical implications of hiring Frank Abagnale as a consultant.
3. Access various search engines to find information relating to the use of drones (unmanned aerial vehicles [UAVs]) for electronic surveillance purposes.
 - a. Take the position favouring the use of drones for electronic surveillance.
 - b. Take the position against the use of drones for electronic surveillance.
4. Research the Volkswagen “Diesel Dupe.” The fundamental tenets of ethics include responsibility, accountability, and liability. Discuss each of these tenets as it applies to the Volkswagen scandal. Start with Beth Gardner, “Dirty Lies: How the Car Industry Hid the Truth about Diesel Emissions,” March 22, 2019, Guardian News & Media Limited.
5. Research the Facebook–Cambridge Analytica scandal and the current status of lawsuits.
 - a. Discuss the legality and the ethics of Facebook in the Facebook–Cambridge Analytica incident.
 - b. Discuss the legality and the ethics of Cambridge Analytica in the Facebook–Cambridge Analytica incident.
 - c. Describe how each of the fundamental tenets of ethics (responsibility, accountability, and liability) applies to Facebook (now Meta Platforms) and then to Cambridge Analytica in this incident.
6. Research Quizlet (www.quizlet.com).
 - a. Discuss the ethics of students’ use of Quizlet (and similar apps) for exams
 - b. If students discover that their actual exam questions were on Quizlet, discuss the ethics of them not telling the professor.
7. Do you feel that Canadians have adequate privacy protections for their data? Why or why not? Does your answer change for Europeans?

Problem-Solving Activities

1. An information security manager routinely monitored Web surfing among her company’s employees. She discovered that many employees were visiting the “sinful six” kinds of websites. (*Note:* The “sinful six” are websites with material related to pornography, gambling, hate, illegal activities, tastelessness, and violence.) She then prepared a list of the employees and their surfing histories and gave the list to management. Some managers punished their employees. Some employees, in turn, objected to the monitoring, claiming that they and other employees should have a right to privacy.
 - a. Is monitoring of Web surfing by managers ethical? (It is legal.) Support your answer.
 - b. Is employee Web surfing on the “sinful six” ethical? Support your answer.
 - c. Is the security manager’s submission of the list of abusers to management ethical? Why or why not?
 - d. Is punishing the abusers ethical? Why or why not? If yes, then what types of punishment are acceptable?
 - e. What should the company do in this situation? (*Note:* There are a variety of possibilities here.)
2. Access the Computer Ethics Institute’s website at www.cpsr.org/issues/ethics/cei. The site offers the “Ten Commandments of Computer Ethics.” Study these rules and decide whether any others should be added.
3. Access the Association for Computing Machinery’s code of ethics for its members (<https://www.acm.org/code-of-ethics>). Discuss

the major points of this code. Is this code complete? Why or why not? Support your answer.

4. The Electronic Frontier Foundation (<https://www EFF.org/>) has a mission of protecting rights and promoting freedom in the “electronic frontier.” Review the organization’s suggestions about how to protect your online privacy and summarize what you can do to protect yourself.

5. Access your university’s guidelines for ethical computer and internet use. Are there limitations as to the types of websites that you can visit and the types of material you can view? Are you allowed to change the programs on the lab computers? Are you allowed to download software from the lab computers for your personal use? Are there rules governing the personal use of computers and email?

6. Access www.albion.com/netiquette/corerules.html. What do you think of this code of ethics? Should it be expanded? Is it too general?

7. Access www.cookiecentral.com. Does this site provide information that helps you protect your privacy? If so, then explain how.

8. Do you believe that a university should be allowed to monitor email sent and received on university computers? Why or why not? Support your answer.

9. Go to www.google.com and research the company’s privacy policy. Do you feel that it goes far enough? What changes will help further protect your privacy?

10. Visit www.xns py.com and look at the different cellphone monitoring activities the software performs. All of these activities are legal, but are they ethical? Using the ethical frameworks discussed in this chapter, support your answer.

Closing Case

MIS MKT FIN Say “No, Thank You” to Doughnuts and TikTok

What type of data affects your privacy? Is it only your social insurance number, your salary, or your credit card numbers? This information can be used to engage in identity theft, but did you realize that location data was also crucial? If you get up every morning during the week at seven o’clock, then leave at eight and go to the same location from nine to five, location data can be used to infer where you live and where you work. It can also be used to track which medical clinic you go to, which religious institution you attend regularly, and the location of restaurants and bars where you spend your leisure time. If you always go with the same person for leisure, the tracking data can be used to guess your marital status and might know the gender of the person you are with.

Tim Horton’s Tracking App

In the summer of 2017, Tim Hortons (owned by Restaurant Brands International Inc.) launched its online ordering app to stay competitive with other coffee house restaurants such as Starbucks. The app allows customers to order and pay for their food and beverages before arriving at the restaurant. It would make sense for an ordering app to use your location to tell you where the nearest Tim Hortons was located, and how long it would take you to get there. Tim Horton’s current website titled “Mobile App FAQs” tells us that customers can customize and place their order and pay for it after designating the Tim Horton’s location where they would pick up their order.

The FAQ section has specific instructions on how to download the app and whether and how you would use email with it. It also includes instructions on how to find the nearest Tim Hortons. Near the bottom of a long list of instructions is a Privacy section, which states that, if location services are enabled, the app will only access your location while it is open. There is also an explanation that location tracking can be turned on or off by going to the “Settings” section of the app.

On June 12, 2020, James McLeod authored an article in the *Financial Post* in which he complained that the Tim Hortons app had been secretly tracking him for over a year. The company knew he had gone on vacation to Morocco and had tracked his travels

between his home, his office, and his fun times at Blue Jay games. Hundreds of thousands, even millions, of Canadians were using the app, meaning that the company was collecting huge amounts of data. McLeod found out how much of his data was being tracked after he requested a copy of his data from Tim Hortons’ parent company the previous fall under Canada’s *Personal Information Protection and Electronic Documents Act* (PIPEDA). In the article, McLeod stated that, over a period of five months, 2,700 data points were collected about his location (latitude and longitude), even at times he believed he was not using the app.

A follow-up article a few days later in the *Financial Post* explained the technology used to track time and match it to location. The article showed the actual JavaScript code used, the use of standardized time (called Unix Time), and the fact that a service organization called Radar Labs Inc. was used to provide business intelligence on the data. This included assigning “events” when someone moves around, such as visiting a competitor or going to their office.

The subsequent furor resulted in an investigation by four privacy commissioners: the Office of the Privacy Commissioner of Canada, Commission d’accès à l’information du Québec, Office of the Information and Privacy Commissioner for British Columbia, and Office of the Information and Privacy Commissioner of Alberta. Their report was released on June 1, 2022. The investigation found that users were incorrectly led “to believe information would only be accessed when the app was in use. In reality, the app tracked users as long as the device was on, continually collecting their location data.” The data were supposed to be used for marketing decisions, but that never happened. However, if the data were not needed, they should no longer have been collected, according to the report. Fines were not levied against the company. Instead, the report recommended deleting the data held by both Tim Hortons and its service provider, setting up appropriate privacy management programs, and informing the Commissioners when and how this had been completed.

In September 2022, a class action suit in the Quebec Superior Court against Tim Hortons was settled where the company did not admit fault but provided a free hot beverage and a free baked good (maximum value of \$8.58 plus taxes) to all who were customers at the time of the use of Tim Horton’s app. What does this say about

our privacy laws? Since there was no disclosure of data external to the company, PIPEDA does not apply, so fines could not be levied. Although the company did collect the data, it did not use them in more than a “limited” way, although the potential for such use did exist.

TikTok’s Vast Data Store and Saying “No”

As of March 2023, the governments of Belgium, Canada, and the United States, as well as the European Commission had banned the use of TikTok on government phones. Britain’s National Cyber Security Centre was conducting a review to determine whether Britain should do the same. TikTok is a Chinese-owned video app used by billions of people daily around the world. The bans arose due to allegations that the company was providing data to the Chinese government.

In the wake of Canada’s ban, organizations were banning the app and removing it from their servers. For example, the city of Hamilton removed it from its servers, all provincial governments removed and banned it, and so did the city of London and the Niagara police.

Privacy Problems Large and Small Aboard

Recent examples show us that organizations of many different sizes are affected by privacy exposures due to internal or external issues (such as hacking), discussed further in our next chapter. In July 2022, the Waterloo Regional District School Board discovered that all of its confidential information about its employees since 1970 had been accessed by hackers; it was investigating whether student information had been accessed. BRP Inc. is a large company that has close to 20,000 employees and produces many products such as snowmobiles, watercraft, pontoons, and recreational aircraft. In August 2022, it reported access to confidential data on its suppliers and employees, which were reportedly uploaded to the dark web by a ransomware gang called RansomEXX.

To see a list of the largest privacy disclosures, check the internet; for example, Tech.co at <https://tech.co/news/data-breaches-updated-list> tells us about the massive breaches of 2022 and 2023 that included Uber and Cisco.

In conclusion, know that privacy legislation cannot protect your data, nor can individual organizations. They do their best, but we all need to have “backup plans” and strong security such as multiple email addresses with strong passwords, and the use of two-factor authentication, discussed further in the next chapter.

Questions

1. Was Tim Horton’s capture and use of the location data on its customers ethical? Why or why not?
2. Was Tim Hortons’ capture and use of the location data on its customers a privacy violation? Why or why not?

3. Should apps that potentially place Canadian data in the hands of foreign governments be banned? Why or why not? Would your answer be different depending on the countries where the data would be accessed? Why or why not?

Sources: Compiled from BRP Inc., “BRP Resumes Operations After Cyberattack,” August 15, 2022, <https://news.brp.com/news-releases/news-release-details/brp-resumes-operations-after-cyberattack>; Aaron Drapkin, “Data Breaches That Have Happened in 2022 and 2023 So Far,” *Tech.co*, March 13, 2023, <https://tech.co/news/data-breaches-updated-list>; James McLeod, “Double-Double Tracking: How Tim Hortons Knows Where You Sleep, Work and Vacation,” *Financial Post*, June 12, 2020, <https://financialpost.com/technology/tim-hortons-app-tracking-customers-intimate-data>; James McLeod, “Inside the Code: How the Tim Hortons App Reveals Details on Its Users,” *Financial Post*, June 15, 2020, <https://financialpost.com/technology/inside-the-code-how-the-tim-hortons-app-reveals-details-on-its-users>; Fakiha Baig, “Ontario Cities, Police Forces Ban TikTok on Devices while Others Consider the Move,” *The Canadian Press*, Global News, March 9, 2023, <https://globalnews.ca/news/9538602/ontario-cities-tiktok-ban/>; Renaud L. Langlois, “Stolen BRP Data Leaked on the Dark Web,” *itbusiness.ca*, August 24, 2022, https://www.itbusiness.ca/news/stolen-brp-data-leaked-on-the-dark-web/122681?utm_source=ITB&utm_medium=enes&utm_campaign=ITB&scid=a54e6a5e-d98d-c496-caa2-4e60432fa2d5; Navneet Alang, “The Price of Privacy Adds Up to More Than a Coffee and a Doughnut,” *Toronto Star*, August 2, 2022, <https://www.thestar.com/business/opinion/2022/08/08/the-price-of-privacy-adds-up-to-more-than-a-coffee-and-a-doughnut.html>; Salman Aslam, “TikTok by the Numbers: Stats, Demographics & Fun Facts,” *Omnicores*, February 27, 2023, <https://www.omnicoreagency.com/tiktok-statistics/>; Office of the Privacy Commissioner of Canada, “Tim Hortons App Violated Privacy Laws in Collection of ‘Vast Amounts’ of Sensitive Location Data,” News Release, June 1, 2022, https://www.priv.gc.ca/en/opc-news/news-and-announcements/2022/nr-c_220601/; Tim Hortons, “Tim Hortons Mobile App FAQs,” <https://www.timhortons.com/mobile-app-faq>; LPC Avocat, Inc., “Tim Hortons—National Class Action Settlement Regarding the Collection of Geolocation Data from Users of the Tim Hortons App,” September 2022, <https://lpclex.com/timhortons/>; S. Harris, “Tim Hortons Set to Launch Order App after Months of Delay and Controversy,” *CBC News*, July 29, 2017, <https://www.cbc.ca/news/business/tim-hortons-mobile-order-and-pay-app-rbi-franchisee-1.4211247>; Kylie Maclellan, “UK’s National Cyber Security Centre Reviewing TikTok Risks, Minister Says,” *Reuters*, March 14, 2023, <https://www.reuters.com/world/uk/uks-national-cyber-security-centre-reviewing-tiktok-risks-minister-says-2023-03-14/>; Kevin Nielsen, “Waterloo School Board Says Hackers Accessed Sensitive Employee and Student Info,” *Global News*, August 15, 2022, <https://globalnews.ca/news/9060506/waterloo-school-board-hacked/>.

Information Security and Controls

CHAPTER OUTLINE

LEARNING OBJECTIVES

4.1 Introduction to Information Security	4.1 Identify the five factors that contribute to the increasing vulnerability of information resources and provide specific examples of each factor.
4.2 Unintentional Threats to Information Systems	4.2 Compare and contrast human mistakes and social engineering and provide a specific example of each one.
4.3 Deliberate Threats to Information Systems	4.3 Discuss the 10 types of deliberate attacks.
4.4 What Organizations Are Doing to Protect Information Resources	4.4 Describe the three risk mitigation strategies and provide an example of each one in the context of owning a home.
4.5 Information Security Controls	4.5 Identify the three major types of controls that organizations can use to protect their information resources and provide an example of each one.
4.6 Personal Information Asset Protection	4.6 Explain why it is critical that you protect your information assets, and identify actions that you could take to do so.

Opening Case

MIS Our Biggest Infrastructure Failure

On Friday, July 8, 2022, the message “service interruption” was what millions of people received when they attempted to use their Rogers land line, cellular, or internet-based services (2.82 million wireline and 10.242 million wireless customers). No communications services were available. Police, hospitals, 9-1-1 call centres, financial services, business point-of-sale systems, and telephone services were all down. Rogers Communications was experiencing virtually total disruption. Important treatments such as cancer treatments had to be cancelled or redirected. Concerts were cancelled and regulators such as the Canadian Radio-television and Telecommunications Commission (CRTC) could not be contacted.

How frequently do you use cash these days? Without debit, you needed cash to buy a coffee or pay for your meal. Some early morning

restaurants had prepared food for their customers but could not collect payment when they realized their systems were down.

Technology website The Verge reported that day that internet traffic in Canada was down 25 percent overall and that a denial-of-service mitigation company, Cloudflare, tracked Rogers’ traffic going down to 0 percent around 3 a.m. that morning. Rogers was only able to state that networks were starting to recover at 9:52 p.m., the same day. Although most services were back by the afternoon of the next day, Saturday, July 9, some systems took several days or even weeks to stabilize.

A Maintenance Problem, Twice

Rogers’ CEO Tony Staffieri published a letter of apology and disclosed that a “maintenance update” was the cause of the failure.

It was later disclosed that distribution routers in the Rogers network had been updated. The three routers had a software error that caused too many routes to be calculated (over 900,000) since a routing filter had been deleted, so they crashed. Multiple gateways (internet gateways and what was termed a core gateway) as well as distribution routers stopped communicating with each other and with all the Rogers networks.

Only 15 months earlier, in April 2021, Rogers' mobile networks were halted due to a vendor software update. All mobile services (calls, text, and data) had crashed. Since only mobile services went down, emergency services were not affected as core systems continued to run.

When everything stops, how do you find the problem? It becomes a technical search that highly qualified employees must participate in. You need to have good tracking of all of software and hardware changes, even the most apparently mundane. You need to be able to reverse the changes, specify the problem, or retest and debug every change going backward from the present. The company stated that its experiences in 2021 gave it "learnings" so that it could recover faster. Even so, it took hours to find and fix the problem, and then several more hours to start from the core systems and work outward to open the gateways for wireless services, first to emergency providers (such as 9-1-1) and then to others.

The Legislative Response

Three companies control 90 percent of Canada's data communications infrastructure: Bell Canada, Rogers, and Telus. The Canadian federal government demanded that they start backing each other up in the event of a failure of essential services.

On July 6, 2022, two days prior to the Rogers failure, the Federal Communications Commission (FCC) released a Report and Order and Further Notice of Proposed Rulemaking on the topic of improved readiness and reliability in the event of an emergency. The intention was to provide access to roaming (e.g., if your home systems were down), have multiple providers support each other to ensure service availability, and make consumers, local governments, and others more aware of what would need to be done in an emergency.

After its failure, the CRTC sent queries to Rogers, requiring that it specify the safeguards that would be established to enable critical functions to continue in the event of another network failure. With the assistance of a third-party adviser, the company was setting up alternative communications carriers "into critical locations" and was giving key employees a second mobile method of communicating. Management actions included an examination of processes around network reliability and automated incident management.

François-Philippe Champagne, federal Minister of Innovation, Science and Industry, worked with the CEOs of Canadian telecommunications companies to develop a "Memorandum of Understanding on Telecommunications Reliability," which has been published on the Canadian federal government's website. The memorandum was signed effective September 7, 2022, by 12 telecom companies. Its principles state that the companies agree to inform both the public and government authorities about network outages based upon action plans that each telecom has prepared, and that the companies have sufficient backup plans to do those communications. It also includes having available emergency roaming services and assisting people and organizations so that

they have basic telephone service and can process transactions. The agreement was reached because the Minister demanded that the telecom CEOs make it happen.

On the same date, Minister Champagne unveiled a Telecom Reliability Agenda for the federal government that targets improved telecommunications infrastructure reliability. His statement included links to letters to the CRTC requesting that the regulator address the issue and to the Canadian Security Telecommunications Advisory Committee, requesting that it report on the issue.

Readiness and Reliability Failure in September and October 2022

Hurricane Fiona created a massive storm surge that flooded Prince Edward Island (PEI) and many parts of the east coast of Canada. Eighty percent of PEI customers lost power. Half had no power for a week, and others took even longer to get their power back. Without power, phone and internet services were also down. The province mobilized rapidly to provide fuel, food, and essential services as rapidly as possible.

Whether the telecommunications companies can deliver on their reliability intentions remains to be seen. Let us hope that people and services will be able to communicate more effectively in the next disaster.

Questions

1. Why is it important for us as a country to maintain effective emergency communications systems?
2. What could a company such as Rogers do to help its employees be ready for an emergency and respond quickly?
3. What are some of the things a company needs to do for emergency preparedness?
4. What could you do as an individual to prepare for an extreme weather emergency?

Sources: Compiled from "Did Telecommunications Companies Fail Atlantic Canada?" *Port Hawkesbury Reporter*, October 1, 2022, Federal Communications Commission, "FCC Improves Resiliency and Reliability of Mobile Wireless Networks," July 6, 2022, <https://www.fcc.gov/fcc-improves-resiliency-and-reliability-mobile-wireless-networks>, accessed March 24, 2023; The Canadian Press, "In P.E.I., Growing Worries about Food Security in Wake of Post-Tropical Storm Fiona," *CTV News*, October 11, 2022, <https://atlantic.ctvnews.ca/in-p-e-i-growing-worries-about-food-security-in-wake-of-post-tropical-storm-fiona-1.6104561>, accessed March 24, 2023; The Canadian Press, "Major Telecoms Agree to Emergency Outage Deal," *Elliot Lake Today*, September 7, 2022, <https://www.elliottlaketoday.com/around-ontario/beyond-local-major-telecoms-agree-to-emergency-outage-deal-5792343>, accessed March 24, 2023; T. Warren and R. Lawler, "Massive Rogers Outage Cut Off 25 Percent of Canada's Internet Traffic for Nearly All of Friday," *The Verge*, July 8, 2022, <https://www.theverge.com/2022/7/8/23199945/rogers-down-outage-internet-issues911-canada>, accessed March 20, 2023; Government of Canada, "Memorandum of Understanding on Telecommunications Reliability," September 7, 2022, <https://ised-isde.canada.ca/site/mobile-plans/en/memorandum-understanding-telecommunications-reliability>, accessed March 24, 2023; The Canadian Press, "Rogers CEO Apologizes for Massive Service Outage, Blames Maintenance Update," *CBC News*, July 9, 2022,

<https://www.cbc.ca/news/business/rogers-outage-interac-debit-restored-1.6515869>, accessed March 20, 2023; H. Honderich, “Rogers Outage: Why a Network Upgrade Pushed Millions in Canada Offline,” *BBC News*, July 20, 2022, <https://www.bbc.com/news/world-us-canada-62174477>, accessed March 20, 2023; J. Rossignal, “Rogers Outage in July 2022: Timeline of Events,” *MacRumors*, July 8, 2022, <https://www.macrumors.com/2022/07/08/rogers-down-phone-internet-canada/>, accessed March 22, 2023; T. Li, “Rogers Provides More Information to CRTC Inquiry on July 8 Outage,” *ITWorld*, August 19, 2022,

<https://www.itworldcanada.com/article/rogers-provides-more-information-to-crtc-inquiry-on-july-8-outage/498916>, accessed March 22, 2023; Innovation, Science and Economic Development Canada, “Statement from Minister Champagne on Canada’s Telecommunications Reliability Agenda Following Rogers’ Outage on July 8, 2022,” <https://www.canada.ca/en/innovation-science-economic-development/news/2022/09/statement-from-minister-champagne-on-canadas-telecommunications-reliability-agenda-following-rogers-outage-on-july-8-2022.html>, accessed on March 24, 2023.

Introduction

The cases in this chapter provide several lessons. First, it is difficult—if not impossible—for organizations to provide perfect security for their data. Second, there is a growing danger that countries are engaging in economic cyberwarfare. Third, it appears to be impossible to secure the internet. Information security impacts each and every one of us, and, unfortunately, our personally identifiable, private data are not secure.

The solutions for these and other related issues are not clear. As you learn about information security in the context of information technology, you will acquire a better understanding of these issues, their importance, their relationships, and their trade-offs. Keep in mind that the issues involved in information security impact individuals and small organizations as well as large enterprises.

Information security is especially important to small businesses. Large organizations that experience an information security problem have greater resources to both resolve and survive the problem. In contrast, small businesses have fewer resources and therefore can be more easily crippled by a data breach.

When properly used, information technologies can have enormous benefits for individuals, organizations, and entire societies. In Chapters 1 and 2, you read about the diverse ways in which IT has made businesses more productive, efficient, and responsive to consumers. Unfortunately, bad actors can misuse information technologies, often with devastating consequences. Consider the following scenarios:

- Individuals can have their personal data and subsequently their identities stolen.
- Organizations can have customer information stolen, leading to financial losses, erosion of customer confidence, and legal actions.
- Countries face the threats of *cyberterrorism* and *cyberwarfare*, terms for internet-based attacks.

The misuse of information technologies has come to the forefront of any discussion of IT. In fact, according to the *Boardroom Cybersecurity 2022 Report*, published by Cybersecurity Ventures, cybercrime will cost the world approximately US \$10.5 trillion per year by 2025.

With organizations facing the loss or theft of billions of records, they must be aware of the full financial impact of a data breach. According to IBM’s 2022 *Cost of a Data Breach* report, the average cost of a breach in the United States in 2022 was US \$9.44 million, while in 2021 it was US \$4.3 million. The global average total cost of a data breach was less than half of the U.S. average at US \$4.35 million.

FIN The direct costs of a data breach include hiring forensic experts, notifying customers, setting up telephone hotlines to field queries from concerned or affected customers, offering free credit monitoring, and providing discounts for future products and services. The more intangible costs include the loss of business from increased customer turnover—called *customer churn*—and diminished customer trust.

HRM Unfortunately, employee negligence causes many data breaches, meaning that organizational employees are a weak link in information security. It is therefore very important for you to learn about information security so that you will be better prepared when you enter the workforce.

4.1

Introduction to Information Security

LEARNING OBJECTIVE

Identify the five factors that contribute to the increasing vulnerability of information resources and specific examples of each factor.

security The degree of protection against criminal activity, danger, damage, or loss.

information security Protecting an organization's information and information systems from unauthorized access, use, disclosure, disruption, modification, or destruction.

threat Any danger to which an information resource may be exposed.

exposure The harm, loss, or damage that can result if a threat compromises an information resource.

vulnerability The possibility that an information resource will be harmed by a threat.

Security can be defined as the degree of protection against criminal activity, danger, damage, or loss. Following this broad definition, **information security** refers to all of the processes and policies designed to protect an organization's information and information systems (IS) from unauthorized access, use, disclosure, disruption, modification, or destruction. You have seen that information and information systems can be compromised by deliberate criminal actions and by anything that can impair the proper functioning of an organization's information systems.

Before continuing, let's consider these key concepts. Organizations collect huge amounts of information, and they employ numerous information systems that are subject to myriad threats. A **threat** to an information resource is any danger to which a system may be exposed. The **exposure** of an information resource is the harm, loss, or damage that can result if a threat compromises that resource. An information resource's **vulnerability** is the possibility that a threat will harm that resource.

Today, five key factors are contributing to the increasing vulnerability of organizational information resources, making it much more difficult to secure them:

1. Today's interconnected, interdependent, wirelessly networked business environment
2. Smaller, faster, inexpensive computers and storage devices
3. Decreasing skills necessary to be a computer hacker
4. International organized crime taking over cybercrime
5. Lack of management support

The first factor is the evolution of the IT resource from mainframe-only to today's highly complex, interconnected, interdependent, wirelessly networked business environment. The internet now enables millions of computers and computer networks to communicate freely and seamlessly with one another. Organizations and individuals are exposed to a world of untrusted networks and potential attackers. In general, a *trusted network* is any network within your organization, and an *untrusted network* is any network external to your organization. Also, wireless technologies enable employees to compute, communicate, and access the internet anywhere at any time. Significantly, wireless is an inherently insecure broadcast communications medium.

The second factor reflects the fact that modern computers and storage devices—for example, thumb drives or flash drives—continue to become smaller, faster, less expensive, and more portable, with greater storage capacity. These characteristics make it much easier to steal or lose a computer or a storage device that contains huge amounts of sensitive information. Moreover, far more people are able to afford powerful computers and connect inexpensively to the internet, thus raising the potential of an attack on information assets.

The third factor is that the computing skills necessary to be a hacker are *decreasing*. The reason is that the internet contains information and computer programs called *scripts* that users with limited skills can download and use to attack any information system that is connected to the internet. (Security experts can also use these scripts for legitimate purposes, such as testing the security of various systems.) IT's About Business 4.1 illustrates how hackers successfully penetrated and disabled the information systems of Chapters Indigo and Toronto's SickKids Hospital.

The fourth factor is that international organized crime groups are taking over cybercrime. **Cybercrime** refers to illegal activities conducted over computer networks, particularly the internet. Consulting company Accenture (www.accenture.com) maintains that groups of well-organized criminal organizations have taken control of a global billion-dollar crime

cybercrime Illegal activities executed on the internet.

network. The network, powered by skillful hackers, targets known software security weaknesses. These crimes are typically nonviolent; however, they are quite lucrative. Consider, for example, that losses from armed robberies average hundreds of dollars and those from white-collar crimes can average tens of thousands of dollars. In contrast, losses from computer crimes can average hundreds of thousands of dollars. Furthermore, computer crimes can be committed from anywhere in the world at any time, effectively providing an international safe haven for cybercriminals.

The fifth, and final, factor is lack of management support. For the entire organization to take security policies and procedures seriously, senior managers must set the tone. Unfortunately, they often do not do so. Ultimately, however, lower-level managers may be even more important. These managers are in close contact with employees every day and are therefore in a better position to determine whether employees are following security procedures.

IT's About Business 4.1

MIS Hospital for Sick Children (SickKids) Goes Code Grey

Code Grey is used to describe system failure. SickKids announced this code for its telephone lines and some of its network systems at 9:30 p.m. on Sunday, December 18, 2022. Hospital spokespersons stated that patient care was able to continue, but that the hospital had taken some of its websites and systems down and notified organizations it worked with of the cybersecurity incident.

The severity of the attack became clear as the hospital posted an update on December 22, saying that the affected systems could be down “for a prolonged time but patient care is continuing.” The hospital said it had prepared for such attacks and was using both experts and law enforcement in its response to the attack. A 4:30 p.m. update on the same announcement page talked about delays in “retrieving lab and imaging results” and the fact that physicians could not send prescriptions online and were using “downtime methods,” presumably manual ones, instead. The employee payroll system was also disrupted, so the hospital was using an “emergency recovery plan” to pay employees.

Chapters Indigo Followed on February 8, 2023

Initially, Chapters Indigo called its problem a “cybersecurity incident” that was affecting customer orders. It posted information on its website and on social media stating that customers could experience delays in shipments of orders that they had already placed. The online ordering system was not functioning on the website or in brick-and-mortar stores. Customers were asked to pay for all of their orders in person in stores using cash, since electronic payments could not be accepted. The company was unable to handle returns or accept gift cards either.

Repair and Rescue

On December 31, 2022, the Canadian Press accessed the dark web page where a ransomware group called LockBit makes its announcements. The U.S. FBI (Federal Bureau of Investigation) has described this group as “one of the world’s most active and destructive.” An apology for the attack on SickKids was posted, along with an offer to provide the hospital with a free decryption tool to get back (unlock) its data and its systems. At the same time, the ransomware group implied that it was not responsible for the attack, since it used the term “partner” for the person(s) responsible for attacking SickKids when it stated that it had blocked them.

The hospital sought expert advice to determine whether the offer was legitimate and whether it should use the decryption tool.

Brett Callow of Emsisoft, a Canadian anti-malware company, said that this was “the first time” he was aware of that LockBit had issued an apology and provided a free decryptor. At that time, SickKids had reported that it had restored more than 60 percent of its systems, without paying the perpetrators. On January 5, 2023, the hospital lifted the Code Grey, with about 80 percent of its systems functional, saying that it did not use the offered decryptor. Their announcement said that EMR (Electronic Medical Records) had not been affected or exposed and described the number of treatment delays as affecting a “small number of patients.”

Chapters Indigo was able to process debit and credit card sales (but not returns) at its stores after two days, but its website remained down. After working with third-party experts, the company confirmed on February 14, 2023, that customer debit and credit card information had not been compromised during the attack. It took until February 17 for the company to be able to handle returns at its stores. It also provided a website that allowed access to information but could not process transactions (it was browsable only). On March 1, the company stated that its systems had been hijacked by software known as LockBit, so the ransomware group is also known by the name of the software that it deploys. Indigo said it would not pay the ransom and took until March 8 to have a fully functional website operational again.

Along the way, it was Shopify that provided a new, temporary website for Indigo—within three days—that provided limited service (browsing and some sales). This shows us the power of collaboration with strong outsourcing organizations, discussed further in Chapter 13.

Statistics Canada’s report on the impact of cybercrime on Canadian business in 2021 stated that almost one-fifth (18 percent) of Canadian business were affected by cybercrime that year. The report said that Canadian businesses spent about \$9.7 billion on preventing or detecting cybersecurity problems, \$2.8 billion more than in 2019. Companies that were affected by downtime were down an average of 36 hours, and reported other types of problems, such as either longer time required or a complete inability of employees to complete their work, as well as loss of revenue. Ransom payments, described in the report as “dollars to recover,” were reported as totalling over \$600 million in 2021, up from \$400 million in 2019. Experts believe that the amount paid to recover data is under-reported.

The high volume of ransomware and other cybersecurity crimes has resulted in significant law enforcement efforts, with some results. For example, a Russian-Canadian from Bradford, Ontario, was charged in November 2022 and later granted bail. At

the same time, his laptop was seized before he was able to lock it. The arrest was part of an international investigation that had been ongoing for almost three years into LockBit global ransomware operations.

Questions

1. Ransomware groups steal data, including employee, client, and patient data. They then post the data available for sale. Is there an ethical difference between attacking the information systems of a bookstore versus a children's hospital? Why or why not?
2. Discuss the principle of data minimization (storing less data or only partial data) as it applies to the two breaches above.
3. Should Canada have strong protection laws for data relating to children? Why or why not? Support your answer.

Sources: Compiled from P. Evans, "Indigo Website Still Offline Nearly 1 Week after Cybersecurity Incident," *CBC News*, February 14, 2023, <https://www.cbc.ca/news/business/indigo-cyberattack-update-1.6747714>, accessed March 28, 2023; J. Fieguel, "SickKids Responding to Cybersecurity Incident That Has Affected the Hospital's Phone Lines," *CP24 Bell Media*, December 19, 2022, <https://www.cp24.com/news/sickkids-responding-to-cybersecurity-incident-that-has-affected-the-hospital-s-phone-lines-1.6201854>, accessed March 28, 2023; O. Mosieh, "SickKids Attack—and Apology—Pulls Ransomware's 'Robin Hood' into Spotlight," *Toronto Star*, January 5, 2023, <https://www.thestar.com/news/canada/2023/01/05/>

[sickkids-attack-and-apology-pulls-ransomwares-robin-hood-into-spotlight.html](#), accessed March 28, 2023; J. Omstead, "Ransomware Group LockBit Apologizes, Saying 'Partner' Was behind SickKids Attack," *CTV News*, January 2, 2023, <https://toronto.ctvnews.ca/ransomware-group-lockbit-apologizes-saying-partner-was-behind-sickkids-attack-1.6214906>, accessed March 28, 2023; M. Orsilides, "Alleged Russian Hacker from Bradford Granted Bail," *CTB News*, January 31, 2023, <https://barrie.ctvnews.ca/alleged-russian-hacker-from-bradford-granted-bail-1.6253902>, accessed March 28, 2023; J. Scott, "Shopify Built Indigo's New Website in Three Days Following Ransomware Attack," *betakit*, February 27, 2023, <https://betakit.com/shopify-built-indigos-new-website-in-three-days-following-ransomware-attack/>, accessed March 28, 2023; The Hospital for Sick Children, "Update on SickKids Response to Cybersecurity Incident," December 22, 2022, <https://www.sickkids.ca/en/news/archive/2022/update-on-sickkids-response-to-cybersecurity-incident/>, accessed March 28, 2023; The Hospital for Sick Children, "SickKids Lifts Code Grey with 80 Per Cent of Priority Systems Restored," January 5, 2023, <https://www.sickkids.ca/en/news/archive/2023/sickkids-lifts-code-grey-with-80-per-cent-of-priority-systems-restored/>, accessed March 28, 2023; Statistics Canada, "Impact of Cybercrime on Canadian Businesses, 2021," <https://www150.statcan.gc.ca/n1/daily-quotidien/221018/dq221018b-eng.htm>, accessed March 28, 2023; The Canadian Press, "Indigo Says 'Cybersecurity Incident' Has Impacted Online Orders, Electronic Payments," *Global News*, February 8, 2023, <https://globalnews.ca/news/9473548/indigo-cybersecurity-incident/>, accessed on: March 27, 2023; The Canadian Press, "Timeline of the Ransomware Attack against Canadian Bookstore Retailer Indigo," *CTV News*, March 8, 2023, <https://www.ctvnews.ca/business/timeline-of-the-ransomware-attack-against-canadian-bookstore-retailer-indigo-1.6304258>, accessed March 28, 2023.

Before you go on...

1. Define information security.
2. Differentiate among a threat, an exposure, and a vulnerability.
3. Why are the skills needed to be a hacker decreasing?

4.2 Unintentional Threats to Information Systems

LEARNING OBJECTIVE

Compare and contrast human mistakes and social engineering and provide a specific example of each one.

Information systems are vulnerable to many potential hazards and threats, as you can see in [Figure 4.1](#). The two major categories of threats are unintentional threats and deliberate threats. This section discusses unintentional threats, and the next section addresses deliberate threats.

Unintentional threats are acts performed without malicious intent that nevertheless represent a serious threat to information security. A major category of unintentional threats is human error.

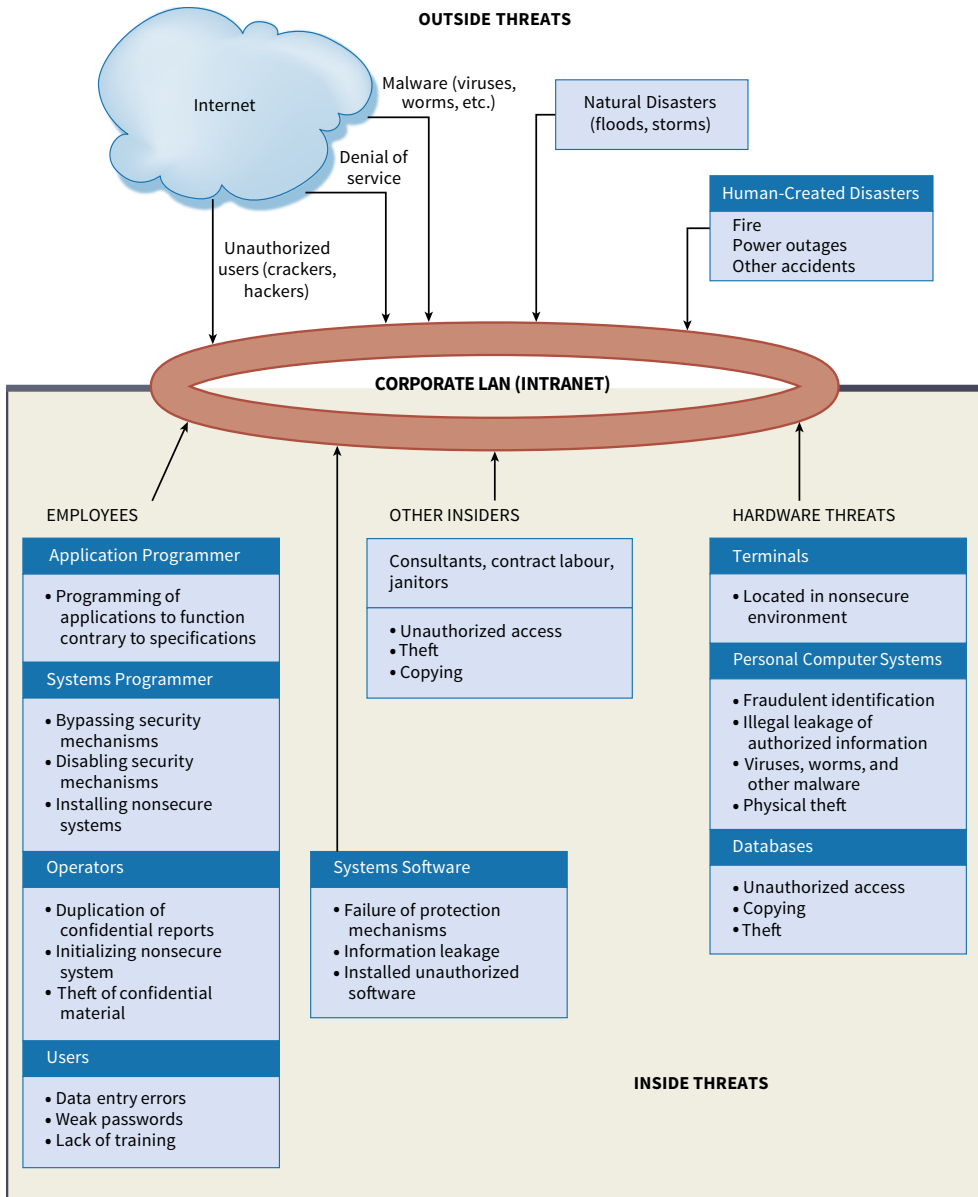


FIGURE 4.1 Security threats.

Human Errors

HRM Organizational employees span the breadth and depth of the organization, from mail clerks to the CEO, across all functional areas. There are two important points to be made about employees. First, the higher the level of the employee, the greater the threat they pose to information security. This is true because higher-level employees typically have greater access to corporate data and enjoy greater privileges on organizational information systems. Second, employees in two areas of the organization pose especially significant threats to information security: human resources and information systems. Human resources employees generally have access to sensitive personal information about all employees. Likewise, IS employees not only have access to sensitive organizational data, but they also frequently control the means to create, store, transmit, and modify those data. Consider these two examples.

- MIS

POM

For 10 years, a Siemens contractor created spreadsheets that the company used to manage equipment orders. The spreadsheets contained custom macros that enabled Siemens to automate inventory and order management. The contractor embedded logic bombs that would trigger after a certain date and crash the spreadsheets. Each time the spreadsheets would crash, Siemens would call him and he would “fix the problem” for a fee.

The scheme fell apart when the contractor was out of town and had to give his password for the spreadsheets to Siemens IT staff so that they could use the spreadsheets to fill an urgent order. They found the logic bombs and the police arrested the contractor.
- MKT

A marketing and software company in the United Kingdom terminated an IT employee. After he left, he could still access the company’s systems because he had stolen a fellow employee’s login credentials. He then deleted each of the firm’s 23 Amazon Web Services servers. As a result, the firm said that it lost “big contracts with some clients” totalling about \$700,000. The perpetrator was sentenced to two years in prison.

Other relevant employees include contract labour, consultants, and janitors and guards. Contract labour, such as temporary hires, may be overlooked in information security arrangements. However, these employees often have access to the company’s network, information systems, and information assets. Consultants, although technically not employees, perform work for the company. Depending on the nature of their work, they may also have access to the company’s network, information systems, and information assets.

Finally, janitors and guards are the most frequently ignored people in information security systems. Companies frequently outsource their security and janitorial services. As with contractors, then, these individuals work for the company although they are technically not employees. Moreover, they are usually present when most—if not all—other employees have gone home. They typically have keys to every office, and nobody questions their presence in even the most sensitive parts of the building. In fact, an article from *2600: The Hacker Quarterly* (www.2600.com) described how to get a job as a janitor for the purpose of gaining physical access to an organization.

Human errors or mistakes by employees pose a serious problem. These errors are typically the result of laziness, carelessness, or lack of awareness concerning information security. This lack of awareness arises from poor education and training efforts by the organization. Human mistakes manifest themselves in many different ways, as illustrated in [Table 4.1](#).

TABLE 4.1
Human Mistakes

Human Mistake	Description and Examples
Carelessness with computing devices (e.g., laptops, tablets, smartphones)	Losing or misplacing devices, leaving them in taxis or in other public places. Also includes using them carelessly so that malware is introduced into an organization’s network.
Opening questionable emails	Opening emails from someone unknown, or clicking on links embedded in emails (see <i>phishing attack</i> in Table 4.2).
Careless internet surfing	Accessing questionable websites; can result in malware and alien software being introduced into the organization’s network.
Poor password selection and use	Choosing and using weak passwords (see <i>strong passwords</i> in the “Authentication” section later in this chapter).
Carelessness with one’s office	Leaving desks and filing cabinets unlocked when employees go home at night; not logging off the company network when leaving the office for any extended period of time.
Carelessness using unmanaged devices	Unmanaged devices are those outside the control of an organization’s IT department and company security procedures. These devices include computers belonging to customers and business partners, computers in the business centres of hotels, libraries, or other public shared equipment.
Carelessness with discarded equipment	Discarding old computer hardware and devices without completely wiping the memory; includes computers, smartphones, digital copiers, and printers.
Careless monitoring of environmental hazards	These hazards, which include dirt, dust, humidity, and static electricity, are harmful to the operation of computing equipment.

The human errors you have just studied, although unintentional, are committed entirely by employees. However, employees can also make mistakes in response to actions by an attacker. Attackers often employ social engineering to induce individuals to make mistakes and disclose sensitive information.

Social Engineering

Social engineering is an attack in which the perpetrator uses social skills to trick or manipulate legitimate employees into providing confidential company information such as passwords. The most common example of social engineering occurs when the attacker impersonates someone else on the telephone, such as a company manager or an IS employee. The attacker claims they forgot their password and asks the legitimate employee to give them a password to use. Other common ploys include posing as an exterminator, an air conditioning technician, or a fire marshal. Examples of social engineering abound.

In one company, a perpetrator entered a company building wearing a company ID card that looked legitimate. He walked around and put up signs on bulletin boards reading “The help desk telephone number has been changed. The new number is 555-1234.” He then exited the building and began receiving calls from legitimate employees thinking they were calling the company help desk. Naturally, the first thing the perpetrator asked for was each caller’s username and password. He now had the information necessary to access the company’s information systems.

Two other social engineering techniques are tailgating and shoulder surfing. *Tailgating* is a technique designed to allow the perpetrator to enter restricted areas that are controlled with locks or card entry. The perpetrator follows closely behind a legitimate employee and, when the employee gains entry, the attacker asks them to “hold the door.” *Shoulder surfing* occurs when a perpetrator watches an employee’s computer screen over their shoulder. This technique is particularly successful in public areas such as in airports and on commuter trains and airplanes.

social engineering Getting around security systems by tricking computer users inside a company into revealing sensitive information or gaining unauthorized access privileges.

Before you go...

1. What is an unintentional threat to an information system?
2. Provide examples of social engineering attacks other than the ones just discussed.

4.3 Deliberate Threats to Information Systems

LEARNING OBJECTIVE

Discuss the 10 types of deliberate attacks.

There are many types of deliberate threats to information systems. We provide a list of 10 common types for your convenience:

1. Espionage or trespass
2. Information extortion
3. Sabotage or vandalism
4. Theft of equipment or information
5. Identity theft

6. Compromises to intellectual property
7. Software attacks
8. Alien software
9. Supervisory control and data acquisition (SCADA) attacks
10. Cyberterrorism and cyberwarfare

Espionage or Trespass

Espionage or trespass occurs when an unauthorized individual attempts to gain illegal access to organizational information. It is important to distinguish between competitive intelligence and industrial espionage. Competitive intelligence consists of legal information-gathering techniques, such as studying a company's website and press releases, attending trade shows, and similar actions. In contrast, industrial espionage crosses the legal boundary such as by theft of confidential data.

Information Extortion

Information extortion occurs when an attacker either threatens to steal, or actually steals, information from a company. The perpetrator demands payment for not stealing the information, for returning stolen information, or for agreeing not to disclose the information. An increasingly serious type of information extortion is ransomware.

ransomware (or digital extortion) Malicious software that blocks access to a computer system or encrypts an organization's data until the organization pays a sum of money.

Ransomware, or digital extortion, blocks access to a computer system or encrypts an organization's data until the organization pays a sum of money. Victims are told to pay the ransom, usually in Bitcoin. Attackers typically use the anonymizing Tor network (www.torproject.org).

Ransomware attacks are growing rapidly. In 2021, ransomware attacks extorted over US \$20 billion globally, with similar amounts estimated for 2022. As bad as these figures look, the reality is probably worse. Experts estimate that fewer than 25 percent of ransomware attacks are reported. Significantly, security analysts note that over half of the companies compromised by ransomware pay the ransom.

Methods of Attack Most commonly, ransomware attacks use spear phishing and whaling attacks. These emails are carefully tailored to look as convincing as possible, so they appear no different from any other email the victim might receive.

Some ransomware developers distribute ransomware to any hacker who wants to use it. This process is called *ransomware-as-a-service*. In this type of ransomware, the original creators publish the software on the Dark Web, allowing other criminals to use the code in return for receiving 40 to 50 percent of each ransom paid.

Rather than threatening to delete encrypted data, some cybercriminals are beginning to threaten to release it to the public, a strategy known as *doxing*. For organizations that deal with private and sensitive customer data, such as financial services, hospitals, and law firms, such attacks can have severe consequences. In addition to the impact on brand reputation, privacy laws require customer notifications and other activities that can quickly total hundreds of thousands of dollars. Compared to other industry segments, personal health information is 50 times more valuable than financial information on the Dark Web.

The Costs of Ransomware Direct costs are the ransom payment. Indirect costs include the cost of recovering files from backup and restoring encrypted systems, business interruption, loss of reputation, liability (lawsuits), loss of data, investments in additional cybersecurity software, additional staff training, and increased cyber insurance (particularly covering ransomware attacks).

Protection against Ransomware There are many steps that an organization can take to protect itself against ransomware infections.

- Perhaps most importantly, all organizations must provide education and training so that users are aware of phishing, spear phishing, and whaling attacks and do not click on any suspicious emails or links in emails.
- Organizations must install the latest versions of software and apply patches immediately.
- Organizations must back up crucial data and information often, preferably through an encrypted cloud-based storage company or an online backup service. Examples are iDrive (www.idrive.com) and Carbonite (www.carbonite.com). Important: the backup data storage must be connected to your system only when you are actually backing up the data.
- Organizations should employ *anti-ransomware software*. Packages such as Acronis Ransomware Protection (www.acronis.com) and Malwarebytes Anti-Ransomware Beta (www.malwarebytes.com) use two methods to defeat ransomware. First, they detect the digital signatures of known malware to recognize it in future. This approach does not work if the software has not yet encountered a particular type of malware. Second, they detect malware by its behaviour. These programs monitor the activity of apps, and they quarantine processes that perform suspicious actions, such as generating an encryption key or starting to encrypt files. This method is more effective at detecting and stopping ransomware than simply searching for malware signatures because it can detect new threats as well as known ones.
- Organizations should utilize the *No More Ransom* initiative (www.nomoreransom.org). The portal, founded by the Netherlands police's National High Tech Crime Unit, Europol's European Cybercrime Centre, and cybersecurity companies Kaspersky and McAfee, launched in 2016 and today involves 188 partners in law enforcement, cybersecurity companies, academia, and other fields. The portal is available in 37 languages.

As of March 2023, the portal offered 136 free ransomware decryption tools which can decrypt 165 ransomware families. No More Ransom has helped over six million ransomware victims recover their encrypted files at no charge. To date, the portal has saved victims from paying over \$1 billion.

The portal also offers information and advice on how to avoid falling victim to ransomware as well as free decryption tools for various types of ransomware to help victims retrieve their encrypted data. The portal is updated as often as possible to ensure that tools are available to fight the latest forms of ransomware. The portal's Crypto Sheriff app allows users to upload encrypted files to help identify which form of ransomware they have fallen victim to and then directs them to a free decryption tool if one is available.

- Organizations should also be aware that individual security companies regularly release decryption tools to counter the ongoing evolution of ransomware. Many of these companies post updates about these tools on their company blogs as soon as they have cracked the malware's code.

IT's About Business 4.2 discusses a successful ransomware attack against Colonial Pipeline

IT's About Business 4.2

The Colonial Pipeline Hack

On January 11, 2021, antivirus company Bitdefender announced that it had discovered an error in the ransomware that an entity known as DarkSide was using to attack businesses in the United States and Europe. Bitdefender then provided companies facing ransom demands from DarkSide with a free tool they could download to avoid paying millions of dollars to the hackers.

Unfortunately, by publicizing its tool, Bitdefender alerted DarkSide to the error, which involved reusing the same digital keys to lock and unlock multiple victims. The next day, DarkSide

announced that it had repaired the flaw and thanked Bitdefender for "helping us fix our issues."

The following May, DarkSide successfully attacked Colonial Pipeline (www.colpipe.com), the largest pipeline system for refined oil products in the United States. The pipeline is 5,500 miles (8,900 km) long, and it can carry 3 million barrels of fuel per day between Texas and New York, which is nearly half the fuel for the East Coast.

Attackers accessed Colonial's network through an exposed password for a VPN (virtual private network) account. A Colonial employee probably used the same password for the VPN at a

different location. That password became compromised in a different data breach. The attackers infected some of the company's digital systems, shutting down its pipeline for several days.

The Colonial hack was the largest publicly disclosed cyber-attack against vital infrastructure in U.S. history. It consisted of multiple stages that targeted the company's IT systems.

The attack began when DarkSide hacked into Colonial's network. The attackers stole 100 gigabytes of data in two hours. They then infected the company's network with ransomware that impacted many computer systems, including billing and accounting. Fortunately, the pipeline's operational technology systems that actually move the oil were not directly compromised.

To prevent the ransomware from spreading, Colonial shut down its pipeline. It then engaged cybersecurity firm Mandiant (www.mandiant.com) to investigate the attack. Colonial also informed the FBI, Cybersecurity and Infrastructure Security Agency, U.S. Department of Energy, and Department of Homeland Security about the incident.

The attack caused significant and immediate impacts. For example, many carriers in the airline industry experienced a jet fuel shortage. Some airports, including Atlanta and Nashville, also experienced disruptions.

In addition, fear of a gas shortage caused panic buying and long lines at gas stations in many states, particularly in the Southeast. Prices at gas pumps also jumped. In some areas, panic buying led to shortages as consumers purchased more gasoline than usual. Finally, the attack was classified as a national security threat because the pipeline transports oil from refineries to industry markets. As a result, on May 9, President Biden declared a state of emergency.

In addition to its impacts on the nation's fuel supplies, the attack compromised nearly 6,000 people's personal information most of them were past or present Colonial employees and their relatives. The hackers gained access to records including names, contact information, birth dates, social security numbers, driver's licence and military ID numbers, and health insurance information. On May 7, DarkSide demanded a ransom of 75 Bitcoins, which was worth approximately US \$4.4 million.

Colonial CEO Joseph Blount stated that, when DarkSide issued the ransom demand, it was not clear how widespread the intrusion was or how long it would take Colonial to restore the compromised systems. Colonial paid the ransom in hopes of speeding up its recovery time. The company restarted its pipeline operations on May 12.

Bitcoin is a cryptocurrency that is commonly used by ransomware attackers due to the mistaken belief that it cannot be traced. In fact, users must have a digital wallet to hold Bitcoins. The U.S. Department of Justice (DOJ) was able to find the digital address of the wallet that the Colonial attackers had used. It then obtained a court order to seize the Bitcoins. In a June 7 press conference, Deputy Attorney General Lisa Monaco announced that the DOJ's Ransomware and Digital Extortion Task Force had traced the ransom paid by Colonial. The operation recovered 64 of the 75 Bitcoins that Colonial had paid. At the time of the recovery, the 64 Bitcoins were worth approximately US \$2.4 million.

Court documents released by the DOJ revealed that the FBI followed the Bitcoin public ledger to an address that received two payments on May 8 totalling 75 Bitcoins. The FBI then accessed

the funds by using the private key linked to the Bitcoin address. The FBI did not specify how it obtained the key or why it did not recover the full ransom amount.

After the attack, DarkSide announced on its website that future attacks "would avoid social consequences." Soon afterward, DarkSide publicly shut down its operations. It then reappeared under the name BlackMatter, which soon shut down as well. A new ransomware group, called BlackCat or ALPHV, then appeared. Authorities believe that BlackCat is operated by the same people who created DarkSide and BlackMatter.

Questions

1. Why has ransomware become such a serious global problem? (Hint: What is a so-called "victimless crime"?)
2. You are the CEO of a company that has just experienced a ransomware attack. Discuss all the variables you would consider in your decision whether to pay the ransom. (Hints: Consider the amount and type of data stolen, and the amount of ransom demanded.)
3. Would you consider the Colonial Pipeline attack to also be a SCADA attack (see the section on SCADA attacks later in this chapter)? Why or why not? Support your answer.
4. Would you consider the Colonial Pipeline attack to also be a supply chain attack? Why or why not? Support your answer. (Hint: Look ahead to Chapter 11 for a description of supply chains.)

Sources: Compiled from N. Wasson, "Ransomware Gang behind Colonial Pipeline Attack Claims Another Major Victim," *HotHardware*, August 2, 2022; M. Kapko, "Luxembourg Supplier Encevo Hit by Ransomware Attack," *Cybersecurity Dive*, August 1, 2022; S. Kerner, "Colonial Pipeline Hack Explained: Everything You Need to Know," *TechTarget*, April 26, 2022; "Reward Offers for Information to Bring DarkSide Ransomware Variant Co-Conspirators to Justice," *U.S. Department of State Press Release*, November 4, 2021; B. Fung, "Colonial Pipeline Says Ransomware Attack Also Led to Personal Information Being Stolen," *CNN Business*, August 16, 2021; D. Uberti, "How the FBI Got Colonial Pipeline's Ransom Money Back," *The Wall Street Journal*, June 11, 2021; A. Culafi, "Mandiant: Compromised Colonial Pipeline Password Was Reused," *TechTarget*, June 9, 2021; K. Benner and N. Perlroth, "U.S. Seizes Share of Ransom from Hackers in Colonial Pipeline Attack," *The New York Times*, June 8, 2021; A. Waldman, "FBI Seized Colonial Pipeline Ransom Using Private Key," *TechTarget*, June 8, 2021; R. Dudley and D. Golden, "The Colonial Pipeline Ransomware Hackers Had a Secret Weapon: Self-Promoting Cybersecurity Firms," *Wired*, May 24, 2021; L. Manfredi, "Colonial Pipeline Hacker DarkSide Reaped \$90M from 47 Victims," *Fox News*, May 18, 2021; K. Lyons, "Colonial Pipeline Says Operations Back to Normal Following Ransomware Attack," *The Verge*, May 15, 2021; L. Newman, "Colonial Pipeline Paid a \$5M Ransom—and Kept a Vicious Cycle Turning," *Wired*, May 14, 2021; W. Englund and E. Nakashima, "Panic Buying Strikes Southeastern United States as Shuttered Pipeline Resumes Operations," *The Washington Post*, May 12, 2021; S. Nichols, "Colonial Pipeline Runs Dry Following Ransomware Attack," *TechTarget*, May 10, 2021; M. Russon, "U.S. Fuel Pipeline Hackers 'Didn't Mean to Create Problems'," *BBC News*, May 10, 2021; www.colpipe.com, accessed August 7, 2022.

Sabotage or Vandalism

Sabotage and vandalism are deliberate acts that involve defacing an organization's website, potentially damaging the organization's image and causing its customers to lose faith. One form of online vandalism is a hacktivist or cyberactivist operation. These are cases of high-tech civil disobedience to protest the operations, policies, or actions of an organization or government agency. For example, on February 25, 2022, Twitter accounts associated with Anonymous, a decentralized hacktivist movement, stated that they had launched cyberoperations against the Russian Federation in retaliation for the invasion of Ukraine.

The group temporarily disabled the website of the Russian Defence Ministry along with other state-owned websites. Anonymous also leaked 200 gigabytes of emails from a Belarusian weapons manufacturer which provided logistical support for Russian in the invasion of Ukraine. Anonymous also hacked into Russian television channels and played Ukrainian music through them and showed uncensored news of events in the Ukraine.

Theft of Equipment or Information

Computing devices and storage devices are becoming smaller yet more powerful with vastly increased storage. Common examples are laptops, iPads, smartphones, digital cameras, thumb drives, and iPods. As a result, these devices are becoming easier to steal and easier for attackers to use to steal information. In fact, not all attacks on organizations involve sophisticated software.

Table 4.1 points out that one type of human mistake is carelessness with laptops and other small computers such as tablets and, particularly, smartphones. In fact, many computing devices have been stolen because of such carelessness. The cost of a stolen device includes the loss of data, the loss of intellectual property, device replacement, legal and regulatory costs, investigation fees, and lost productivity.

One form of theft, known as *dumpster diving*, involves rummaging through commercial or residential trash to find discarded information. Paper files, letters, memos, photographs, IDs, passwords, credit cards, and other forms of information can be found in dumpsters. Unfortunately, many people never consider that the sensitive items they throw in the trash might be recovered and used for fraudulent purposes.

Dumpster diving is not necessarily theft, because the legality of this act varies. Because dumpsters are usually located on private premises, dumpster diving is illegal in some parts of the country. Even in these cases, however, these laws are enforced with varying degrees of rigour.

Identity Theft

Identity theft is the deliberate assumption of another person's identity, usually to gain access to their financial information or to frame them for a crime. Techniques for illegally obtaining personal information include the following:

- Stealing personal data in computer databases
- Infiltrating organizations that store large amounts of personal data; for example, data aggregators such as Acxiom (www.acxiom.com)
- Impersonating a trusted organization in an electronic communication (phishing)
- Stealing mail or dumpster diving

The Office of the Privacy Commissioner of Canada provides instructions for businesses and individuals to help reduce their risk of identity theft (see <https://www.priv.gc.ca/en/privacy-topics/identities/identity-theft/>). Additional information and articles are also available at the Better Business Bureau website (www.bbb.org).

identity theft Crime in which someone uses another person's personal information to create a false identity and then uses it fraudulently.

Consider this identity-theft scheme launched in May 2020. With 40 million Americans filing for jobless benefits as a result of the COVID-19 pandemic, criminals targeted outdated computer systems in some state unemployment offices. A Nigerian crime ring called Scattered Canary used stolen password data and Social Security numbers to file false unemployment claims in Washington and several other states.

The criminals stole approximately US \$650 million from Washington. When the state detected the breach in June 2020, officials were able to recover US \$333 million of the money. The damage was so extensive that the state used its National Guard to examine nearly 200,000 claims for fraud.

In Toronto, Sanjay Madan was charged and convicted for creating over 43,000 fictitious applications to steal close to \$10 million from the Ontario government's 2020 Support for Families fund early in the pandemic. Under the guise of rushing applications through, Madan talked IT employees into circumventing controls and assisting with the processing of false applications. He even hired an employee in India to assist. Apparently, the fraud was first detected by his bank. Charges ensnared his family and revealed poor controls at the iAccess Solutions branch of the Ministry of Education in Ontario. This was not strictly identity theft, since false names and addresses were used in the scheme.

Recovering from identity theft is costly, time-consuming, and burdensome. Victims also report problems in obtaining credit and obtaining or holding a job, as well as adverse effects on insurance rates or credit ratings. They also state that it is often difficult to remove negative information from their records, such as their credit reports.

Compromises to Intellectual Property

Protecting intellectual property is a vital issue for people who make their livelihood in knowledge fields. **Intellectual property** is the property created by individuals or corporations that is protected under trade secret, patent, and copyright laws.

A **trade secret** is an intellectual work, such as a business plan, that is a company secret and is not based on public information. An example is the formula for Coca-Cola. A **patent** is an official document that grants the holder exclusive rights on an invention or a process for a specified period of time. **Copyright** is a statutory grant that provides the creators or owners of intellectual property with ownership of the property, also for a designated period. Current U.S. and Canadian laws award patents for 20 years and copyright protection for the life of the creator plus 70 years. (Canada used to have copyright protection for 50 years but it was extended to 70 years in 2022 align with countries like the United States and Mexico.) Owners are entitled to collect fees from anyone who wants to copy their creations. It is important to note that these are definitions under each country's laws. There is some international standardization of copyrights and patents, but it is far from total. Therefore, there can be differences between Canadian law and other countries' laws.

The most common intellectual property related to IT deals with software. However, copyright law does not protect fundamental concepts, functions, and general features such as pull-down menus, colours, and icons. Under copyright law, copying a software program without making payment to the owner—including giving a disk to a friend to install on their computer—is a copyright violation. Not surprisingly, this practice, called **piracy**, is a major problem for software vendors. The global trade in pirated software amounts to billions of dollars per year.

Software Attacks

Software attacks have evolved since the early years of the computer era, when attackers used malicious software—called **malware**—to infect as many computers worldwide as possible, to the profit-driven, Web-based attacks of today. Modern cybercriminals use sophisticated, blended malware attacks, typically through the Web, to make money.

Software attacks target all internet-connected devices, even smart televisions. As increasing numbers of Internet of Things devices (see Chapter 8) are installed, they provide billions of new targets for cybercriminals to target. As a result, hackers could hold your connected

intellectual property The intangible property created by individuals or corporations, which is protected under trade secret, patent, and copyright laws.

trade secret Intellectual work, such as a business plan, that is a company secret and is not based on public information.

patent A document that grants the holder exclusive rights to an invention or process for a specified period of time, currently 20 years.

copyright A grant from a governmental authority that provides the creator of intellectual property with ownership of it for a specified period of time, currently the life of the creator plus 70 years.

piracy Copying a software program (other than freeware, demo software, etc.) without making payment to the owner.

malware Malicious software such as viruses and worms.

home or connected car hostage. There is even the potential that hackers could infect medical devices, thereby putting lives directly at risk.

Table 4.2 displays a variety of software attacks. These attacks are grouped into three categories: remote attacks requiring user action, remote attacks requiring no user action, and software attacks initiated by programmers during the development of a system.

Not all cybercriminals are sophisticated, however. For example, a student at a U.S. university was sentenced to one year in prison for using keylogging software (discussed later in

TABLE 4.2 Types of Software Attacks

Type	Description
<i>Remote Attacks Requiring User Action</i>	
Virus	Segment of computer code that performs malicious actions by attaching to another computer program.
Polymorphic virus	Segment of computer code that modifies itself (i.e., changes its computer code) to avoid detection by anti-malware systems, while keeping the same functionality.
Worm	Segment of computer code that performs malicious actions and will replicate, or spread, by itself (without requiring another computer program).
Phishing attack	Uses deception to acquire sensitive personal information by masquerading as official looking emails or instant messages.
Spear phishing attack	Targets large groups of people. The attackers find out as much information as they can about an individual, tailoring their attacks to improve their chances that they will, and obtain sensitive, personal information.
Whaling attack	Phishing attack that targets specific high-value individuals such as senior executives in an attempt to steal sensitive information from a company such as financial data or personal details about employees.
Smishing attack	A phishing attack carried out over mobile text message. Also known as Short Message Service phishing.
Vishing attack	Short for “voice phishing,” these attacks attempt to defraud people over the phone.
<i>Remote Attacks Needing No User Action</i>	
Denial-of-service attack	An attacker sends so many information requests to a target computer system that the target cannot manage them successfully and typically ceases to function (crashes).
Distributed denial-of-service attack	An attacker first takes over many computers, typically by using malicious software. These computers are called <i>zombies</i> or bots . The attacker uses these bots—which form a botnet —to deliver a coordinated stream of information requests to a target computer, causing it to crash.
<i>Attacks by a Programmer Developing a System</i>	
Trojan horse	Software programs that hide in other computer programs and reveal their designed behaviour only when they are activated.
Back door	Typically a password, known only to the attackers, that allows then to access a computer system at will, without having to go through any security procedures (also called a <i>trap door</i>).
Logic bomb	A segment of computer code that is embedded within an organization’s existing computer programs and is designed to activate and perform a destructive action under specific conditions, such as at a certain time or date.

bots A computer that has been compromised by, and is under the control of, a hacker.

botnet A network of computers that have been compromised by, and are under the control of, a hacker, who is called the botmaster.

this chapter) to steal 750 fellow students' passwords and vote himself and four of his fraternity brothers into the student government's president and four vice president positions. The five positions would have brought the students a combined US \$36,000 in stipends.

The student was caught when university security personnel noticed strange activity on the campus network. Authorities identified the computer used in the activity from its IP address. On this computer, which belonged to the student in question, authorities found a PowerPoint presentation detailing the scheme. Authorities also found research on his computer, with queries such as "how to rig an election" and "jail time for keylogger."

Once the university caught on to the scheme, the student reportedly turned to hacking yet again to try to get himself out of trouble. He created new Facebook accounts in the names of actual classmates, going as far as conducting fake conversations between the accounts to try to deflect the blame. Those actions contributed to the one-year prison sentence, which the judge imposed even after the student pleaded guilty and requested probation.

Data can also be stolen without informing the organization and then posted on the Dark Web for sale. For example, the CFIB (Canadian Federation of Independent Business), did not know that its data had been stolen in late 2022 until contacted by a journalist who stated that data from the CFIB had been posted on a "criminal marketplace" with names, addresses, email addresses, and mobile phone numbers. On March 16, 2023, ITbusiness.ca reported that 972,235 CFIB records were offered on December 29, 2022. In response, the CFIB said that it was investigating the situation, and that the data appeared to be old sales leads rather than current database data.

Alien Software

alien software Clandestine software that is installed on your computer through duplicitous methods.

adware Alien software designed to help pop-up advertisements appear on your screen.

spyware Alien software that can record your keystrokes or capture your passwords.

Many personal computers have alien software, or pestware, running on them that the owners are unaware of. **Alien software** is clandestine software that is installed on your computer through duplicitous methods. It is typically not as malicious as viruses, worms, or Trojan horses, but it does use up valuable system resources. It can also enable other parties to track your Web surfing habits and other personal behaviours.

The vast majority of pestware is **adware**—software that causes pop-up advertisements to appear on your screen. Adware is common because it works. According to advertising agencies, for every 100 people who close a pop-up ad, three click on it. This "hit rate" is extremely high for internet advertising.

Spyware is software that collects personal information about users without their consent. Three common types of spyware are stalkerware, keystroke loggers, and screen scrapers.

Stalkerware is spyware used to monitor people close to the perpetrator. Victims typically do not know the stalkerware is on their device unless they run an antivirus scan. Developers of stalkerware market their apps as child safety or anti-theft tools. However, these apps can easily be used for the purpose of spying on a partner.

This software has powerful surveillance functions, including keylogging; making screenshots; monitoring internet activity; recording location; recording video and phone calls; and intercepting app communications made via Skype, Facebook, WhatsApp, and iMessage, as well as others. Most stalkerware apps are not available on official app stores. Installation does not necessarily require access to the victim's device. Rather, a perpetrator can send the intended victim an innocuous-seeming download, such as a picture.

Keystroke loggers, also called *keyloggers*, record both your individual keystrokes and your Web browsing history. The purposes range from criminal—for example, theft of passwords and sensitive personal information such as credit card numbers—to annoying—for example, recording your internet search history for targeted advertising.

Companies have attempted to counter keyloggers by switching to other forms of identifying users. For example, at some point, all of us have been forced to look at wavy, distorted letters and type them correctly into a box. That string of letters is called a *CAPTCHA*, and it is a test. The point of CAPTCHA is that computers cannot (yet) accurately read those distorted letters. Therefore, the fact that you can transcribe them means that you are probably not a software program run by an unauthorized person, such as a spammer. As a result, attackers have turned to *screen scrapers*, or *screen grabbers*. This software records a continuous "movie" of a screen's contents rather than simply recording keystrokes.

Spamware is pestware that uses your computer as a launch pad for spammers. **Spam** is unsolicited email, usually advertising for products and services. When your computer is infected with spamware, emails from spammers are sent to everyone in your email address book, but they appear to come from you.

Not only is spam a nuisance, but it wastes time and money. Spam costs companies around the world billions of dollars every year. These costs arise from productivity losses, clogged email systems, additional storage, user support, and antis spam software. Spam can also carry viruses and worms, making it even more dangerous.

A new tool from DoNotPay (www.donotpay.com) offers help in unsubscribing from email lists. To use most subscription management tools, such as Unroll.me, you have to grant the service access to your email account, so that it can analyze your messages. DoNotPay's antis spam service works differently. You just forward your spam emails to a designated email address and a bot (software robot) will automatically unsubscribe you from that mailing list. In that way, DoNotPay does not need access to your account and only sees emails that you want it to manage.

Going further, DoNotPay will check if there is currently a class action settlement against the organization that sent you the email. If there is, you can instruct DoNotPay to automatically claim any compensation for which you are eligible on your behalf. If your claim is successful, you will receive payment. DoNotPay is not involved in the payment transaction.

Cookies are small amounts of information that websites store on your computer, temporarily or more or less permanently. In many cases, cookies are useful and innocuous. For example, some cookies are passwords and user IDs that you do not want to retype every time you access the website that issued the cookie. Cookies are also necessary for online shopping because merchants use them for your shopping carts.

Tracking cookies, however, can be used to track your path through a website, the time you spend there, what links you click on, and other details that the company wants to record, usually for marketing purposes. Tracking cookies can also combine this information with your name, purchases, credit card information, and other personal data to develop an intrusive profile of your spending habits.

Most cookies can be read only by the party that created them. However, some companies that manage online banner advertising are, in essence, cookie-sharing rings. These companies can track information such as which pages you load and which ads you click on. They then share this information with their client websites, which may number in the thousands.

spamware Alien software that uses your computer as a launch platform for spammers.

spam Unsolicited email.

cookies Small amounts of information that websites store on your computer, temporarily or more or less permanently.

Supervisory Control and Data Acquisition (SCADA) Attacks

SCADA refers to a large-scale distributed measurement and control system. SCADA systems are used to monitor or to control chemical, physical, and transport processes such as those used in oil refineries, water and sewage treatment plants, electrical generators, and nuclear power plants. Essentially, SCADA systems provide a link between the physical world and the electronic world.

SCADA systems consist of multiple sensors, a master computer, and communications infrastructure. The sensors connect to physical equipment. They read status data such as the open/closed status of a switch or a valve, as well as measurements such as pressure, flow, voltage, and current. They control the equipment by sending signals to it, such as opening or closing a switch or a valve or setting the speed of a pump. The sensors are connected in a network, and each sensor typically has an internet address (Internet Protocol, or IP, address, discussed in Chapter 6). If attackers gain access to the network, then they can cause serious damage, such as disrupting the power grid over a large area or upsetting the operations of a large chemical or nuclear plant. Such actions could have catastrophic results. Consider these examples.

- In April 2022, Russian hackers targeted the Ukrainian power grid and attempted to cause a blackout that would have affected two million people. The hackers attempted to disable computers at a Ukrainian energy company, using malware specifically designed to damage targeted systems by erasing key data and rendering them useless. Ukrainian officials said that they successfully handled the attack, which they stated was intended to support Russian military operations in eastern Ukraine.

cyberterrorism A premeditated, politically motivated attack against information, computer systems, computer programs, and data that results in violence against noncombatant targets by subnational groups or clandestine agents.

cyberwarfare War in which a country's information systems could be paralyzed by a massive attack by destructive software.

- In October 2021, an employee of a water treatment plant in the city of Oldsmar, Florida, noticed that his mouse cursor was moving strangely and was not under his control. The cursor began clicking through the plant's controls. In just seconds, the intruder was attempting to change the water supply's levels of sodium hydroxide, also known as caustic soda, increasing the setting from 100 parts per million to 11,100 parts per million. In low concentrations, the chemical regulates the pH level of drinkable water. At high levels, it severely damages any human tissue that it touches. According to city officials, the operator noticed the intrusion and rapidly restored normal levels of sodium hydroxide.

Cyberterrorism and Cyberwarfare

Cyberterrorism and **cyberwarfare** refer to malicious acts in which attackers use a target's computer systems, particularly through the internet, to cause physical, real-world harm or severe disruption, often to carry out a political agenda. These actions range from gathering data to attacking critical infrastructure; for example, through SCADA systems. We treat the two types of attacks as synonymous here, even though cyberterrorism is typically carried out by individuals or groups, whereas cyberwarfare is carried out by nation-states or non-state actors such as terrorists.

Before you go on...

1. Why has the theft of computing devices become more serious over time?
2. What are the three types of software attacks?
3. Define alien software and explain why it is a serious problem.
4. What is a SCADA system? Why can attacks against SCADA systems have catastrophic consequences?

4.4 What Organizations Are Doing to Protect Information Resources

LEARNING OBJECTIVE

Describe the three risk mitigation strategies and provide an example of each one in the context of owning a home.

Why is stopping cybercriminals such a challenge? **Table 4.3** illustrates the many major difficulties involved in protecting information. Because organizing an appropriate defence system is so important to the entire enterprise, it is one of the major responsibilities of any prudent CIO as well as of the functional managers who control information resources. In fact, IT security is the business of *everyone* in an organization. As explained in Chapter 3, governments assist with such processes by implementing legislation, such as the anti-spam legislation that was passed in Canada in 2010 and came into force in 2014.

In addition to the problems listed in Table 4.3, another reason why information resources are difficult to protect is that the online commerce industry is not particularly willing to install safeguards that would make completing transactions more difficult or complicated. As one example, merchant systems could demand passwords or personal identification numbers for all credit card transactions. However, these requirements might discourage people from

TABLE 4.3 Difficulties in Protecting Information Resources**Hundreds of potential threats exist.**

Computing resources may be situated in many locations.

Many individuals control or have access to information assets.

Computer networks can be located outside the organization, making them difficult to protect.

Rapid technological changes make some controls obsolete as soon as they are installed.

Many computer crimes are undetected for a long time, so it is difficult to learn from experience.

People tend to violate security procedures because the procedures are inconvenient.

The amount of computer knowledge necessary to commit computer crimes is usually minimal. As a matter of fact, a potential criminal can learn hacking, free, from the internet.

The costs of preventing hazards can be very high. Therefore, most organizations simply cannot afford to protect themselves against all possible hazards.

It is difficult to conduct a cost-benefit justification for controls before an attack occurs because it is difficult to assess the impact of a hypothetical attack.

shopping online. For credit card companies, it is cheaper to block a stolen credit card and move on than to invest time and money prosecuting cybercriminals.

The final reason why information resources are difficult to protect is that it is extremely difficult to catch perpetrators. However, it is possible to catch attackers, albeit with great effort, time, and expense, as this chapter's closing case illustrates.

Organizations spend a great deal of time and money protecting their information resources. Before doing so, they engage in risk management.

A **risk** is the probability that a threat will impact an information resource. The goal of **risk management** is to identify, control, and minimize the impact of threats. In other words, risk management seeks to reduce risk to acceptable levels.

FIN The Enterprise Risk Management (ERM) framework guides risk management in the enterprise. ERM is a risk-based approach to managing an enterprise that integrates internal control, legal requirements, and strategic planning. ERM consists of several steps:

- Determine the relationship of risk to organizational goals.
- Differentiate between risks and opportunities.
- *Risk analysis*, which involves three steps: (1) assess the value of each asset being protected, (2) estimate the probability that each asset will be compromised, and (3) compare the probable costs of the asset's being compromised with the costs of protecting that asset. The organization then considers how to mitigate the risk.
- *Risk mitigation* has two functions: (1) implementing controls to prevent identified threats from occurring, and (2) developing a means of recovery if the threat becomes a reality. The three most common risk mitigation strategies are:
 1. *Risk acceptance*: Accept the potential risk, continue operating with no controls, and absorb any damages that occur.
 2. *Risk transference*: Transfer the risk by using other means to compensate for the loss, such as by purchasing insurance.
 3. *Risk limitation*: Limit the risk by implementing controls that minimize the impact of the threat.
- Implement controls.
- Evaluate the controls. The organization identifies security deficiencies and calculates the costs of implementing adequate control measures to compare against the value of those control measures. If the costs of implementing a control are greater than the value of the asset being protected, the control is not cost-effective. Organizations evaluate controls using auditing.

risk The likelihood that a threat will occur.

risk management A process that identifies, controls, and minimizes the impact of threats, in an effort to reduce risk to manageable levels.

Information Systems Auditing

Companies implement security controls to ensure that information systems function properly. These controls can be installed in the original system, or they can be added after a system is in operation. Installing controls is necessary but not sufficient to provide adequate security. People who are also responsible for security need to answer questions such as: Are all controls installed as intended? Are they effective? Has any breach of security occurred? If so, what actions are required to prevent future breaches?

These questions must be answered by independent and unbiased observers. Such observers perform the task of internal or external auditing, which includes *information systems auditing*. An audit involves the accumulation and evaluation of evidence that is used to prepare a report about the information or controls that are being examined, using established criteria and standards. An **information systems audit** is an evaluation and examination of management control systems for information systems, their inputs, outputs, and processing. It can also include an assessment of the efficiency and effectiveness of the system.

information systems audit

An evaluation and examination of management control systems for information systems, their inputs, outputs, and processing. It can also include an assessment of the efficiency and effectiveness of the system.

There are several types of auditors and audits. External auditors, also referred to as independent auditors, work at a public accounting firm, and audit primarily financial statements. Government auditors work for the provincial or federal auditors general's offices. Canada Revenue Agency auditors audit compliance with tax legislation. Internal auditors work for specific organizations and may have the Certified Internal Auditor (CIA) designation. Specialist auditors can be from a variety of fields. Information systems auditors, for example, may work for any of the previously mentioned organizations, and may have a Certified Information Systems Auditor (CISA) designation.

IS auditing is usually conducted as part of the controls evaluation for the financial statement audit or as part of *internal auditing*, which looks at systems' efficiency or effectiveness.

IS auditing is a broad topic, so we present only its essentials here. IS auditing focuses on topics such as operations, data integrity, software applications, security and privacy, budgets and expenditures, cost control, and productivity. Guidelines are available to assist auditors in their jobs, such as those from the Institute of Internal Auditors (IIA) (www.theiia.org), or the Information Systems Audit and Control Association (ISACA) (www.isaca.org).

Created by ISACA, COBIT 5 (Control Objectives for Information and related Technologies) provides an IT governance framework for developing IT security controls and for use during IS auditing. The framework's intent is to align IT with business objectives and assist in managing risk. The COBIT 5 framework is based on five principles, the first three of which apply most directly to security issues.

1. Meeting stakeholder needs: A system should be in place that addresses enterprise information security requirements and provides value. For example, the system should include metrics for the number of clearly defined key security roles and the number of security-related incidents reported.
2. Covering the enterprise end to end: A security plan should be accepted and communicated throughout the organization. This process includes the level of stakeholder satisfaction with the plan, the number of security solutions that are different from those in the plan, and the number of security solutions deviating from the enterprise security architecture that can lead to security gaps and possibly increase the time needed to resolve security or compliance issues.
3. Applying a single, integrated framework: Information security solutions are implemented throughout the organization. The solutions include the number of services and solutions that align with the security plan and security incidents caused by noncompliance with the security plan.
4. Enabling a holistic approach: Include all areas of the organization to support governance and management of IT, including security for systems based on assessed risk.
5. Separating governance from management: Governance and management have different responsibilities. Appropriate supportive structures to enable both effective management of IT security and its governance would be established.

Before you go on...

1. Identify and discuss several reasons why it is difficult to protect information resources.
2. Compare and contrast risk management and risk analysis.
3. Why is information systems auditing important?

4.5 Information Security Controls

LEARNING OBJECTIVE

Identify the three major types of controls that organizations can use to protect their information resources and provide an example of each one.

The purpose of **controls** or defence mechanisms (also called *countermeasures*) is to safeguard assets, optimize the use of the organization's resources, and prevent or detect errors or fraud. These controls are designed to protect all of the components of an information system, including data, software, hardware, and networks. Because there are so many diverse threats, organizations utilize layers of controls, or *defence-in-depth*. Controls are intended to prevent accidental hazards, deter intentional acts, detect problems as early as possible, enhance damage recovery, and correct problems.

Before you study controls in more detail, it is important to emphasize that the single most valuable control is user education and training. Effective and ongoing education makes every member of the organization aware of the vital importance of information security.

The most important category of controls is the control environment, and then general controls, followed by application controls. The **control environment** encompasses management attitudes toward controls, as evidenced by management actions, as well as by stated policies and procedures that address ethical issues and the quality of supervision. **General controls** apply to more than one functional area. For example, passwords are general controls. Controls specific to one application, such as payroll, are **application controls**. A typical payroll application control would be the approval of payroll wage rates by a human resources supervisor.

Information systems security encompasses all of the categories of controls, as organizations need to have security policies and procedures, to protect all applications using physical and software controls such as antivirus or firewalls, and to protect individual applications with controls over how information is entered and managed. *Security controls* are designed to protect all of the components of an information system, including data, software, hardware, and networks.

In this section, you will learn about three categories of general controls: physical controls, access controls, and communications controls. **Figure 4.2** illustrates these controls. Then, we will look at examples of application controls.

In addition to applying controls, organizations plan for business continuity in case of a disaster, and they periodically audit their information resources to detect possible threats. You will study these topics in this section as well.

Physical Controls

Physical controls prevent unauthorized individuals from gaining access to a company's facilities. Common physical controls include walls, doors, fencing, gates, locks, badges, guards, and alarm systems. More sophisticated physical controls include pressure sensors, temperature sensors, and motion detectors. One shortcoming of physical controls is that they can be inconvenient to employees.

controls Defence mechanisms (also called *countermeasures*). Actions used to safeguard assets, optimize the use of the organization's resources, and prevent or detect errors or fraud.

control environment Controls that encompass management attitudes toward controls, as evidenced by management actions, as well as by stated policies and procedures that address ethical issues and the quality of supervision.

general controls Controls that apply to more than one functional area.

application controls Security countermeasures that protect specific applications in functional areas.

physical controls Controls that restrict unauthorized individuals from gaining access to a company's computer facilities.

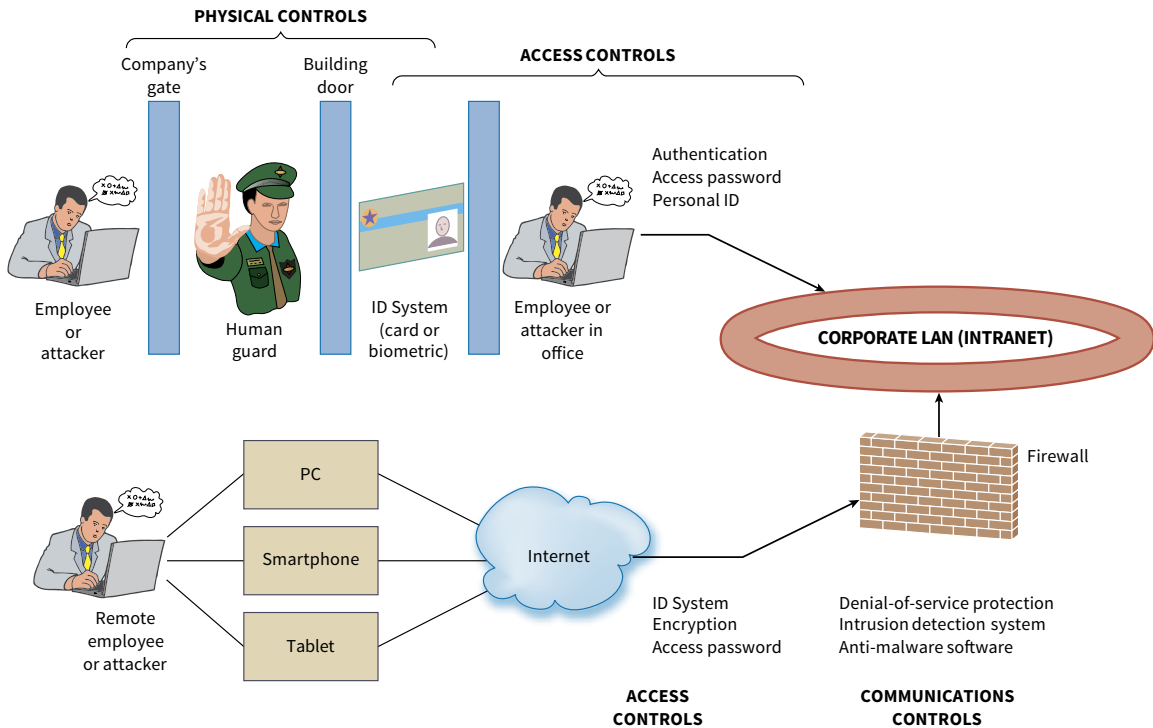


FIGURE 4.2 Where defence mechanisms are located.

Guards deserve special mention because they have very difficult jobs, for at least two reasons. First, their jobs are boring and repetitive and generally do not pay well. Second, if guards perform their jobs thoroughly, the other employees may harass them, particularly if they slow down the process of entering the facility.

Organizations also implement physical security measures in combination with access controls (discussed later in this section).

Business Continuity Planning, Backup, and Recovery

An important strategy for organizations is to be prepared for any eventuality. A critical element of any IT system is a *business continuity plan*, also known as a *disaster recovery plan*.

Business continuity planning is the chain of events linking planning to protection and to recovery. The purpose of the business continuity plan is to provide guidance to people who keep the business operating after a disaster occurs. Employees use this plan to prepare for, respond to, and recover from events that affect the security of information assets. The objective is to restore the business to normal operations as quickly as possible following an attack. The plan is intended to ensure that critical business functions continue.

In the event of a major disaster, organizations can employ several strategies for business continuity. These strategies include hot sites, warm sites, and cold sites and off-site data and program storage. A *hot site* is a fully configured computer facility with all of the company's services, communications links, and physical plant operations. A hot site duplicates computing resources, peripherals, telephone systems, applications, and workstations. A *warm site* provides many of the same services and options as a hot site. However, it typically does not include the actual applications the company needs. A warm site includes computing equipment such as servers, but it often does not include user workstations. A *cold site* provides only

business continuity planning

The chain of events linking planning to protection and to recovery.

rudimentary services and facilities, such as a building or a room with heating, air conditioning, and humidity control. This type of site provides no computer hardware or user workstations. Off-site storage means that the organization makes a duplicate copy of its data and software (including operating systems) so that it can be taken to another computer and used elsewhere.

Hot sites reduce risk to the greatest extent, but they are the most expensive option. Conversely, cold sites reduce risk the least, but they are the least expensive option. In addition to hot, warm, and cold sites, organizations also use off-site data storage services. Off-site data storage is a service that allows companies to store valuable data in a secure location geographically distant from the company's data centre.

In our online, fast-paced world, being “down” or unavailable for a short period of time can cause financial losses for organizations or upset customers. Being down longer, as occurred with Rogers, described in our opening case, can be disastrous or even life-threatening, such as for 9-1-1 services. These types of problems cannot be dealt with using hot sites or warm sites. There is no time to take all the equipment elsewhere. Instead, organizations implement redundancy: in other words, having duplicate servers or systems. Organizations also need to implement good quality controls for testing their programs to prevent systems going down because they are not functioning due to a program or maintenance error (as was the case for Rogers).

As our opening case illustrates, organizations need to consider infrastructure such as telecommunications as part of their business continuity plans. Even being able to process some transactions manually needs to be an option. If we move to a deeper level, even having electrical power backup is important to smoothly shut down systems to prevent database corruption. For example, SolvestInc. implemented and operates the northernmost BESS (Battery Energy Storage System) at Snowline Gold's “Forks” camp, situated on the Traditional Territory of the First Nation of Na-Cho Nyäk Dun; it is owned by Na-Cho Nyäk Dun Development Corporation (NNDDC) and leased to Snowline Gold. It uses solar power to charge the batteries and is projected to save over 12,000 litres of fuel per year.

Other BESS projects are planned. For example, on February 10, 2023, a cooperative project that involved the governments of Ontario, Canada, and the Six Nations of the Grand River was announced to build a 250 MW/1,000 MWh BESS. In 2020, Toronto Hydro opened a 2 MW/2 MWh BESS at the decommissioned Bulwer electrical substation in downtown Toronto.

Access Controls

Access controls restrict unauthorized individuals from using information resources. Access controls can be physical controls or logical controls. Both types restrict unauthorized individuals from using information resources. **Logical controls** are implemented by software. For example, access control programs limit users to acceptable login times and acceptable login locations. These controls can limit the number of unsuccessful login attempts and they require everyone to log off their computers when they leave for the day. In addition, computers are set to automatically log the user off after a certain period of disuse. Note that logical controls can be used for other purposes (such as checking calculations), not just for controlling access.

Access controls involve two major functions: authentication and authorization. **Authentication** confirms the identity of the person requiring access. After the person is authenticated (identified), the next step is authorization. **Authorization** determines which actions, rights, or privileges the person has, based on their verified identity. Good control systems limit authorization to tasks needed to accomplish a person's job. Let's examine these functions more closely.

Authentication To authenticate (identify) authorized personnel, an organization can use one or more of the following types of methods: something the user is, something the user has, something the user does, or something the user knows.

Something the user is, also known as **biometrics**, is an authentication method that examines a person's innate physical characteristics. There are many different types of biometrics, which include fingerprint scanning, palm prints, retinal scanning, iris scanning, analysis of heartbeats and body temperature, voice recognition, and facial recognition. Let's look at examples of how organizations use biometrics for authentication.

access controls Controls that restrict unauthorized individuals from using information resources and are concerned with user identification.

logical controls Controls that are implemented by software.

authentication A process that determines the identity of the person requiring access.

authorization A process that determines which actions, rights, or privileges the person has, based on verified identity.

biometrics The science and technology of authentication (i.e., establishing the identity of an individual) by measuring the subject's physiological or behavioural characteristics.

- **POM** Your voice changes as you age, becoming a little rougher each year. Nuance Communications Gatekeeper (www.nuance.com), a voice biometrics tool, analyzes the caller's voice "roughness" and other "micro-characteristics" that humans cannot hear to confirm that an older person is calling. Nuance customer Telefónica (www.telefonica.com/en) used the tool to help with increased contact centre volume during the COVID-19 pandemic. When the tool identifies an older person, the company routes them to priority customer service with shorter wait times and protocols to prevent fraudulent account takeover.
- **FIN** At Barclays Bank (www.barclays.co.uk), over 65 percent of calls are now handled by voice recognition, giving enrolled customers much faster, easier access to account services. Rather than spending five minutes providing passwords and PINs and answering security questions, Barclays' customers spend just 20 seconds verifying their identities with voice recognition.
- **FIN** Security personnel were watching activity in a bank branch. Biometric sensors had detected unusual heartbeats and body heat patterns from new customers who had entered to open an account. It turns out that those "customers" had entered the United States days before as human cargo on a ship from another country. A criminal gang was using them to orchestrate financial fraud. The sensors had detected telltale signs of stress, alerting bank personnel to the attempted fraud.

Something the user has is an authentication mechanism that includes regular identification (ID) cards, smart ID cards, and tokens. *Regular ID cards*, or *dumb cards*, typically have the person's picture and often their signature. *Smart ID cards* have an embedded chip that stores pertinent information about the user. (Smart ID cards used for identification differ from smart cards used in electronic commerce, which you will learn about in Chapter 7. Both types of cards have embedded chips, but they are used for different purposes.) *Tokens* have embedded chips and a digital display that presents a login number that the employees use to access the organization's network. The number changes with each login.

Something the user does is an authentication mechanism that includes voice recognition, signature recognition, and keystroke dynamics. In *voice recognition*, the user speaks a phrase—for example, their name and department—that has previously been recorded under controlled conditions. The voice recognition system matches the two voice signals.

In *signature recognition*, the user signs their name, and the system matches this signature with one previously recorded under controlled, monitored conditions. Signature recognition systems also match the speed and pressure of the signature.

Keystroke dynamics identifies an individual based on their typing pattern and the rhythm and speed of typing on a keyboard. This mechanism creates a baseline for users' typing and then uses that baseline to watch for abnormalities. Keystroke dynamics is also called, somewhat confusingly, behavioural biometrics. We place it here because the process is what a user does.

The main two measurements used for keystroke dynamics are dwell time and flight time. Dwell time is how long a key is pressed and flight time is the length of time between releasing one key and pressing the next key. Other measurements include frequent mistakes and which shift keys an individual uses for capitalization.

Something the user knows is an authentication mechanism that includes passwords and passphrases. **Passwords** are private combinations of characters that only the user should know. Passwords, which are often weak and repeated, present a huge information security problem to organizations and to our online lives. Security firms typically find the most popular passwords are "123456," "123456789," "qwerty," and "password."

Most of us have to remember numerous passwords for different online services, and we must typically choose complicated strings of characters to make them harder to guess. Passwords must effectively manage the trade-off between convenience and security. For example, if passwords are 50 characters in length and include special symbols, they might keep your computer and its files safe, but they would be impossible to remember.

We have all bought into the idea that a password is sufficient to protect our data, as long as it is sufficiently elaborate. In reality, however, passwords by themselves can no longer protect us, regardless of how unique or complex we make them. In fact, security experts refer

password A private combination of characters that only the user should know.

to passwords and PINs as a “double fail.” First, they are easily stolen or hacked and easily forgotten. Second, they provide very poor security and a terrible customer experience at the same time.

Weak passwords leave users and organizations vulnerable to hacking. In fact, they are cybercriminals’ key target, and some 80 percent of successful attacks involve weak or stolen passwords. Attackers employ many strategies to obtain our passwords, no matter how strong they are. They can guess them, steal them (with phishing or spear phishing attacks), crack them using brute force computation, guess them from information on social media profiles, or obtain them online. (*Brute force password cracking* means that a computer system tries all possible combinations of characters until a password is discovered.)

If you must use passwords, make them *strong passwords*, which are more difficult for hackers to discover. A strong password should have at least 12 characters. The longer your password is, the stronger it will be. Strong passwords should include a mix of uppercase and lowercase letters, a mix of letters and numbers, and special characters such as ! * & \$ #.

Many users have turned to passphrases. A **passphrase** is a series of characters that is longer than a password but is still easy to memorize. Examples of passphrases are “maytheforbewithyoualways” and “thisisagoodasitgets.”

The problems with passwords and potentially passphrases remain. Given these problems, what are users and businesses supposed to do?

passphrase A series of characters that is longer than a password but is still easy to memorize.

- *Use password managers.*

Rather than users creating, and then trying to remember, passwords and passphrases, security experts recommend the use of password managers. *Password managers* are software packages that provide users with the capability to generate unique, long, complex, easily changed passwords for their online accounts. These packages also offer the secure, encrypted storage of these passwords in either a local or cloud-based password vault. Users must provide a single master password to access the vault. By using a password manager, users do not have to memorize different passwords for all their online accounts.

However, if hackers access the password to the vault, then they have access to all the user’s accounts. Therefore, many password managers provide two-factor authentication for additional security.

- *Use multifactor authentication.*

To identify authorized users more efficiently and effectively, organizations are implementing more than one type of authentication, a strategy known as *multifactor authentication*. This system is particularly important when users log in from remote locations.

Single-factor authentication, which is notoriously weak, commonly consists simply of a password. Two-factor authentication consists of a password plus one type of biometric identification, such as a fingerprint. Three-factor authentication is any combination of three authentication methods.

Multifactor authentication is useful for several reasons. For example, voice recognition is effective when a user calls from an office but is less optimal when calling from a crowded subway or busy street. Similarly, fingerprint and iris scanners are effective when users are not busy with other tasks, but less than optimal when users are driving.

Multifactor authentication enables increasingly powerful security processes. For example, a quick fingerprint scan in a mobile banking app could enable a customer to access their account balance or perform other low-level functions. However, a request to transfer money, pay bills, or apply for a line of credit would trigger a request for voice or iris recognition. In most cases, the more factors the system uses, the more reliable it is. However, stronger authentication is also more expensive and, as with strong passwords, it can be irritating to users.

- *Use passwordless authentication.*

Passwordless authentication is a way to verify a user’s identity without a password. Passwordless authentication decreases complexity while increasing security. This type of authentication can be achieved in several different ways:

- Use biometrics, including physical biometrics (see above) as well as behavioural biometrics.

- Use tokens: For example, consider the YubiKey from Yubico (www.yubico.com), which is a hardware-based security key. The key replaces passwords and passphrases with strong hardware-based authentication using Private/Public Key (asymmetric) cryptography. In addition, a single security key can work across thousands of accounts.
- Use magic links: A user enters their email address and the system sends them an email. The email contains a link; clicking that link grants access to the user.

Several initiatives are under way to improve the authentication process under the auspices of the Fast Identity Online (FIDO) alliance (www.fidoalliance.org). FIDO is an industry consortium that was created to address the inability of strong authentication devices to work together and the problems that users face in creating and remembering multiple usernames and passwords.

FIDO2 is the latest specification of the FIDO Alliance. FIDO2 enables authentication where users identify themselves with cryptographic authenticators, such as biometrics, or external authenticators, such as FIDO keys (see passkeys below), tokens, or mobile devices. FIDO2 provides the option of using two-factor authentication.

In May 2022, with the support of Google, Apple, and Microsoft, the FIDO Alliance announced a new type of authentication that uses FIDO2-based passkeys stored on your phone to unlock your online accounts without requiring a password or passphrase. The passkey will be encrypted to protect it from compromise and will be accessible only when you unlock your phone. When you try to sign into an app or website on either the phone itself, a nearby computer, or another device, the passkey will automatically log you in regardless of the operating system or browser and without you having to enroll or re-enroll your device. If you switch to a new phone, your passkey will transfer seamlessly to it.

- *Adaptive authentication.*

The next step is to combine passwordless authentication with adaptive (behavioural) authentication. Adaptive authentication uses machine learning (see Chapter 14) to develop patterns of typical user behaviour. Any time the system notices a deviation from the pattern, it regards the login attempt as risky and takes appropriate actions.

For example, suppose a user logs in to the system via their laptop early in the morning every weekday. Over time, the system establishes that this is their typical login behaviour. Then one Saturday, the user logs in to the system.

The user used the same laptop as always, it was early in the morning, and their geographical location remained the same. The system calculates a relatively higher risk score for this behaviour, which warrants the use of a secondary authentication factor, such as a token.

A few days later, the system detects another login attempt from the same user, originating in a different country and a different device. The system calculates an exponentially higher risk score and blocks the user. It is later discovered that it was a login attempt from a cybercriminal who had spoofed the user's identity.

privilege A collection of related computer system operations that can be performed by users of the system.

least privilege A principle that users be granted the privilege for some activity only if there is a justifiable need to grant this authorization.

communications controls (also network controls)

Controls that deal with the movement of data across networks.

network controls See **communications controls**.

firewall A system (either hardware, software, or a combination of both) that prevents a specific type of information from moving between untrusted networks, such as the internet, and private networks, such as your company's network.

Authorization After users have been properly authenticated, the rights and privileges to which they are entitled on the organization's systems are established in a process called *authorization*. A **privilege** (also known as a user profile) is a collection of related computer system operations that a user is authorized to perform. Companies typically base authorization policies on the principle of **least privilege**, which posits that users should be granted the privilege for an activity only if there is a justifiable need for them to perform that activity.

Communications Controls

Communications controls (also called **network controls**) secure the movement of data across networks. Communications controls consist of firewalls, anti-malware systems, whitelisting and blacklisting, encryption, virtual private networks (VPNs), transport layer security (TLS), and employee monitoring systems.

Firewalls A **firewall** is a system that prevents a specific type of information from moving between untrusted networks, such as the internet, and private networks, such as your

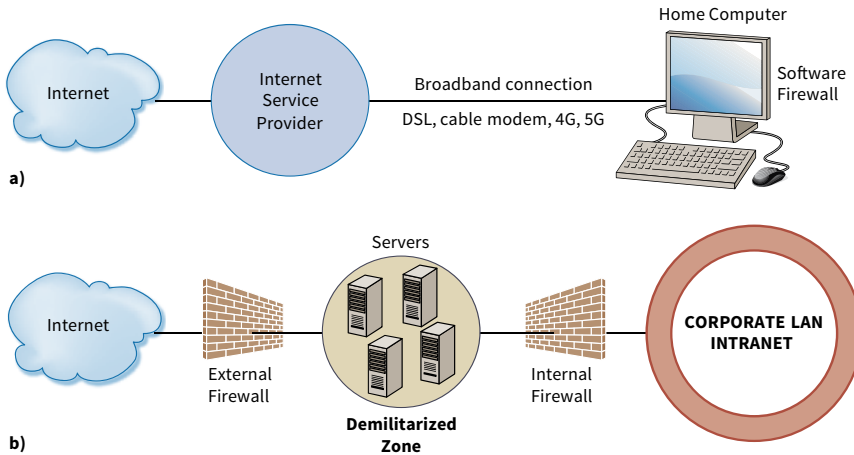


FIGURE 4.3 (a) Basic firewall for a home computer. (b) Organization with two firewalls and a demilitarized zone.

company's network. Put simply, firewalls prevent unauthorized internet users from accessing private networks. All messages entering or leaving your company's network pass through a firewall. The firewall examines each message and blocks those that do not meet specified security rules.

Firewalls range from simple, for home use, to very complex, for organizational use. **Figure 4.3(a)** illustrates a basic firewall for a home computer. In this case, the firewall is implemented as software on the home computer. **Figure 4.3(b)** shows an organization that has implemented an external firewall, which faces the internet, and an internal firewall, which faces the company network. Corporate firewalls typically consist of software running on a computer dedicated to the task. A **demilitarized zone (DMZ)** is located between the two firewalls. Messages from the internet must first pass through the external firewall. If they conform to the defined security rules, they are then sent to company servers located in the DMZ. These servers typically handle Web page requests and email. Any messages designated for the company's internal network—for example, its intranet—must pass through the internal firewall, again with its own defined security rules, to gain access to the company's private network.

The danger from viruses and worms is so severe that many organizations are placing firewalls at strategic points *inside* their private networks. In this way, if a virus or worm does get through both the external and internal firewalls, then the internal damage may be contained.

Anti-Malware Systems Anti-malware systems, also called *antivirus*, or *AV*, software, are software packages that attempt to identify and eliminate viruses and worms, and other malicious software. AV software is implemented at the organizational level by the IS department. Hundreds of AV software packages are currently available. Among the best known are Norton AntiVirus (<https://ca.norton.com>), McAfee VirusScan (www.mcafee.com), and Trend Micro Maximum Security (www.trendmicro.com).

Anti-malware systems are generally reactive. Whereas firewalls filter network traffic according to categories of activities that are likely to cause problems, anti-malware systems filter traffic according to a database of specific problems. These systems create definitions, or signatures, of various types of malware and then update these signatures in their products. The anti-malware software then examines suspicious computer code to determine whether it matches a known signature. If the software identifies a match, it removes the code. For this reason, organizations regularly update their malware definitions using automatic online updates.

Because malware is such a serious problem, the leading vendors are rapidly developing anti-malware systems that function proactively as well as reactively. These systems evaluate behaviour rather than relying entirely on signature matching. In theory, therefore, it is possible to catch malware before it can infect systems.

demilitarized zone (DMZ)

A separate organizational local area network that is located between an organization's internal network and an external network, usually the internet.

anti-malware systems

(antivirus software) Software packages that attempt to identify and eliminate viruses, worms, and other malicious software.

It is important to note that organizations must not rely only on anti-malware systems. The reason is that new types of malware are appearing too rapidly for such systems to keep pace. Therefore, multifactor authentication is critically important.

whitelisting A process in which a company identifies acceptable software and permits it to run, and either prevents anything else from running or lets new software run in a quarantined environment until the company can verify its validity.

blacklisting A process in which a company identifies certain types of software that are not allowed to run in the company environment.

encryption The process of converting an original message into a form that cannot be read by anyone except the intended recipient.

public-key encryption (also called *asymmetric encryption*) A type of encryption that uses two different keys: a public key and a private key.

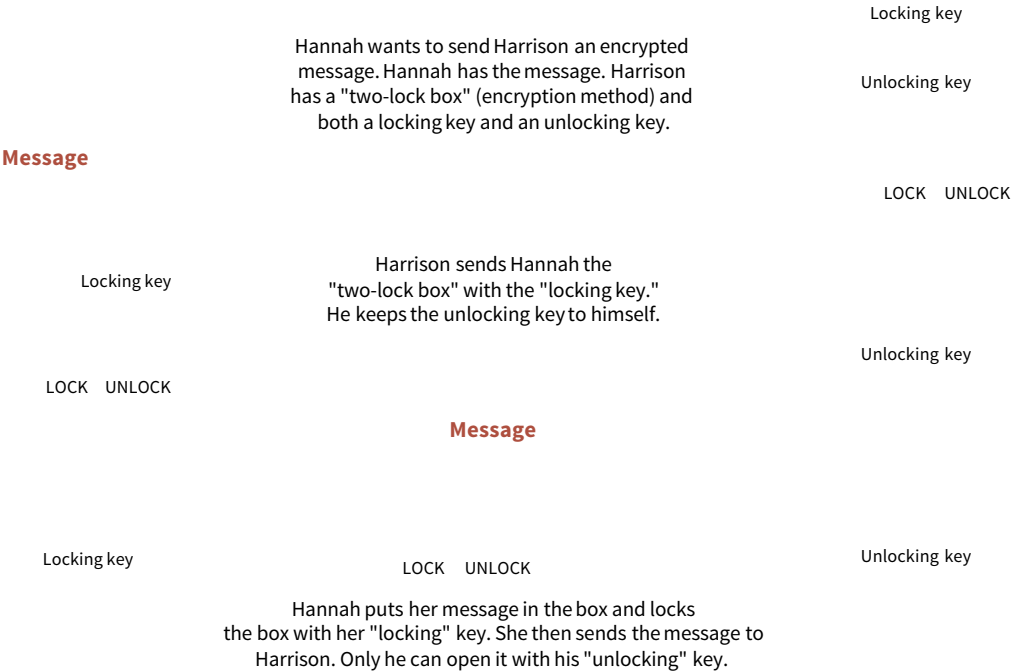
Whitelisting and Blacklisting A report by the Yankee Group (www.451research.com), a technology research and consulting firm, stated that 99 percent of organizations had installed anti-malware systems, but 62 percent still suffered malware attacks. As we have seen, anti-malware systems are usually reactive, and malware continues to infect companies.

One solution to this problem is **whitelisting**. Whitelisting is a process in which a company identifies the software that it will allow to run on its computers. Whitelisting permits acceptable software to run, and it either prevents any other software from running or lets new software run only in a quarantined environment until the company can verify its validity.

Whereas whitelisting allows nothing to run unless it is on the whitelist, **blacklisting** allows everything to run unless it is on the blacklist. A blacklist, then, states which types of software are not allowed to run in the company environment. For example, a company might blacklist peer-to-peer file sharing on its systems. Besides software, people, devices, and web-sites can also be whitelisted and blacklisted.

Encryption Organizations that do not have a secure channel for sending information use encryption to stop unauthorized eavesdroppers. **Encryption** is the process of converting an original message into a form that cannot be read by anyone except the intended receiver.

All encryption systems use a key, which is the code that scrambles and then decodes the messages. The majority of encryption systems use public-key encryption. **Public-key encryption**—also known as *asymmetric encryption*—uses two different keys: a public key and a private key (see [Figure 4.4](#)). The public key (locking key) and the private key (the unlocking key) are created simultaneously using the same mathematical formula or algorithm. Because the two keys are mathematically related, the data encrypted with one key can be decrypted by using the other key. The public key is publicly available in a directory that all parties can



How public-key encryption works.

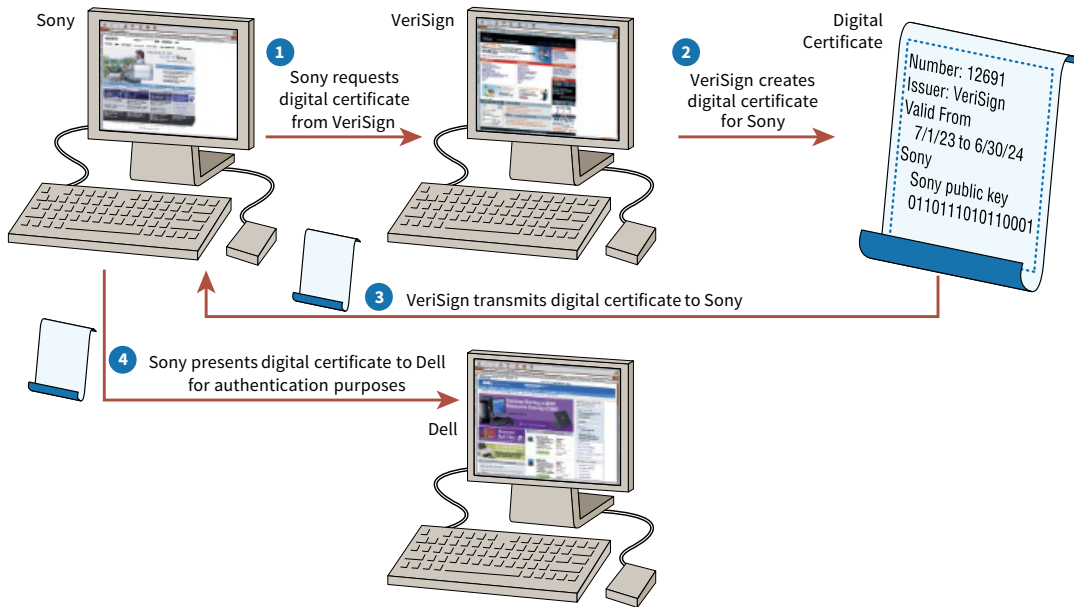


FIGURE 4.5 How digital certificates work. Sony and Dell, business partners, use a digital certificate from VeriSign for authentication.

access. The private key is kept secret, never shared with anyone, and never sent across the internet. In this system, if Hannah wants to send a message to Harrison, she first obtains Harrison's public key (locking key), which she uses to encrypt her message (put the message in the "two-lock box"). When Harrison receives Hannah's message, he uses his private key to decrypt it (open the box).

Although this arrangement is adequate for personal information, organizations that conduct business over the internet require a more complex system. In these cases, a third party, called a **certificate authority**, acts as a trusted intermediary between the companies. The certificate authority issues digital certificates and verifies the integrity of the certificates. A **digital certificate** is an electronic document attached to a file that certifies that the file is from the organization it claims to be from and has not been modified from its original format. As you can see in **Figure 4.5**, Sony requests a digital certificate from VeriSign, a certificate authority, and it uses this certificate when it conducts business with Dell. Note that the digital certificate contains an identification number, the issuer, validity dates, and the requester's public key. For examples of certificate authorities, see www.entrust.com, www.verisign.com, www.cybertrust.com, www.secude.com, and www.thawte.com.

Virtual Private Networking A **virtual private network (VPN)** is a private network that uses a public network (usually the internet) to connect users. VPNs essentially integrate the global connectivity of the internet with the security of a private network and thereby extend the reach of the organization's networks. VPNs are called *virtual* because they have no separate physical existence. They use the public internet as their infrastructure. They are created by using log-ins, encryption, and other techniques to enhance the user's *privacy*, which we defined in Chapter 3 as the right to be left alone and to be free of unreasonable personal intrusion.

VPNs have several advantages. First, they allow remote users to access the company network. Second, they provide flexibility. That is, mobile users can access the organization's network from properly configured remote devices. Third, organizations can impose their security policies through VPNs. For example, an organization may dictate that only corporate email applications are available to users when they connect from unmanaged devices.

To provide secure transmissions, VPNs use a process called **tunnelling**. **Tunnelling** encrypts each data packet to be sent and places each encrypted packet inside another packet. In this manner, the packet can travel across the internet with confidentiality, authentication, and integrity. **Figure 4.6** illustrates a VPN and tunnelling.

certificate authority

A third party that acts as a trusted intermediary between computers (and companies) by issuing digital certificates and verifying the worth and integrity of the certificates.

digital certificate An electronic document attached to a file certifying that the file is from the organization it claims to be from and has not been modified from its original format or content.

virtual private network (VPN) A private network that uses a public network (usually the internet) to securely connect users by using encryption.

tunnelling A process that encrypts each data packet to be sent and places each encrypted packet inside another packet.

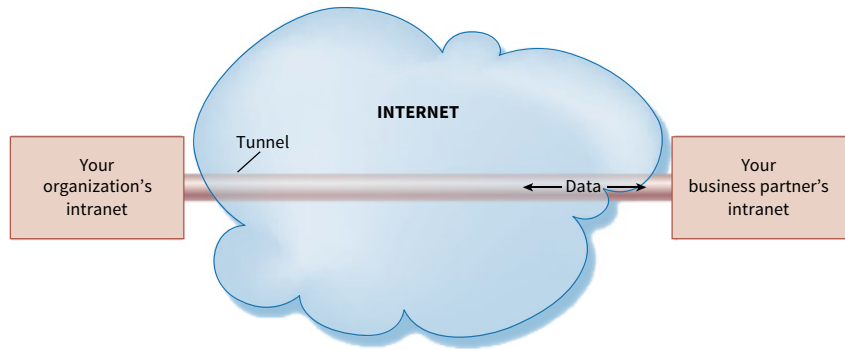


FIGURE 4.6 Virtual private network and tunnelling.

transport layer security (TLS) An encryption standard used for secure transactions such as credit card purchases and online banking.

secure socket layer (SSL) See **transport layer security**.

Transport Layer Security **Transport layer security (TLS)**, formerly called **secure socket layer (SSL)**, is an encryption standard used for secure transactions such as credit card purchases and online banking. TLS encrypts and decrypts data between a Web server and a browser end to end.

TLS is indicated by a URL that begins with “https” rather than “http,” and it often displays a small padlock icon in the browser’s status bar. Using a padlock icon to indicate a secure connection and placing this icon in a browser’s status bar are artifacts of specific browsers. Other browsers use different icons; for example, a key that is either broken or whole. The important thing to remember is that browsers usually provide visual confirmation of a secure connection.

HRM Employee Monitoring Systems Many companies are taking a proactive approach to protecting their networks against what they view as one of their major security threats, namely, employee mistakes. These companies are implementing **employee monitoring systems**, which scrutinize their employees’ computers, email activities, and internet surfing activities. These products are useful to identify employees who spend too much time surfing on the internet for personal reasons, who visit questionable websites, or who download music illegally. Vendors that provide monitoring software include Veriato (www.veriato.com) and Forcepoint (www.forcepoint.com).

employee monitoring systems Systems that monitor employees’ computers, email activities, and internet surfing activities.

Application Controls

Application controls, as their name suggests, are security countermeasures that protect specific applications in functional areas. They can be automated or performed by people. Application controls fall into three major categories: input controls, processing controls, and output controls.

Input controls are programmed routines that edit input data for errors before they are processed. For example, social insurance numbers should not contain any alphabetical characters.

Processing controls are programmed routines that perform actions that are part of the organization’s record-keeping, reconcile and check transactions, or monitor the operation of applications. Processing controls, for example, might match entered quantities of goods received in the shipping area to amounts ordered on authorized purchase orders. Processing controls also balance the total number of transactions processed with the total number of transactions input or output.

Finally, output controls are programmed routines that edit output data for errors or help to ensure that output is provided only to authorized individuals. An example of output controls is documentation specifying that authorized recipients have received their reports, paycheques, or other critical documents.

Before you go on...

1. What is the single most important information security control for organizations?
2. Differentiate between authentication and authorization. Which of these processes is always performed first?
3. Compare and contrast whitelisting and blacklisting.
4. Describe the major types of controls for information systems.
5. What is the purpose of a disaster recovery plan?

4.6 Personal Information Asset Protection

LEARNING OBJECTIVE

Explain why it is critical that you protect your information assets, and identify actions that you could take to do so.

While travelling in our jobs or working from home, we access the internet from home and from wireless hot spots for various purposes—shopping, ordering products, planning trips, gathering information, or staying in touch with friends and family via email. Unfortunately, every time you access the internet, you risk exposing both professional and personal information to people who are looking to steal or exploit that information. It is important to protect your information assets whether you are computing at home or “on the road.” The level of protection needs to be geared toward the type of information that is being stored or transported. Your term paper requires a different level of protection from your banking records and identification information. Information that you are a custodian of (such as your employer’s customers’ data) requires a high level of protection, while other information, such as pictures of your cat, requires less security.

When you connect at work or access your organization’s network at home or on the road, you have the advantage of the “industrial-strength” information security implemented by your organization’s IS department. In all other cases, however, you are on your own, so it is *your* responsibility to protect yourself. Protecting yourself is more critical than ever because organized crime is increasingly turning its attention to home users. Because businesses are improving their information security, consumers are now the next logical target. According to Symantec (www.symantec.com), which manufactures the Norton Internet security products, in 2003, it took 15 minutes to hack an unprotected computer; now it takes just seconds. Today, that same computer will be attacked within seconds.

The first step to any security actions you take is to make an inventory of the types of information you are using, storing, or accessing. Then, you need to consider what could go wrong if the information were to be copied or stolen. That will be your guide as to the level of protection you need to put in place.

Perhaps the most fundamental rule concerning your computer-related behaviours is to never provide personal information to strangers in any format—physical, verbal, or electronic. **Table 4.4** provides a selection of actions that you can consider for protecting your information assets. The table first shows behavioural actions that you could consider, and why, then computer-related actions.

TABLE 4.4 Possible Actions to Protect Personal Information Assets

Possible actions to protect personal information assets	Why the actions are important
<i>Behavioural actions</i>	
Verify the identity of telephone callers or emails who ask for personal information by calling them using an independently obtained telephone number or seeking out primary websites.	Prevent potential social engineering attacks or phishing attacks.
Ask why service providers need your social insurance number (SIN) and withhold your SIN if it is not needed to obtain the service.	Prevent possible identity theft.
Carefully check your credit card bills and bank statements, querying unknown transactions.	Detect unauthorized use of your credit card or unauthorized access to your bank accounts promptly.
If you suspect identity theft, check the mailing address and status of your bills and follow the actions listed on the website of the Office of the Privacy Commissioner of Canada (www.priv.gc.ca/en/privacy-topics/identities/identity-theft/).	Protect your credit rating and help prevent further theft of your information and financial assets.
<i>Computer-related actions</i>	
Use current software that is updated regularly for antivirus, anti-spam and anti-adware.	Help prevent your data or programs from being disrupted or copied; prevent your system from being hijacked as a bot.
Take regular backups of your data and system and store it off-site, away from your computer system.	Enable recovery of your data and system in case of disruption due to viruses, ransomware, or theft of your equipment.
Use passwords based on word phrases to make them difficult to guess and use different passwords for leisure and financial systems.	Protect your confidential data and financial assets from unauthorized access.

Before You Go On . . .

1. Do a personal risk assessment and identify your three most important types of data.
2. What are two specific actions that you could take to protect the data that you identified?

What’s in IT for me?

ACCT For the Accounting Major

Public companies, their accountants, and their auditors have significant information security responsibilities. Accountants are now being held professionally responsible for reducing risk, assuring compliance, eliminating fraud, and increasing the transparency of transactions according to enurally accepted accounting principles (GAAP). Regulatory agencies require information security, fraud prevention and detection, and internal controls over financial reporting and over the privacy of confidential information. Forensic accountants, who investigate potential violations of the law (such as theft of money or data), require knowledge of a combination of accounting and information security. This is one of the most rapidly growing areas in accounting today.

FIN For the Finance Major

Because information security is essential to the success of organizations today, it is no longer the concern only of the CIO. As a result of

global regulatory requirements and the passage of Bill 198, responsibility for information security also lies with the CEO and CFO. Consequently, all aspects of the security audit, including the security of information and information systems, are a key concern for financial managers.

CFOs and treasurers are also increasingly involved with investments in information technology. They know that a security breach of any kind can have devastating financial effects on a company. Banking and financial institutions are prime targets for computer criminals. A related problem is fraud involving shares and bonds that are sold over the internet. Finance personnel must be aware of both the hazards and the available controls associated with these activities.

MKT For the Marketing Major

Marketing professionals have new opportunities to collect data on their customers; for example, through business-to-consumer

electronic commerce. Customers expect their data to be properly secured. However, profit-motivated criminals want those data. Therefore, marketing managers must analyze the risk of their operations. Failure to protect corporate and customer data will cause significant public relations problems and make customers very angry. It can also lead to lawsuits, and it could cause companies to lose customers to competitors. Customer relationship management operations and tracking customers' online buying habits can expose data to misuse (if they are not encrypted) or result in privacy violations.

POM For the Production/Operations Management Major

Every process in a company's operations—inventory purchasing, receiving, quality control, production, and shipping—can be disrupted by an IT security breach either inside the company or at a business partner. Any weak link in supply chain management or enterprise resource management systems puts the entire chain at risk. Companies may be held liable for IT security failures that impact other companies.

HRM For the Human Resource Management Major

HR managers have responsibilities to secure confidential employee data. They must also ensure that all employees explicitly verify that they understand the company's information security policies and procedures.

MIS For the MIS Major

The MIS function provides the security infrastructure that protects the organization's information assets. This function is critical to the success of the organization, even though it is almost invisible until an attack succeeds. All application development, network deployment, and introduction of new information technologies must be guided by IT security considerations. MIS personnel must customize the information systems risk assessments and responses to help the company identify security risks and prepare responses to security incidents and disasters.

Senior executives of publicly held companies look to the MIS function for help in detecting and remediating significant deficiencies or material (important) weaknesses in internal controls. Other functional areas also look to the MIS function to help them meet their security responsibilities.

Summary

4.1 Identify the five factors that contribute to the increasing vulnerability of information resources, and provide specific examples of each factor.

The five factors are the following:

- Today's interconnected, interdependent, wirelessly networked business environment.
 - *Example:* The internet
- Smaller, faster, cheaper computers and storage devices
 - *Examples:* Netbooks, thumb drives, iPads
- Decreasing skills necessary to be a computer hacker
 - *Example:* Information system hacking programs circulating on the internet
- International organized crime taking over cybercrime
 - *Example:* Organized crime has formed transnational cyber-crime cartels. Because it is difficult to know exactly where cyberattacks originate, these cartels are extremely hard to bring to justice.
- Lack of management support
 - *Example:* Suppose that your company spent \$10 million on information security countermeasures last year, and it did not experience any successful attacks on their information resources. Short-sighted management might conclude that the company could spend less during the next year and obtain the same results. Bad idea!

4.2 Compare and contrast human mistakes and social engineering and provide a specific example of each one.

Human mistakes are unintentional errors. However, employees can also make unintentional mistakes as a result of actions by an attacker, such as social engineering. *Social engineering* is an attack by which the perpetrator uses social skills to trick or manipulate a legitimate employee into providing confidential company information.

An example of a human mistake is tailgating. An example of social engineering is when an attacker calls an employee on the phone and impersonates a superior in the company.

4.3 Discuss the 10 types of deliberate attacks.

The 10 types of deliberate attacks are the following:

1. *Espionage or trespass* occurs when an unauthorized individual attempts to gain illegal access to organizational information.
2. *Information extortion* occurs when an attacker either threatens to steal, or actually steals, information from a company. The perpetrator demands payment for not stealing the information, for returning stolen information, or for agreeing not to disclose the information.
3. *Sabotage and vandalism* are deliberate acts that involve defacing an organization's website, possibly tarnishing the organization's image, causing it to experience a loss of confidence by its customers.
4. *Theft of equipment and information* is becoming a larger problem because computing devices and storage devices are becoming smaller but more powerful with vastly increased storage, making them easier and more valuable to steal.
5. *Identity theft* is the deliberate assumption of another person's identity, usually to gain access to their financial information or to frame them for a crime.

6. Preventing *compromises to intellectual property* is a vital issue for people who make their livelihood in knowledge fields. Protecting intellectual property is particularly difficult when that property is in digital form.
7. *Software attacks* occur when malicious software penetrates an organization's computer system. Today, these attacks are typically profit-driven and Web-based.
8. *Alien software* is clandestine software that is installed on a computer through duplicitous methods. It is typically not as malicious as viruses, worms, or Trojan horses, but it does use up valuable system resources.
9. *Supervisory control and data acquisition* refers to a large-scale distributed measurement and control system. SCADA systems are used to monitor or control chemical, physical, and transport processes. A *SCADA attack* attempts to compromise such a system to cause damage to the real-world processes that the system controls.
10. With both *cyberterrorism* and *cyberwarfare*, attackers use a target's computer systems, particularly through the internet, to cause physical, real-world harm or severe disruption, usually to carry out a political agenda.

4.4 Describe the three risk mitigation strategies and provide examples of each one in the context of owning a home.

The three risk mitigation strategies are the following:

Risk acceptance, in which the organization accepts the potential risk, continues operating with no controls, and absorbs any damages that occur. If you own a home, you may decide not to insure it. Thus, you are practicing risk acceptance. Clearly, this is a bad idea.

Risk limitation, in which the organization limits the risk by implementing controls that minimize the impact of threats. As a homeowner, you practice risk limitation by putting in an alarm system or cutting down damaged trees near your house.

Risk transference, in which the organization transfers the risk by using other means to compensate for a loss, such as by purchasing insurance. The vast majority of homeowners practice risk transference by purchasing insurance on their houses and other possessions.

4.5 Identify the major types of controls that organizations can use to protect their information resources and provide an example of each one.

Information systems are protected with a wide variety of controls such as security procedures, physical guards, and detection software. Management is responsible for the *control environment*, the attitudes, and the policies used as a framework to establish controls. *General controls* include controls for the prevention, deterrence, detection, damage control, recovery, and correction of information systems. The major types of general controls include *physical controls* (e.g., security guards or locks), *logical controls* (e.g., passwords or automated calculations), *access controls* (e.g., multifactor authentication), and *communications controls* (e.g., firewalls). *Application controls* include input, processing, and output controls.

- Preparation for disaster recovery specifically addresses how to avoid, plan for, and quickly recover from a disaster. Information systems auditing is a specialization that helps financial, internal, government, or tax auditors evaluate or assess controls or compliance with procedures or legislation. A detailed internal and external IT audit may involve hundreds of issues and can be supported by both software and checklists.

4.6 Explain why it is critical that you protect your information assets, and identify actions that you could take to do so.

Most of us use the internet in many different ways—on our telephones, computers, and even during telephone calls and when getting building access. With the COVID-19 pandemic that started in spring 2020, this reliance became crucial. Yet every time we access the internet, our information could be exposed to others who would steal or exploit that information. Personal information asset protection starts with taking an inventory of your information usage, storage, and access methods. Then, do a risk assessment. Consider how vulnerable your information is to the threats we have discussed in this chapter, and what your exposure is to destruction or damage to data or to financial loss. Then, decide upon behavioural or computer-related actions that you could take to protect your data and your finances. Table 4.4 provides examples of these actions, such as checking credit card bills carefully (a behavioural action) or keeping your anti-malware software up to date (a computer-related action).

Key Terms

access controls 105
adware 98
alien software 98
anti-malware systems (antivirus software) 109
application controls 103
authentication 105
authorization 105
biometrics 105
blacklisting 110
botnet 97
bots 97
business continuity planning 104
certificate authority 111

communications controls (also network controls) 108
control environment 103
controls 103
cookies 99
copyright 96
cybercrime 86
cyberterrorism 100
cyberwarfare 100
demilitarized zone (DMZ) 109
digital certificate 111
employee monitoring systems 112
encryption 110
exposure 86

firewall 108
general controls 103
identity theft 95
information security 86
information systems audit 102
intellectual property 96
least privilege 108
logical controls 105
malware 96
network controls 108
passphrase 107
password 106
patent 96
physical controls 103

piracy 96
 privilege 108
 public-key encryption 110
 ransomware (or digital extortion) 92
 risk 101
 risk management 101
 secure socket layer (SSL) 112

security 86
 social engineering 91
 spam 99
 spamware 99
 spyware 98
 threat 86
 trade secret 96

transport layer security (TLS) 112
 tunnelling 111
 virtual private network (VPN) 111
 vulnerability 86
 whitelisting 110

Discussion Questions

1. Why are computer systems so vulnerable?
2. Why should information security be a prime concern to management?
3. Is security a technical issue? A business issue? Both? Support your answer.
4. Compare information security in an organization with insuring a house.
5. Why are authentication and authorization important to e-commerce?
6. Why is cross-border cybercrime expanding rapidly? Discuss possible solutions.
7. What types of user authentication are used at your university or place of work? Do these measures seem to be effective? What if a higher level of authentication were implemented? Would it be worth it, or would it decrease productivity?
8. Why are federal authorities so worried about SCADA attacks?

Problem-Solving Activities

1. A critical problem is assessing how far a company is legally obligated to go in order to secure personal data. Because there is no such thing as perfect security (i.e., there is always more that one can do), resolving this question can significantly affect cost.
 - a. When are security measures that a company implements sufficient to comply with its obligations?
 - b. Is there any way for a company to know if its security measures are sufficient? Can you devise a method for any organization to determine if its security measures are sufficient?
2. Enter www.scambusters.org. Find out what the organization does. Learn about email scams and website scams. Report your findings.
3. Visit <https://www.publicsafety.gc.ca>. Find the report on “National Cyber Security Strategy: Canada’s Vision for Security and Prosperity in the Digital Age.” Read the section on “Leadership and Collaboration” and write a report on the agenda and accomplishments to date. Enter www.alltrustnetworks.com and other vendors of biometrics. Find the devices they make that can be used to control access into information systems. Prepare a list of their products and the major capabilities of each vendor.
4. Software piracy is a global problem. Access the following resources: www.bsa.org and <https://news.microsoft.com/download/archived/presskits/antipiracy/docs/piracy10.pdf>. What can organizations do to mitigate this problem? Are some organizations dealing with the problem better than others? Is Microsoft’s approach to addressing privacy relevant for other organizations?
5. Investigate the BRP Inc. hack that occurred in August 2022. BRP “helps people move” and employs over 20,000 people. Start by reading the article, “[Stolen BRP data leaked on the dark web](#),” and then answer the following questions.
 - a. What type of attack was it?
 - b. Why did the attack affect suppliers, customers, and employees? Provide specific examples to support your answer.
 - c. Which BRP controls failed?
 - d. Could the hack have been prevented? If so, how?
 - e. Discuss BRP’s response to the hack.
 - f. Describe the damages that BRP incurred from the hack.
6. Investigate the Equifax hacks in 2017.
 - a. What type of attack was it?
 - b. What actions should Equifax have taken to prevent the breaches? Provide specific examples to support your answer.
 - c. Imagine you are a victim in the Equifax breaches. What should you do when you are notified (or when you think) that your personal data have been compromised?
 - d. In light of the Equifax breaches, should all consumers have the option to opt out of credit bureaus? Why or why not?
7. Visit www.cyber.gc.ca/en and read the section titled Information for Individuals. Select Get Cyber Safe and browse the tips for securing your devices. Select one threat that you have experienced and write about what could be done to prevent it.
8. Check out a password manager such as www.1password.com. What are the benefits and limitations to such a system? Would you use this product? Why or why not?
9. Visit www.cyber.gc.ca/en, look for the guidance on ransomware for organizations, and select the section on how to prevent and recover. This is part of the Canadian Government’s site for resources to tackle ransomware more effectively. List three actions you can take to better protect yourself and your employer.

Closing Case

MIS FIN Massive Cryptocurrency Web Dissolves

FTX Had a Short Life

FTX, a large cryptocurrency exchange launched in April 2019, went from an estimated value of US \$16 billion to zero, as the group of companies filed for bankruptcy protection in the United States on November 11, 2022.

Three individuals, Sam Bankman-Fried (founder), Gary Wang, and Nishad Singh (co-founders), established the over 100 companies that belonged to four types. These were venture capital companies to invest in other companies, trading companies that invested in other cryptocurrency organizations (hedge funds), a cryptocurrency exchange for U.S. customers, and an international cryptocurrency exchange.

One of the hedge fund companies was Alameda, which accepted wire transfers on behalf of the FTX group for FTT tokens. Thomson Reuters defines a digital token as a “representation of value or rights.” The token provides access or participation in digital systems such as distributed ledgers, cryptocurrency exchanges, or other blockchain systems. The terms “digital token,” “token,” and “digital coin” are often used synonymously.

FTT tokens were specifically designed for FTX and were usable for transactions within the group. They had attributes of shares, since they had voting rights and group profits were to be added to the tokens’ value. The FTT token was supposedly protected from valuation decreases by providing trading discounts to large holders, encouraging them to use the FTX platform for their cryptocurrency trading rather than other platforms. There was to be a collateral pool (other assets, such as investments) protecting the value of the tokens, and the FTT token was used for settlement of other tokens, trading with other cryptocurrency exchanges without having to cash in the FTT tokens. As of closing on July 13, 2022, there were over 30 different types of FTT tokens with a then market value of US \$3.2 billion.

The FTX group ran out of cash when Alameda made poor investment decisions (losing about US \$8 billion of customer money). The losses meant that there were no profits available to increase the value of FTT tokens. Funds that were supposed to be transferred by Alameda to the two cryptocurrency exchanges had been invested instead of being provided to the exchanges for payment of tokens. The losses were hidden by reporting inaccurate financial information.

Control Failures at FTX

The news site CoinDesk reported on November 2, 2022, that Alameda had assets of US \$14.6 billion as at June 30, 2022. Of that, US \$3.66 billion was listed as “unlocked FTT,” while another US \$2.16 billion was listed as “FTT collateral,” assets that FTX had created, for a total of US \$5.82 billion. Other assets included purchases of other digital currencies, rather than investments that would protect the value of FTT tokens. FTX had failed to implement corporate governance controls to establish investments at the appropriate risk level. Customers wanted to withdraw billions of dollars’ worth of coins.

Following the CoinDesk article, another cryptocurrency exchange, Binance, was considering purchasing international FTX

assets, which would have relieved the liquidity problems at FTX. It sold its FTT tokens, then walked away from the deal, increasing the liquidity crisis at FTX. Without cash, FTX was forced into bankruptcy and filed for Chapter 11 bankruptcy protection in the United States on November 11 after Bankman-Fried stepped down as CEO. The next day, FTX reported a hack of US \$477 million FTT tokens, locking the rest of the tokens away. This showed a lack of adequate security controls at the company.

FTX was primarily located in the Bahamas. Just prior to its bankruptcy, it had been the third-largest cryptocurrency exchange in the world. After seizing the assets of the local FTX subsidiary, the Securities Commission of the Bahamas (SCB) required that the cryptocurrency assets there be moved to the SCB’s digital wallet for creditor protection. Bankman-Fried was arrested in the Bahamas on December 12. He was extradited to the United States, where he was placed under house arrest (with an electronic monitoring bracelet) with his parents after paying US \$250 million in bail. He was charged with numerous offences, including embezzlement, by U.S. courts, and pleaded not guilty on January 3, 2023; his trial date is expected to be in October 2023. The U.S. prosecutors charged that inadequate and deliberately altered records were kept of the transactions initiated by Bankman-Fried related to payments to political campaigns. The charges included misappropriating (stealing) money from customers to pay loans from another company (Alameda Research).

If this is true, it meant that transactions could be initiated at one or more of the companies without an electronic or paper trail or that Bankman-Fried was able to have the nature of transactions deliberately altered.

On March 2023, FTX’s new management reported that a total of US \$3.2 billion (over US \$2 billion to Bankman-Fried) had been transferred from FTX to personal bank accounts.

FTX Tried to Enter Canada in June 2022

Cryptocurrencies are not legal tender in Canada, so cannot be used as cash equivalents. The cryptocurrency needs to be exchanged first. Instead of being regulated by banking or credit union legislation, cryptocurrency exchanges are regulated as “restricted dealers” under securities laws that also regulate the sale of shares and other types of investments, since cryptocurrencies are a tradeable asset. Canada is considered a leader in cryptocurrency regulations, since it mentioned cryptocurrencies in the 2014 version of its Proceeds of Crime (Money Laundering) and Terrorist Financing Act.

On June 17, 2022, FTX announced that it had purchased Bitvo Inc., a Canadian platform dealing in crypto assets. Bitvo is registered to sell crypto assets in all of Canada. At the time, it was announced that the deal was expected to close in the third quarter of 2022. The deal had not closed as of the date of FTX’s bankruptcy, so Bitvo announced on November 15 that it was terminating the deal and that it had never owned or traded FTT tokens.

Billions Lost for Good?

On March 2, 2023, current FTX officers stated that they could not locate about US \$8 billion in customer funds. The amount was calculated after completing a full inventory of FTX digital wallets. Amounts were based on values prior to the failure of FTX, which

were uncertain since there would no longer be a market for the FTT tokens.

It will likely take years for claims and counterclaims to be dealt with, and thousands of hours of professional time to unravel what actually happened to transactions within the FTX group.

Questions

1. Research the advantages and disadvantages of investing in a cryptocurrency. Use this information to discuss the likelihood of FTX customers receiving any of their money back.
2. How could corporate governance have been used to prevent or detect the alleged misuse of funds by FTX's former CEO?
3. How could general security controls have been used to prevent or detect the alleged misuse of funds by FTX's former CEO?
4. How could financial application controls have been used to prevent or detect the alleged misuse of funds by FTX's former CEO?

Sources: Compiled from I. Allison, "Divisions in Sam Bankman-Fried's Crypto Empire Blur on His Trading Titan Alameda's Balance Sheet," *CoinDesk*, November 2, 2022, <https://www.coindesk.com/business/2022/11/02/divisions-in-sam-bankman-frieds-crypto-empire-blur-on-his-trading-titan-alamedas-balance-sheet/>,

accessed April 12, 2023; K. Barr, "FTX Confirms \$9 Billion in Customer Funds Vanished," *Gizmodo*, March 3, 2023, <https://gizmodo.com/ftx-sbf-sam-bankman-fried-crypto-1850183784>, accessed April 12, 2023; A. Hern and D. Milmo, "What Do We Know So Far about Collapse of Crypto Exchange FTX?" *The Guardian*, November 18, 2022, <https://www.theguardian.com/technology/2022/nov/18/how-did-crypto-firm-ftx-collapse>, accessed April 12, 2023; C. Jackson, "Is Cryptocurrency Regulated in Canada?" *Koho*, 2023, <https://www.koho.ca/learn/is-cryptocurrency-regulated-in-canada/>, accessed April 12, 2023; A. Lawson, "Sam Bankman-Fried Received \$2.2bn from FTX-Linked Entities, Say Court Filings," *The Guardian*, March 16, 2023, <https://www.theguardian.com/business/2023/mar/16/sam-bankman-fried-received-22bn-from-ftx-linked-entities-say-court-filings>, accessed April 12, 2023; Linen Mobile Inc., "FTX Token 101. What Is FTX Token? FTT Explained in Plain English," *Linen.app*, July 13, 2022, <https://linen.app/articles/what-is-ftx-token-ftt-explained-in-plain-english/>, accessed April 12, 2023; N. Reiff, "The Collapse of FTX: What Went Wrong with the Crypto Exchange?" *Investopedia*, February 27, 2023, <https://www.investopedia.com/what-went-wrong-with-ftx-6828447>, accessed April 12, 2023; Thomson Reuters, "Glossary Digital Token," *Thomson Reuters Practical Law*, 2023, [https://uk.practicallaw.thomsonreuters.com/w-024-0323?transitionType=Default&contextData=\(sc.Default\)&firstPage=true](https://uk.practicallaw.thomsonreuters.com/w-024-0323?transitionType=Default&contextData=(sc.Default)&firstPage=true), accessed April 12, 2023; B. Shector, "Calgary-Based Crypto Platform Bitvo Terminates Deal to Be Acquired by FTX," *Financial Post*, November 15, 2022, <https://financialpost.com/fp-finance/cryptocurrency/calgary-bitvo-terminates-ftx-deal>, accessed April 12, 2023.

Data and Knowledge Management

CHAPTER OUTLINE

LEARNING OBJECTIVES

5.1 Managing Data

5.1 Discuss ways that common challenges in managing data can be addressed using data governance.

5.2 The Database Approach

5.2 Discuss the advantages and disadvantages of relational databases.

5.3 Big Data

5.3 Define *Big Data* and its basic characteristics.

5.4 Data Warehouses and Data Marts

5.4 Explain the elements necessary to successfully implement and maintain data warehouses.

5.5 Knowledge Management

5.5 Describe the benefits and challenges of implementing knowledge management systems in organizations.

5.6 Appendix: Fundamentals of Relational Database Operations

5.6 Understand the processes of querying a relational database, entity–relationship modelling, and normalization and joins.

Opening Case

Elementary, Watson. Not Quite So Fast, IBM.

In 2015, IBM launched Watson Health, an artificial intelligence (AI) platform with the intended purpose of helping health care providers revolutionize cancer treatment. Sound ambitious? It was, even for a massive company like IBM. If anyone could accomplish great things, however, it was IBM. The company had already demonstrated Watson's remarkable ability to learn and make decisions: in 2011, Watson beat the world's best chess players.

Recognizing that technology can help provide better health care, the industry has identified AI as a potential source of deep insights and suggestions. AI can consume vast amounts of data, analyze and interpret those data, and provide insights to physicians. It can be applied to the most practical problems clinicians face every day, keeping up with the latest information while treating each patient as a unique case.

For example, to provide better care, oncologists—doctors who treat cancers—could use AI to access information dealing with entire populations rather than rely on specific cases they had been able to review. However, physicians are not the only group interested in health-care-related AI. Numerous stakeholders—patients, providers, hospitals, and insurers—could employ AI to address their distinctive needs.

Unfortunately, in the case of Watson Health, AI did not deliver the kind of progress IBM had initially envisioned. In fact, the unit wasn't even profitable. In 2021, *The Wall Street Journal* reported that Watson Health had generated only \$1 billion in revenue. This number was far lower than the \$4 billion that IBM had invested in the technology. Meanwhile, several IBM partners and clients had cancelled or scaled back their oncology projects with Watson. Ultimately, in early 2022, IBM sold Watson Health to another company.

What Went Wrong?

In assessing Watson Health's lack of success, many analysts point to the sheer complexity of health care data. IBM apparently underestimated the complexity of health care records and overestimated Watson's ability to consume, compile, and interpret those records. Most records are on paper and are recorded differently. Although Watson could quickly analyze data, it took an enormous amount of human effort to prepare the data points so that Watson could analyze them.

Additionally, combining an individual's multiple data records into a single cohesive story was nearly impossible. For example, a patient could go to a hospital for lung cancer treatment while visiting a family practice physician for breathing problems. Logically, the records are intertwined. From Watson's perspective, however, they are separate, unique stories.

Another problem is that the data entered into Watson's cancer diagnostic tool were not actual patient data. Recognizing how highly complex health care record data are, IBM decided to load hypothetical data, meaning that the original data sample contained diagnoses on fake cases to train the system to analyze real patient data. Medical providers, however, rely on real studies that are approved and recognized by the government and the medical profession and are published in professional journals. Therefore, many providers refused to accept the advice they received from Watson as viable. Other physicians expressed concerns about the recommendations that Watson was giving. They just were not relevant. Some physicians reported that Watson would suggest a treatment that was not available in the local area, did not comply with existing protocols, or simply was not effective.

Furthermore, some of these location-specific needs are related to socio-economic status. For example, one of the primary sources of diagnostic information was a group of experts at Memorial Sloan Kettering Cancer Center in New York. Although the hospital is considered one of the most renowned cancer institutions in the world, and its health care suggestions are highly viable, its patient list is biased toward a wealthy subset of patients. This tendency is called *AI bias*. It is a mounting concern, especially for demographic groups that are under-represented in the data used to create the diagnostic tools.

To improve Watson's validity in the eyes of health care providers, IBM spent billions of dollars on data acquisitions. It bought Truven Health Analytics, Phytel, Explorys, and Merge Healthcare. Truven offered an insurance database with 300 million customer data points. Explorys provided a clinical database of electronic health records kept by health systems representing roughly 50 million patients. Phytel provided additional physician data, and Merge offered a huge imaging database. IBM's plan was to make these vast data sources available to Watson, which could then identify patterns that physicians could never find.

Results

The health care industry is data-rich but analysis-deficient. Data are incompatible across practice, specializations, and groups, creating a vacuum where the industry can do better. A unified approach to data storage and sharing is required to make the intent of Watson Health a reality. Only when all data can be easily shared, accessed, and analyzed and the resulting report shared with the community can the full breadth of AI truly impact health care.

Fast Healthcare Interoperability Resources (FHIR, pronounced "fire") is a standard that defines how health care information can be exchanged electronically. Several governments,

including those of the United States, Canada, Australia, Israel, Switzerland, and Denmark, are working on FHIR projects. In the past three years, Canada has witnessed significant progress in terms of the interoperability of health care systems. Canada Health Infoway, a federally funded, not-for-profit organization that has the mandate of speeding up the adoption of digital health solutions across Canada, regularly develops Pan-Canadian initiatives to extend FHIR capabilities. However, several of these initiatives are still in their nascent stages.

On the positive side, AI does perform certain health care tasks that can support the type of widespread improvements that Watson was created to implement. Two major examples are image classification and natural language processing (a computer's ability to understand spoken commands and carry out a basic conversation). Computers can rapidly analyze thousands of images for correlations to aid in diagnostics. Unfortunately, health care data include much more than just image data.

The final outcome for Watson? In January 2022, IBM sold Watson Health to Francisco Partners, which changed the name to Merative and narrowed the scope of the system to more manageable expectations.

Questions

1. Why was Watson so much better at chess than at health care?
2. Identify and discuss three problems with the data that Watson was using to produce recommendations.
3. What would you recommend that Francisco Partners do differently to realize success from the Merative platform?

Sources: Compiled from A. Dhala and S.R. Chakravarthy, "FHIR—A Choice or a Necessity?" *Digital Health Canada*, January 27, 2023; J. Glaser, M. O'Kane, B. Ryan, and E. Schneider, "How to Use Digital Health Data to Improve Outcomes," *Harvard Business Review*, September 12, 2022; L. Vespoli, "Where Watson Went Wrong," *mmm-online.com*, September 8, 2021; K. Gulen, "Artificial Intelligence as the Cornerstone of Emerging Technologies," *dataconomy.com*, September 6, 2022; E. Sweeney, "Experts Say IBM Watson's Flaws Are Rooted in Data Collection and Interoperability," *Fierce Healthcare*, September 6, 2017; eHealth Network, "How Are AI and ML Changing the Way Healthcare Is Delivered?" *ehealth.eletsonline.com*, August 31, 2022; J. Kagan, "IBM Watson Health Fails, Becomes Merative After Acquisition," *equities.com*, July 25, 2022; D. Muoio, "Watson Health, under New Investment Firm Ownership, Is Reborn as Merative," *Fierce Healthcare*, July 5, 2022; A. Sradars, "Data Sharing in Health Care Is Complicated. Industry Executives Discuss How They're Thinking about Improving and Using It," *Fortune*, May 12, 2022; P. Olson, "Too Much AI May Not Be Good for Your Health or the NHS," *Washington Post*, May 12, 2022; J. Gagnon, "IBM Watson Health's Challenges Tell Us More About Healthcare Data Than It Does About AI," *Forbes*, May 3, 2022; S. Durbhakula, "IBM Dumping Watson Health Is an Opportunity to Reevaluate Artificial Intelligence," *medcitynews.com*, March 27, 2022; S. Konam, "Where Did IBM Go Wrong with Watson Health?" *qz.com*, March 2, 2022; L. O'Leary, "How IBM's Watson Went from the Future of Health Care to Sold Off for Parts," *slate.com*, January 31, 2022; J. Davis, "Watson Health Sale Signals More Pragmatic AI for Healthcare," *Information Week*, January 27, 2022; M. Davis, S. Deveau, and J. Davalos, "IBM Sells Some Watson Health Assets for More Than \$1 Billion," *Bloomberg.com*, January 21, 2022; R. Miller, "IBM Reportedly Shopping Watson Health Just as Healthcare Gets Hot," *TechCrunch.com*, January 7, 2022; P. Smirnov, "7 Facts About FHIR You Need to Know," *Chief Healthcare Executive*, September 19, 2018.

Introduction

Information technologies and systems support organizations in managing—that is, acquiring, organizing, storing, accessing, analyzing, and interpreting—data. As you saw in Chapter 1, when these data are managed properly, they become *information* and then *knowledge*. Information and knowledge are invaluable organizational resources that can provide any organization with a competitive advantage.

So, just how important are data and data management to organizations? From confidential customer information (see this chapter’s opening case) to intellectual property to financial transactions to social media posts, organizations possess massive amounts of data that are critical to their success. Of course, to benefit from these data, they need to manage them effectively. This type of management, however, comes at a huge cost. According to Symantec’s State of Information survey, digital information costs organizations worldwide more than \$1 trillion annually. In fact, it makes up roughly *half* of an organization’s total value. The survey found that large organizations spend an average of \$40 million annually to maintain and use data, and small to medium-sized businesses spend almost \$350,000.

This chapter examines the processes whereby data are transformed first into information and then into knowledge. Managing data is critical to all organizations. Few business professionals are comfortable making or justifying business decisions that are not based on solid information. This is especially true today, when modern information systems make access to that information quick and easy. For example, there are information systems that format data in a way that managers and analysts can easily understand. Consequently, these professionals can access these data themselves and then analyze the data according to their needs. The result is useful *information*. Managers can then apply their experience to use this information to address a business problem, thereby producing *knowledge*. Knowledge management, enabled by information technology, captures and stores knowledge in forms that all organizational employees can access and apply, thereby creating the flexible, powerful “learning organization.”

Organizations store data in databases. Recall from Chapter 1 that a *database* is a collection of related data files or tables that contain data. We discuss databases in Section 5.2, focusing on the relational database model. In Section 5.6, we take a look at the fundamentals of relational database operations.

Clearly, data and knowledge management are vital to modern organizations. But why should *you* learn about them? The reason is that you will play an important role in the development of database applications. The structure and content of your organization’s database depend on how users (meaning you) define your business activities. For example, when database developers in the firm’s MIS group build a database, they use a tool called *entity-relationship (ER) modelling*. This tool creates a model of how users view a business activity. When you understand how to create and interpret an ER model, then you can evaluate whether the developers have captured your business activities correctly.

Keep in mind that decisions about data last longer, and have a broader impact, than decisions about hardware or software. If decisions concerning hardware are wrong, then the equipment can be replaced relatively easily. If software decisions turn out to be incorrect, they can be modified, though not always painlessly or inexpensively. Database decisions, in contrast, are much harder to undo. Database design constrains what the organization can do with its data for a long time. Remember that business users will be stuck with a bad database design, while the programmers who created the database will quickly move on to their next projects.

Furthermore, consider that databases typically underlie the enterprise applications that users access. If there are problems with organizational databases, then it is unlikely that any applications will be able to provide the necessary functionality for users. Databases are difficult to set up properly and to maintain. They are also the component of an information system that is most likely to be blamed when the system performs poorly and the least likely to be recognized when the system performs well. This is why it is so important to get database designs right the first time—and you will play a key role in these designs.

You might also want to create a small personal database using a software product such as Microsoft Access. If so, you will need to be familiar with at least the basics of the product.

After the data are stored in your organization’s databases, they must be accessible in a form that helps users make decisions. Organizations accomplish this objective by developing

data warehouses. You should become familiar with data warehouses because they are invaluable decision-making tools. We discuss data warehouses in Section 5.4.

You will also make extensive use of your organization's knowledge base to perform your job. For example, when you are assigned a new project, you will likely research your firm's knowledge base to identify factors that contributed to the success (or failure) of previous, similar projects. We discuss knowledge management in Section 5.5.

You will begin this chapter by examining the multiple challenges involved in managing data. You then study the database approach that organizations use to help address these challenges. After that, you will turn your attention to Big Data, which organizations must manage in today's business environment. Next, you study data warehouses and data marts and learn how to use them for decision making. You will conclude the chapter by examining knowledge management.

5.1 Managing Data

LEARNING OBJECTIVE

Discuss ways that common challenges in managing data can be addressed using data governance.

All IT applications require data. These data should be of high quality, meaning that they should be accurate, complete, timely, consistent, accessible, relevant, and concise. Unfortunately, the process of acquiring, keeping, and managing data is becoming increasingly difficult.

The Difficulties of Managing Data

Because data are processed in several stages and often in multiple locations, they are frequently subject to problems and difficulties. Managing data in organizations is difficult for many reasons.

1. The amount of data is increasing exponentially with time. Many historical data must be kept for a long time, and new data are added rapidly. For example, to support millions of customers, large retailers such as Walmart must manage many petabytes of data. (A petabyte is approximately 1,000 terabytes, or trillions of bytes; see Technology Guide 1.)
2. Data are also scattered throughout organizations, and they are collected by many individuals using various methods and devices. These data are frequently stored in numerous servers and locations and in different computing systems, databases, formats, and human and computer languages.

MIS Organizations employ information systems for specific business processes, such as transaction processing, supply chain management, and customer relationship management. Information systems that specifically support these processes impose unique requirements on data, which lead to repetition and conflicts across the organization. For example, the marketing function might maintain information on customers, sales territories, and markets. These data might be duplicated within the billing or customer service functions. This arrangement can produce inconsistent data within the enterprise. Inconsistent data prevent a company from developing a unified view of core business information—data concerning customers, products, finances, and so on—across the organization and its information systems. This situation is referred to as data silos.

A **data silo** is a collection of data held by one group that is not easily accessible by other groups. Data silos hinder the process of gaining actionable insights from organizational data, create barriers to an overall view of the enterprise and its data, and delay digital transformation efforts (see Chapter 1). One major method to remove data silos is through cloud data management (see Technology Guide 3 for a complete discussion of cloud computing).

data silo A collection of data held by one group that is not easily accessible by other groups.

3. Another problem is that data are generated from multiple sources: internal sources (e.g., corporate databases and company documents); personal sources (e.g., personal thoughts, opinions, and experiences); and external sources (e.g., commercial databases, government reports, and corporate websites).

Some of these data sources are in the form of *data streams*, which are data that are continuously generated by point-of-sale systems, clickstream data, social media, and sensors. We take a brief look at these data streams here.

- **POM** *Point-of-sale data.* Organizations capture data from each customer purchase with their POS systems. Clerks (or customers themselves using self-checkout) use bar code scanners to scan each item purchased. POS systems collect data in real time, such as the name, product identification number, and unit price of each item; the total amount of all items purchased; the sales tax on that amount; the payment method used; a time stamp of the purchase; and many other data points.
- **MKT** *Clickstream data.* Clickstream data are those data that visitors and customers produce when they visit a website and click on hyperlinks (described in Chapter 6). Clickstream data include the terms that the visitor to the website entered into a search engine to reach that website, all links that users click, how long they spend on each page, if they click the “back” button, if they add or remove items from a shopping cart, and many other data points.
- **MKT** *Social media data.* Social media data (also called social data) are the data collected from individuals’ activity on social media websites, including Facebook, YouTube, LinkedIn, Twitter, and many others. These data include shares, likes and dislikes, ratings, reviews, recommendations, comments, and many other examples.
- **MIS** *Sensor data.* The Internet of Things (IoT; see Chapter 8) is a system in which any object, natural or manufactured, contains internal or external wireless sensor(s) that communicate with each other without human interaction. Each sensor monitors and reports data on physical and environmental conditions around it, such as temperature, sound, pressure, vibration, and movement. Sensors can also control physical systems, such as opening and closing a valve and adjusting the fuel mixture in your car. (See our discussion of supervisory control and data acquisition (SCADA) systems in Chapter 4.)

As with all technology, being able to collect massive amounts of data from many different sources is a double-edged sword.

4. Adding to these problems is the fact that new sources of data such as blogs, podcasts, Tweets, Facebook posts, YouTube videos, texts, and RFID tags and other wireless sensors are constantly being developed, and the data these technologies generate must be managed. Moreover, the data become less current over time. For example, customers move to new addresses or they change their names, companies go out of business or are bought, new products are developed, employees are hired or fired, and companies expand into new countries.
5. Data are also subject to *data rot*. Data rot refers primarily to problems with the media on which the data are stored. Over time, temperature, humidity, and exposure to light can cause physical problems with storage media and thus make it difficult to access data. The second aspect of data rot is that finding the machines needed to access the data can be difficult. For example, it is almost impossible today to find 8-track players to listen to music on. Consequently, a library of 8-track tapes has become relatively worthless, unless you have a functioning 8-track player or you convert the tapes to a more modern medium such as DVDs.
6. Data security, quality, and integrity are critical, yet they are easily jeopardized. Legal requirements relating to data also differ among countries as well as among industries, and they change frequently.
7. **ACCT** **FIN** Two other factors complicate data management. First, federal government regulations—most significantly, Bill 198, the Canadian equivalent of the U.S. Sarbanes-Oxley Act—require companies to account for how information is being managed within their organizations. The law in Canada requires that (1) public companies evaluate and disclose the effectiveness of their internal financial controls, and (2) independent auditors for these companies agree to this disclosure. The law also holds CEOs and CFOs personally responsible for such disclosures. If their companies lack satisfactory

data management policies and fraud or a security breach occurs, then the company officers could be held liable and face prosecution.

Second, companies are drowning in data, much of which are unstructured. As you have seen, the amount of data is increasing exponentially. To be profitable, companies must develop a strategy for managing these data effectively. (See IT's About Business 5.1.)

8. An additional problem with data management is Big Data. Big Data is so important that we devote Section 5.3 to this topic.

IT's About Business 5.1

MIS Data Governance Key to Unlocking Dark Data

The Business Problem

Organizations save vast amounts of data. However, their capacity for collecting data typically exceeds their ability to analyze the data. As a result, many of the data are not used to acquire knowledge or make decisions. We call these data *dark data* because they have not been brought to light and made useful to the organization.

A large majority of enterprise information is composed of dark data. According to a July 2022 report from the Enterprise Strategy Group (www.esg-global.com), an international research and consulting firm that focuses on technology, 20 percent of organizations state that more than 70 percent of their data are dark data. Significantly, a large proportion of these data is unstructured—for example, videos, images, and emails—making it challenging for any tool to analyze them since the data do not fit neatly inside a database.

Why do organizations continue to collect dark data if they cannot utilize them? One reason is to comply with government regulations. Also, organizations fear they will need this information in the future, even though much of it is not currently helpful. For example, most companies maintain past employee files, financial information, transaction logs, confidential intelligence data, emails, internal presentations, download attachments, and even surveillance video footage for which they have no current purpose. Instead, they save it “just in case” they need it one day.

Dark data, then, can be anything and come from anywhere. They are generated by employees, customers, and business processes. They are created as log files by machines, applications, and security systems. They can be sensitive data that should never be saved but still are. They are any data generated by a user's daily digital interactions, such as instant messages or video meeting chats. They are often forgotten, unknown, and unused. They exist everywhere, spread across an organization's complete portfolio of data repositories, from databases to applications.

Although dark data are not used, they constitute potentially valuable information that organizations can employ to increase productivity and boost growth. For example, an organization installs sensors to identify the location of a gas leak. It then stores the data generated by the sensors. However, it never finishes the reporting structure. As a result, the organization has years of sensor data that it never uses. Now, imagine that a safety incident occurs. Information collected by those sensors could have prevented the incident if the organization had used it. Analyses of the available data could have both boosted profits by identifying the leak and potentially saved lives. Additionally, having the data and not utilizing them could lead to lawsuits or a public relations nightmare. Should the organization be liable for not using every bit of data at its disposal?

Given this scenario, should organizations stop collecting data they do not plan to use currently? The answer is, not necessarily. Let's look at potential paths forward.

IT Solution

Organizations must realize that what makes data “dark” is the fact that they are unstructured and unused. A logical starting point to utilizing dark data is understanding what data are available and what issues they might have.

This activity falls under data governance, which we define in Section 5.1 as an approach to managing information across an entire organization. Data governance involves a formal set of business processes and policies that are designed to ensure data are handled according to clearly defined practices. It is essential to determining what data an organization has, what data are valuable, what should be deleted, and what should be kept.

After identifying the valuable data, an organization has at least two paths forward. First, it can connect the dots between the dark data and good, operational data that are available inside individual business units. Identifying these relationships can create valuable insights that drive business decisions.

Second, companies can leave these data where they currently reside but add a metadata layer to index and search these data. Metadata, defined as data about the data, can intelligently classify data by project, customer, workflow, status, or other criteria relating to critical organizational components. This approach takes the data out of the dark and makes them useful by organizing them. AI is designed to search through unstructured yet indexed data, and it could mine those data for insights.

Regardless of which path an organization chooses, the real advantage of bringing dark data to light is that the data can be used to benefit the business.

Questions

1. Define dark data.
2. Give examples of dark data.
3. What is the potential value of dark data to an organization?

Sources: Compiled from B. Lynch, “Three Keys to Securing Shadow Data,” *Security Boulevard*, September 13, 2022; A. Sayed, “The Key to Business Growth? A Solid Data Strategy,” *Fast Company*, September 12, 2022; T. Jones, “Mainframes Are Drowning in the Data Deluge,” *datacenterdynamics.com*, September 9, 2022; N. Sonawane, “Strategies to Make the Most Out of Dark Data,” *Enterprise Talk*, August 23, 2022; H. Selman, “If Only You Knew the Power of the Dark Data...,” *dataconomy.com*, August 22, 2022; M. Korolov, “Unlocking the Hidden Value of Dark Data,” *CIO*, August 11, 2022; M. Labovich, “How Dark Data Can Unlock Real Value by Understanding Risk,” *pwc.com*, May 3, 2022.

Data Governance

To address the numerous problems associated with managing data, organizations are turning to data governance. **Data governance** is an approach to managing information across an entire organization. It involves a formal set of business processes and policies that are designed to ensure that data are handled in a certain, well-defined fashion. That is, the organization follows unambiguous rules for creating, collecting, handling, and protecting its information. The objective is to make information available, transparent, and useful for the people who are authorized to access it, from the moment it enters an organization until it becomes outdated and is deleted.

One strategy for implementing data governance is master data management. **Master data management** is a process that spans all of an organization's business processes and applications. It provides companies with the ability to store, maintain, exchange, and synchronize a consistent, accurate, and timely "single version of the truth" for the company's master data.

Master data are a set of core data, such as customer, product, employee, vendor, geographic location, and so on, that span the enterprise's information systems. It is important to distinguish between master data and transactional data. **Transactional data**, which are generated and captured by operational systems, describe the business's activities, or *transactions*. In contrast, master data are applied to multiple transactions, and they are used to categorize, aggregate, and evaluate the transactional data.

Let's look at an example of a transaction. You (Mary Jones) purchase one Samsung 55-inch OLED television, part number 1234, from Bill Roberts at Best Buy, for \$2,100, on March 15, 2023. In this example, the master data are "salesperson," "store," "product," and "customer." Master data are used to conduct, process, and store transactions. Therefore, specific values related to a transaction are considered transaction data. For instance, in this example, "55-inch OLED television," "Samsung," "Bill Roberts," "1234," "\$2,100," and "March 15, 2023" are transactional data.

An example of master data management concerns home renovation retailer Ace Hardware, which implemented a plan to standardize the master data on its 90,000 products, starting with product names and descriptions, manufacturer names, brands, and item attributes such as dimensions, weights, and colours. It had to do this to improve search effectiveness, increase accuracy, make it easier to enter new products into the DBMS, and facilitate transaction processing at retail stores. Any Ace Hardware store in Canada can use the master database.

How does the system work? For example, if someone visits a store and cannot find the tool they want, a sales associate can look up the item to see if it is available. If it is out of stock, the associate can identify a comparable item according to the characteristics the database lists for the unavailable item. As a result, Ace Hardware can help its customers select from thousands of products fast and accurately.

Along with data governance, organizations use the database approach to manage their data efficiently and effectively. We discuss the database approach in Section 5.2.

data governance An approach to managing information across an entire organization.

master data management

A process that provides companies with the ability to store, maintain, exchange, and synchronize a consistent, accurate, and timely "single version of the truth" for the company's core master data.

master data A set of core data, such as customer, product, employee, vendor, geographic location, and so on, that spans an enterprise's information systems.

transactional data Data generated and captured by operational systems that describe the business's activities, or transactions.

Before you go on...

1. What are some of the difficulties involved in managing data?
2. Define *data governance*, *master data*, and *transactional data*.

5.2 The Database Approach

LEARNING OBJECTIVE

Discuss the advantages and disadvantages of relational databases.

From the mid-1950s, when businesses first adopted computer applications, until the early 1970s, organizations managed their data in a *file management environment*. This environment evolved because organizations typically automated their functions one application at a time. Therefore,

data file (also table)

A collection of logically related records.

the various automated systems developed independently from one another, without any overall planning. Each application required its own data, which were organized in a data file.

A **data file** is a collection of logically related records. In a file management environment, each application has a specific data file related to it. This file contains all the data records the application requires. Over time, organizations developed numerous applications, each with an associated application-specific data file.

For example, imagine that most of your information is stored in your university's central database. In addition, however, a club to which you belong maintains its own files, the athletics department has separate files for student athletes, and your instructors maintain grade data on their personal computers. It is easy for your name to be misspelled in one of these databases or files. Similarly, if you move, then your address might be updated correctly in one database or file but not in the others.

Using databases eliminates many problems that arose from previous methods of storing and accessing data, such as file management systems. Databases are arranged so that one set of software programs—the database management system—provides all users with access to all the data. (You will study database management systems later in this chapter.) Database systems minimize the following problems:

- *Data redundancy*: The same data are stored in multiple locations.
- *Data isolation*: Applications cannot access data associated with other applications.
- *Data inconsistency*: Various copies of the data do not agree.

Database systems also maximize the following benefits:

- *Data security*: Because data are “put in one place” in databases, there is a risk of losing a lot of data at one time. Therefore, databases must have extremely high security measures in place to minimize mistakes and deter attacks.
- *Data integrity*: Data meet certain constraints; for example, there are no alphabetic characters in a Social Insurance Number (SIN) field.
- *Data independence*: Applications and data are independent of one another; that is, applications and data are not linked to each other, so all applications are able to access the same data.

Figure 5.1 illustrates a university database. Note that university applications from the registrar's office, the accounting department, and the athletics department access data through the database management system.

A database can contain vast amounts of data. To make these data more understandable and useful, they are arranged in a hierarchy. We take a closer look at this hierarchy in the next section.

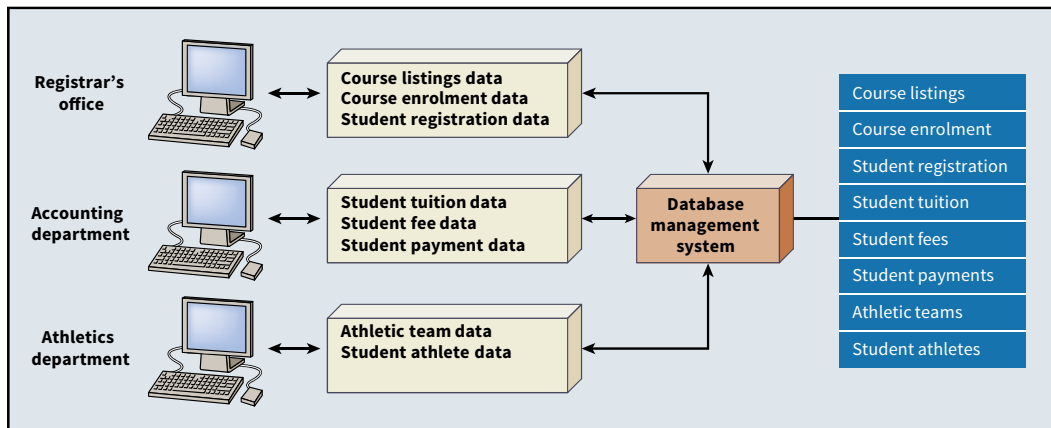


FIGURE 5.1 Database management system.

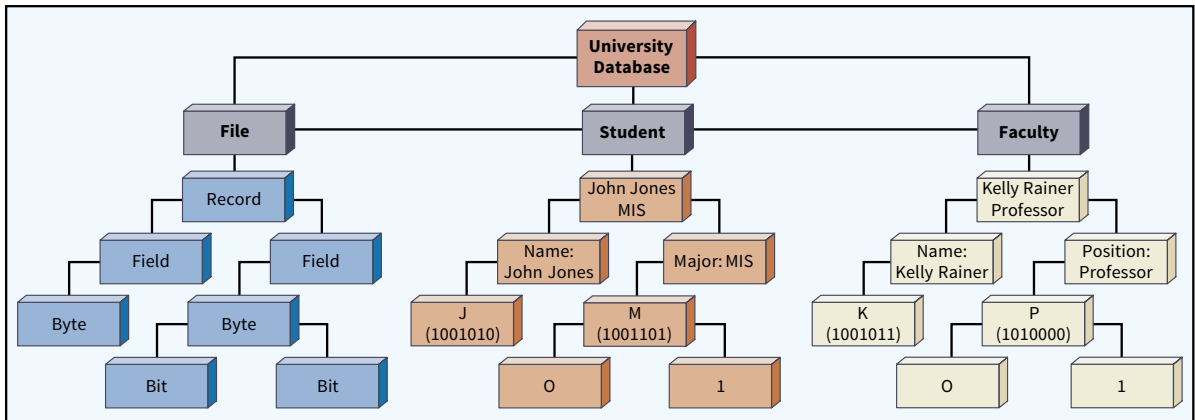


FIGURE 5.2 Hierarchy of data for a computer-based file.

The Data Hierarchy

Data are organized in a hierarchy that begins with bits and proceeds all the way to databases (see [Figure 5.2](#)). A bit (*binary digit*) represents the smallest unit of data a computer can process. The term *binary* means that a bit can consist only of a 0 or a 1. A group of eight bits, called a byte, represents a single character. A byte can be a letter, a number, or a symbol. A logical grouping of characters into a word, a small group of words, or an identification number is called a **field**. For example, a student's name in a university's computer files would appear in the "name" field, and their Social Insurance Number would appear in the "Social Insurance Number" field. Fields can contain data other than text and numbers, such as an image, or any other type of multimedia. For example, a motor vehicle department's licensing database can contain a driver's photograph.

A logical grouping of related fields, such as the student's name, the courses taken, the date, and the grade, comprises a **record**. In the Apple iTunes Store, a song is a field in a record, with other fields containing the song's title, its price, and the album on which it appears. A logical grouping of related records is called a data file or a **table**. For example, a grouping of the records from a particular course, consisting of course number, professor, and students' grades, would constitute a data file for that course. Continuing up the hierarchy, a logical grouping of related files constitutes a *database*. Using the same example, the student course file could be grouped with files on students' personal histories and financial backgrounds to create a student database. In the next section, you will learn about relational database models.

field A characteristic of interest that describes an entity.

record A characteristic of interest that describes an entity.

table A grouping of logically related records.

The Relational Database Model

A **database management system (DBMS)** is a set of programs that provide users with tools to create and manage a database. Managing a database refers to the processes of adding, deleting, accessing, modifying, and analyzing data that are stored in the database. An organization can access these data by using query and reporting tools that are part of the DBMS or by utilizing application programs specifically written to perform this function. DBMSs also provide the mechanisms for maintaining the integrity of stored data, managing security and user access, and recovering information if the system fails. Because databases and DBMSs are essential to all areas of business, they must be carefully managed.

There are several different database architectures, but we focus on the relational database model because it is popular and easy to use. Other database models—for example, the hierarchical and network models—are the responsibility of the MIS function and are not used by organizational employees. Popular examples of relational databases are Microsoft Access and Oracle.

database management system (DBMS) The software program (or group of programs) that provide access to a database.

relational database model

Data model based on the simple concept of tables in order to capitalize on characteristics of rows and columns of data.

data model A diagram that represents entities in the database and their relationships.

entity Any person, place, thing, or event of interest to a user.

instance Each row in a relational table, which is a specific, unique representation of the entity.

attribute Each characteristic or quality of a particular entity.

primary key A field (or attribute) of a record that uniquely identifies that record so that it can be retrieved, updated, and sorted.

Most business data—especially accounting and financial data—were traditionally organized into simple tables consisting of columns and rows. Tables enable people to compare information quickly by row or column. Users can also retrieve items rather easily by locating the point of intersection of a particular row and column.

The **relational database model** is based on the concept of two-dimensional tables. A relational database is generally not one big table—usually called a *flat file*—that contains all of the records and attributes. Such a design would entail far too much data redundancy. Instead, a relational database is usually designed with a number of related tables. Each of these tables contains records (listed in rows) and attributes (listed in columns).

To be valuable, a relational database must be organized so that users can retrieve, analyze, and understand the data they need. A key to designing an effective database is the data model. A **data model** is a diagram that represents entities in the database and their relationships. An **entity** is a person, a place, a thing, or an event—such as a customer, an employee, or a product—about which an organization maintains information. Entities can typically be identified in the user’s work environment. A record generally describes an entity. An **instance** of an entity refers to each row in a relational table, which is a specific, unique representation of the entity. For example, your university’s student database contains an entity called “student.” An instance of the student entity would be a particular student. Thus, you are an instance of the student entity in your university’s student database.

Each characteristic or quality of a particular entity is called an **attribute**. For example, if our entities were a customer, an employee, and a product, entity attributes would include customer name, employee number, and product colour.

Consider the relational database example about students diagrammed in **Figure 5.3**. The table contains data about the entity called students. As you can see, each row of the table corresponds to a single student record. (You have your own row in your university’s student database.) Attributes of the entity are student name, undergraduate major, grade point average, and graduation date. The rows are the records on Sally Adams, John Jones, Jane Lee, Kevin Durham, Juan Rodriguez, Stella Zubnicki, and Ben Jones. Of course, your university keeps much more data on you than our example shows. In fact, your university’s student database probably keeps hundreds of attributes for each student.

Every record in the database must contain at least one field that uniquely identifies that record so that it can be retrieved, updated, and sorted. This identifier field (or attribute) is called the **primary key**. For example, a student record in a university would use a unique student number as its primary key. In **Figure 5.3**, Sally Adams is uniquely identified by her student ID of 111-12-4321.

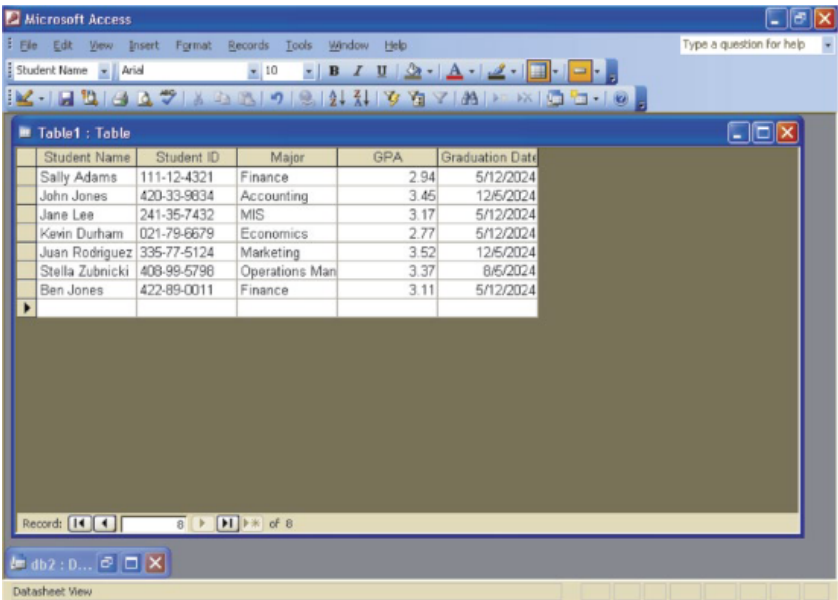


FIGURE 5.3 Student database example.

In some cases, locating a particular record requires the use of secondary keys. A **secondary key** is another field that has some identifying information but typically does not identify the record with complete accuracy. For example, the student's major might be a secondary key if a user wanted to identify all of the students majoring in a particular field of study. It should not be the primary key, however, because many students can have the same major. Therefore, it cannot uniquely identify an individual student.

A **foreign key** is a field (or group of fields) in one table that uniquely identifies a row of another table. A foreign key is used to establish and enforce a link between two tables. We discuss foreign keys in Section 5.6.

Organizations implement databases to manage their data efficiently and effectively. A variety of operations can be performed on databases. We look at three of these operations in detail in Section 5.6: query languages, normalization, and joins.

As we noted earlier in this chapter, organizations must manage huge quantities of data. Such data consist of structured and unstructured data and are called Big Data (discussed in Section 5.3). **Structured data** are highly organized in fixed fields in a data repository such as a relational database. Structured data must be defined in terms of field name and type (e.g., alphanumeric, numeric, and currency). **Unstructured data** refers to data that do not reside in a traditional relational database. Examples of unstructured data are email messages, word processing documents, videos, images, audio files, PowerPoint presentations, Facebook posts, Tweets, Snaps, ratings and recommendations, and Web pages. Industry analysts estimate that 80 to 90 percent of the data in an organization are unstructured. To manage Big Data, many organizations are using special types of databases, which we also discuss in Section 5.3.

Because databases typically process data in real time (or near real time), it is not practical to allow users access to the databases. After all, the data will change while the user is looking at them! As a result, data warehouses have been developed to allow users to access data for decision making. You will learn about data warehouses in Section 5.4.

secondary key A field that has some identifying information, but typically does not uniquely identify a record with complete accuracy.

foreign key A field (or group of fields) in one table that uniquely identifies a row (or record) of another table.

structured data Highly organized data in fixed fields in a data repository such as a relational database that must be defined in terms of field name and type (e.g., alphanumeric, numeric, and currency).

unstructured data Data that do not reside in a traditional relational database.

Before you go on...

1. What is a data model?
2. What is a primary key? A secondary key?
3. What is an entity? An attribute? An instance?
4. What are the advantages and disadvantages of relational databases?

5.3 Big Data

LEARNING OBJECTIVE

Define Big Data and its basic characteristics.

We are accumulating data and information at an increasingly rapid pace from many diverse sources. In fact, organizations are capturing data about almost all events, including events that, in the past, firms never used to think of as data at all—for example, a person's location, the vibrations and temperature of an engine, and the stress at numerous points on a bridge—and then analyzing those data.

Organizations and individuals must process a vast amount of data that continues to increase dramatically. According to IDC (a technology research firm; www.idc.com), the world generates over one zettabyte (10^{21} bytes) of data each year. Furthermore, the amount of data produced worldwide is increasing by 50 percent each year.

As recently as the year 2000, only 25 percent of the stored information in the world was digital. The other 75 percent was analogue; that is, it was stored on paper, film, vinyl records,

Big Data A collection of data so large and complex that it is difficult to manage using traditional database management systems.

and the like. By 2020, the amount of stored information in the world was more than 98 percent digital and less than 2 percent nondigital.

As we discussed at the beginning of this chapter, we refer to the superabundance of data available today as Big Data. **Big Data** is a collection of data that is so large and complex that it is difficult to manage using traditional database management systems. (We capitalize *Big Data* to distinguish the term from large amounts of traditional data.)

Essentially, Big Data is about predictions (see Predictive Analytics in Chapter 12). Predictions do not come from “teaching” computers to “think” like humans. Instead, predictions come from applying mathematics to huge quantities of data to infer probabilities. Consider these examples:

- The likelihood that an email message is spam
- The likelihood that the typed letters “teh” are supposed to be “the”
- The likelihood that the direction and speed of a person jaywalking indicates that he will make it across the street in time, meaning that a self-driving car need only slow down slightly

Big Data systems perform well because they contain huge amounts of data on which to base their predictions. Moreover, these systems are configured to improve themselves over time by searching for the most valuable signals and patterns as more data are input.

Defining Big Data

It is difficult to define Big Data. Here we present two descriptions of the phenomenon. First, the technology research firm Gartner (www.gartner.com) defines Big Data as diverse, high-volume, high-velocity information assets that require new forms of processing in order to enhance decision making, lead to insights, and optimize business processes. Second, the Big Data Institute (TBDI; <https://thebigdatainstitute.wordpress.com>) defines Big Data as vast data sets that:

- Exhibit variety;
- Include structured, unstructured, and semistructured data;
- Are generated at high velocity with an uncertain pattern;
- Do not fit neatly into traditional, structured, relational databases; and
- Can be captured, processed, transformed, and analyzed in a reasonable amount of time only by sophisticated information systems.

Big Data generally consists of the following:

- Traditional enterprise data—for example, customer information from customer relationship management systems, transactional enterprise resource planning data, Web store transactions, operations data, and general ledger data.
- Machine-generated/sensor data—for example, smart meters; manufacturing sensors; sensors integrated into smartphones, automobiles, airplane engines, and industrial machines; equipment logs; and trading systems data.
- Social data—for example, customer feedback comments; microblogging sites such as Twitter; and social media sites such as Facebook, YouTube, and LinkedIn.
- Images captured by billions of devices located throughout the world, from digital cameras and camera phones to medical scanners and security cameras.

Let’s take a look at a few specific examples of Big Data:

- Facebook’s 2.45 billion users upload more than 350 million new photos every day. They also click a “like” button or leave a comment more than 5 billion times every day. Facebook’s data warehouse stores more than 300 petabytes of data, and the platform receives 600 terabytes of incoming data per day.

- The 2 billion users of Google's YouTube service upload more than 300 hours of video per minute. Google itself processes, on average, more than 70,000 search queries per second.
- In July 2020, industry analysts estimated that Twitter users sent some 550 million Tweets per day.
- Autonomous cars generate up to 20 terabytes of data per car per day.

Characteristics of Big Data

Big Data has three distinct characteristics: volume, velocity, and variety. These characteristics distinguish Big Data from traditional data:

1. *Volume*: We have noted the huge volume of Big Data. Consider machine-generated data, which are generated in much larger quantities than nontraditional data. For example, sensors in a single jet engine can generate 10 terabytes of data in 30 minutes. (See our discussion of the Internet of Things in Chapter 8.) With more than 25,000 airline flights per day, the daily volume of data from just this single source is incredible. Smart electrical meters, sensors in heavy industrial equipment, and telemetry from automobiles compound the volume problem.
2. *Velocity*: The rate at which data flow into an organization is rapidly increasing. Velocity is critical because it increases the speed of the feedback loop between a company, its customers, its suppliers, and its business partners. For example, the internet and mobile technology enable online retailers to compile histories not only on final sales, but on their customers' every click and interaction. Companies that can quickly use that information—for example, by recommending additional purchases—gain competitive advantage.
3. *Variety*: Traditional data formats tend to be structured and relatively well described, and they change slowly. Traditional data include financial market data, point-of-sale transactions, and much more. In contrast, Big Data formats change rapidly. They include satellite imagery, broadcast audio streams, digital music files, web page content, scans of government documents, and comments posted on social networks.

Irrespective of its source, structure, format, and frequency, Big Data is valuable. If certain types of data appear to have no value today, it is because we have not yet been able to analyze them effectively. For example, several years ago when Google began harnessing satellite imagery, capturing street views, and then sharing these geographical data for free, few people understood their value. Today, we recognize that such data are incredibly valuable because analyses of Big Data yield deep insights. We discuss analytics in detail in Chapter 12.

Issues with Big Data

Despite its extreme value, Big Data does have issues. In this section, we take a look at data integrity, data quality, and the nuances of analysis that are worth noting.

Big Data Can Come from Untrusted Sources As we discussed earlier, one of the characteristics of Big Data is variety, meaning that it can come from numerous, widely varied sources. These sources may be internal or external to the organization. For example, a company might want to integrate data from unstructured sources such as emails, call centre notes, and social media posts with structured data about its customers from its data warehouse. The question is, how trustworthy are those external sources of data? For example, how trustworthy is a Tweet? The data may come from an unverified source. Furthermore, the data itself, reported by the source, may be false or misleading.

Big Data Is Dirty *Dirty data* refers to inaccurate, incomplete, incorrect, duplicate, or erroneous data. Examples of such problems are misspelling of words and duplicate data such as retweets or company press releases that appear multiple times in social media.

Suppose a company is interested in performing a competitive analysis using social media data. The company wants to see how often a competitor's product appears in social media outlets as well as the sentiments associated with those posts. The company notices that the number of positive posts about the competitor is twice as great as the number of positive posts about itself. This finding could simply be a case of the competitor pushing out its press releases to multiple sources; in essence, blowing its own horn. Alternatively, the competitor could be getting many people to retweet an announcement.

Big Data Changes, Especially in Data Streams Organizations must be aware that data quality in an analysis can change, or the data themselves can change, because the conditions under which the data are captured can change. For example, imagine a utility company that analyzes weather data and smart-meter data to predict customer power usage. What happens when the utility is analyzing these data in real time and it discovers that data are missing from some of its smart meters?

Managing Big Data

Big Data makes it possible to do many things that were previously much more difficult; for example, to spot business trends more rapidly and accurately, prevent disease, track crime, and so on. When Big Data is properly analyzed, it can reveal valuable patterns and information that were previously hidden because of the amount of work required to discover them. Leading corporations, such as Walmart and Google, have been able to process Big Data for years, but only at great expense. Today's hardware, cloud computing (see Technology Guide 3), and open-source software make processing Big Data affordable for most organizations.

For many organizations, the first step toward managing data was to integrate information silos into a database environment and then to develop data warehouses for decision making. An *information silo* is an information system that does not communicate with other related information systems in an organization. After they completed this step, many organizations turned their attention to the business of information management—making sense of their rapidly expanding data. In recent years, Oracle, IBM, Microsoft, and SAP have spent billions of dollars purchasing software firms that specialize in data management and business analytics. (You will learn about business analytics in Chapter 12.)

In addition to existing data management systems, today many organizations employ NoSQL databases to process Big Data. Think of them as “not only SQL” (structured query language) databases. (We discuss SQL in Section 5.6.)

As you have seen in this chapter, traditional relational databases such as Oracle and MySQL store data in tables organized into rows and columns. Recall that each row is associated with a unique record, and each column is associated with a field that defines an attribute of that account.

In contrast, NoSQL databases can manipulate both structured and unstructured data, as well as inconsistent or missing data. For this reason, NoSQL databases are particularly useful when working with Big Data. Hadoop and MapReduce are particularly useful when analyzing massive databases.

Hadoop (<http://hadoop.apache.org>) is not a type of database. Rather, it is a collection of programs that allow people to store, retrieve, and analyze very large data sets using massively parallel processing. *Massively parallel processing* is the coordinated processing of an application by multiple processors that work on different parts of the application, with each processor utilizing its own operating system and memory. As such, Hadoop enables users to access NoSQL databases, which can be spread across thousands of servers, without a reduction in performance. For example, a large database application that could take 20 hours of processing time on a centralized relational database system might take only a few minutes when using Hadoop's parallel processing.

MapReduce refers to the software procedure of dividing an analysis into pieces that can be distributed across different servers in multiple locations. MapReduce first distributes the analysis (map) and then collects and integrates the results back into a single report (reduce).

Many products use NoSQL databases, including Cassandra (<http://cassandra.apache.org>), CouchDB (<http://couchdb.apache.org>), and MongoDB (www.mongodb.org). Let's

take a look at how eHarmony uses Redis's (www.redis.io) in-memory NoSQL database. An in-memory database is a DBMS that primarily relies on main memory (see Technology Guide 1) for data storage, in contrast to DBMSs that use hard-drive storage.

eHarmony (www.eharmony.com) uses Oracle's DBMS for cold data and Redis for hot data. *Cold data* refers to the storage of relatively inactive data that does not have to be accessed frequently or rapidly. *Hot data* refers to data that must be accessed frequently and rapidly. The eHarmony matching system applies analytics in near real time to quickly pair a candidate with a best-case potential match. Quickly serving up compatible matches requires rapid searches of personality trait data (i.e., Redis used with hot data). eHarmony's back-end business operations do not require high-speed access to data and therefore use Oracle with cold data.

Putting Big Data to Use

Modern organizations must manage Big Data and gain value from it. They can employ several strategies to achieve this objective.

Making Big Data Available Making Big Data available for relevant stakeholders can help organizations gain value. For example, consider open data in the public sector. Open data are accessible public data that individuals and organizations can use to create new businesses and solve complex problems. In particular, government agencies gather vast amounts of data, some of which are Big Data. Making those data available can provide economic benefits.

Enabling Organizations to Conduct Experiments Big Data allows organizations to improve performance by conducting controlled experiments. For example, Amazon (and many other companies such as Google and LinkedIn) constantly experiments by offering slightly different looks on its website. These experiments are called A/B experiments; because each experiment has only two possible outcomes. Here is an example of an A/B experiment at Etsy (www.etsy.com), an online marketplace for vintage and handmade products.

MKT When Etsy analysts noticed that one of its Web pages attracted customer attention but failed to retain it, they looked more closely at the page and discovered that it had few “calls to action.” (A call to action is an item, such as a button, on a Web page that enables a customer to do something.) On this particular Etsy page, customers could leave, buy, search, or click on two additional product images. The analysts decided to show more product images on the page.

Consequently, one group of visitors to the page saw a strip across the top of the page that displayed additional product images. Another group saw only the two original product images. On the page with additional images, customers viewed more products and, significantly, bought more products. The results of this experiment revealed valuable information to Etsy.

Microsegmentation of Customers Segmentation of a company's customers means dividing them into groups that share one or more characteristics. Microsegmentation simply means dividing customers up into very small groups, or even down to the individual customer.

MKT For example, Paytronix Systems (www.paytronix.com) provides loyalty and rewards program software for thousands of different restaurants. Paytronix gathers restaurant guest data from a variety of sources beyond loyalty and gift programs, including social media. Paytronix analyzes this Big Data to help its restaurant clients to microsegment their guests. Restaurant managers are now able to customize their loyalty and gift programs more precisely. Since they have taken these steps, they are noting improved profitability and customer satisfaction in their restaurants.

POM **Creating New Business Models** Companies can use Big Data to create new business models. For example, a commercial transportation company operated a substantial fleet of large long-haul trucks. The company recently placed sensors on all its trucks. These sensors wirelessly communicate sizeable amounts of information to the company, a

process called *telematics*. The sensors collect data on vehicle usage—including acceleration, braking, cornering, and so on—in addition to driver performance and vehicle maintenance.

By analyzing this Big Data, the company was able to improve the condition of its trucks through near-real-time analysis that proactively suggested preventive maintenance. The company was also able to improve the driving skills of its operators by analyzing their driving styles.

The transportation company then made its Big Data available to its insurance carrier. Using this data, the insurance carrier was able to perform a more precise risk analysis of driver behaviour and the condition of the trucks. The carrier then offered the transportation company a new pricing model that lowered its premiums by 10 percent due to safety improvements enabled by analysis of the Big Data.

Organizations Can Analyze More Data In some cases, organizations can even process all the data related to a particular phenomenon, so they do not have to rely as much on sampling. Random sampling works well, but it is not as effective as analyzing an entire data set. Random sampling also has some basic weaknesses. To begin with, its accuracy depends on ensuring randomness when collecting the sample data. However, achieving such randomness is problematic. Systematic biases in the process of data collection can cause results to be highly inaccurate. For example, consider political polling using land line phones. This sample tends to exclude people who use only cellphones. This bias can seriously skew the results because cellphone users are typically younger and more liberal than people who rely primarily on land line phones.

Big Data Used in the Organization's Functional Areas

In this section, we provide examples of how Big Data is valuable to various functional areas in the firm.

HRM Human Resources Big Data has caused tremendous changes in various areas of human resources. For instance, Royal Bank of Canada (RBC; www.rbcroyalbank.com) employs Big Data to improve its strategic workforce planning, predicting hiring needs, recruiting, employee training, motivation, and engagement. RBC collects and analyzes both classic HR data such as employee demographics, performance evaluations, work history, opinion surveys, etc., as well as the data from its business outcomes such as sales figures, customer evaluations of services, and customer loyalty to identify how to best optimize its HR practices to improve outcomes for both the business and the employees. The team in charge of this endeavour employs different data analysis techniques such as modelling and simulations to forecast the expected outcome of different decisions, approaches, and interventions or to predict the shortages of human resources that RBC might face. One way that RBC uses Big Data is to improve managerial effectiveness by identifying those managers who most require development such as coaching or training as well as those who could not benefit from such interventions and should be moved to non-managerial positions.

Another example is Catalyte IT Services (www.catalyte.io), a technology outsourcing company that hires teams for programming jobs. Traditional recruiting is typically too slow, and hiring managers often subjectively choose candidates who are not the best fit for the job. Catalyte addresses this problem by requiring candidates to fill out an online assessment. It then uses the assessment to collect thousands of data points about each candidate. In fact, the company collects more data based on *how* candidates answer than on *what* they answer.

For example, the assessment might give a problem requiring calculus to an applicant who is not expected to know the subject. How the candidate responds—labouring over an answer, answering quickly and then returning later, or skipping the problem entirely—provides insight into how that candidate might deal with challenges that they will encounter on the job. That is, someone who labours over a difficult question might be effective in an assignment that requires a methodical approach to problem solving, whereas an applicant who takes a more aggressive approach might perform better in a different job setting.

The benefit of this Big Data approach is that it recognizes that people bring different skills to the table and there is no one-size-fits-all person for any job. Analyzing millions of data points can reveal which attributes candidates bring to specific situations.

As one measure of success, employee turnover at Catalyte averages about 15 percent per year, compared with more than 30 percent for its U.S. competitors and more than 20 percent for similar companies overseas.

MKT Product Development Big Data can help capture customer preferences and put that information to work in designing new products. For example, Ford Motor Company (www.ford.com) was considering a “three blink” turn indicator that had been available on its European cars for years. Unlike the turn signals on its North American vehicles, this indicator flashes three times at the driver’s touch and then automatically shuts off.

Ford decided that conducting a full-scale market research test on this blinker would be too costly and time-consuming. Instead, it examined auto enthusiast websites and owner forums to discover what drivers were saying about turn indicators. Using text-mining algorithms, researchers culled more than 10,000 mentions and then summarized the most relevant comments.

The results? Ford introduced the three-blink indicator on the new Ford Fiesta in 2010, and by 2013 it was available on most Ford products. Although some Ford owners complained online that they have had trouble getting used to the new turn indicator, many others defended it. Ford managers note that the use of text-mining algorithms was critical in this effort because they provided the company with a complete picture that would not have been available using traditional market research.

POM Operations For years, companies have been using information technology to make their operations more efficient. Consider the Aldo Group (www.aldoshoes.com), a Canadian footwear and accessories manufacturer with 3,000 points of sale in more than 100 countries around the world. Aldo uses Big Data analytics to optimize its inventory and order fulfillment processes for digital orders received through its website, mobile app or even in store (when a customer wants a specific product that is out of stock at the store where the customer is shopping). To do that, Aldo does not rely only on minimizing or optimizing the distance of delivery; it also performs a sophisticated analysis involving various variables to decide from what store or inventory a shipment should be made so that stores do not run out of popular products or pile up large stocks. This approach has enabled Aldo to reduce its wasted stock significantly. In addition, Aldo has observed up to 12 percent higher in-store conversion opportunities because it maintains the in-store inventory to satisfy high localized demand instead of shipping the stock to fulfill digital orders.

MKT Marketing Marketing managers have long used data to better understand their customers and to target their marketing efforts more directly. Today, Big Data enables marketers to craft much more personalized messages.

The United Kingdom’s InterContinental Hotels Group (IHG; www.ihg.com) gathered details about the members of its Priority Club rewards program, such as income levels and whether members prefer family-style or business-traveller accommodations. The company then consolidated all this information with information obtained from social media into a single data warehouse. Using its data warehouse and analytics software, the hotelier launched a new marketing campaign. Where previous marketing campaigns generated, on average, between 7 and 15 customized marketing messages, the new campaign generated more than 1,500. IHG rolled out these messages in stages to an initial core of 12 customer groups, each of which is defined by 4,000 attributes. One group, for example, tends to stay on weekends, redeem reward points for gift cards, and register through IHG marketing partners. Using this information, IHG sent these customers a marketing message that alerted them to local weekend events.

The campaign proved to be highly successful. It generated a 35 percent higher rate of customer conversions, or acceptances, than previous similar campaigns.

POM Government Operations Consider the United Kingdom. According to the INRIX Traffic Scorecard, although the United States has the worst congestion on average,

London topped the world list for metropolitan areas. In London, drivers wasted an average of 101 hours per year in gridlock. Congestion is bad for business. The INRIX study estimated that the cost to the UK economy would be £307 billion between 2013 and 2030.

Congestion is also harmful to urban resilience, negatively affecting both environmental and social sustainability in terms of emissions, global warming, air quality, and public health. As for the liveability of a modern city, congestion is an important component of the urban transport user experience (UX).

Calculating levels of UX satisfaction at any given time involves solving a complex equation with a range of key variables and factors: total number of transport assets (road and rail capacity, plus parking spaces), users (vehicles, pedestrians), incidents (roadwork, accidents, breakdowns), plus expectations (anticipated journey times and passenger comfort).

The growing availability of Big Data sources within London—for example, traffic cameras and sensors on cars and roadways—can help to create a new era of smart transport. Analyzing this Big Data offers new ways for traffic analysts in London to “sense the city” and enhance transport via real-time estimation of traffic patterns and rapid deployment of traffic management strategies.

Before you go on...

1. Define Big Data.
2. Describe the characteristics of Big Data.
3. Describe how companies can use Big Data to gain competitive advantage.

5.4

Data Warehouses and Data Marts

LEARNING OBJECTIVE

Explain the elements necessary to successfully implement and maintain data warehouses.

Today, the most successful companies are those that can respond quickly and flexibly to market changes and opportunities. A key to this response is the effective and efficient use of data and information by analysts and managers. The challenge is to provide users with access to corporate data so they can analyze them to make better decisions. Let's consider an example. If the manager of a local bookstore wanted to know the profit margin on used books at their store, then they could obtain that information from the database using SQL or query-by-example (QBE). QBE is a method of creating database queries that allows the user to search for documents based on an example in the form of a selected string of text or in the form of a document name or a list of documents. However, if they needed to know the trend in the profit margins on used books over the past 10 years, then they would have to construct a very complicated SQL or QBE query.

This example illustrates several reasons why organizations are building data warehouses and data marts. First, the bookstore's databases contain the necessary information to answer the manager's query, but the information is not organized in a way that makes it easy for them to find what they need. Therefore, complicated queries might take a long time to answer, and they might also degrade the databases' performance. Second, transactional databases are designed to be updated. This update process requires extra processing. Data warehouses and data marts are read-only. Therefore, the extra processing is eliminated because data already contained in the data warehouse are not updated. Third, transactional databases are designed to access a single record at a time. In contrast, data warehouses are designed to access large groups of related records.

To solve these problems, companies are using a variety of tools with data warehouses and data marts to make it easier and faster for users to access, analyze, and query data. You will learn about these tools in Chapter 12 on business analytics.

Describing Data Warehouses and Data Marts

In general, data warehouses and data marts support business analytics applications. As you will see in Chapter 12, business analytics encompasses a broad category of applications, technologies, and processes for gathering, storing, accessing, and analyzing data to help business users make better decisions. A **data warehouse** is a repository of historical data that are organized by subject to support decision makers within the organization.

Because data warehouses are so expensive, they are used primarily by large companies. A **data mart** is a low-cost, scaled-down version of a data warehouse that is designed for the end-user needs in a strategic business unit (SBU) or an individual department. Data marts can be implemented faster than data warehouses, often in less than 90 days. Furthermore, they support local rather than central control by conferring power on the user group. Typically, groups that need a single or a few business analytics applications require only a data mart, and not a data warehouse.

The basic characteristics of data warehouses and data marts include the following:

- *Organized by business dimension or subject.* Data are organized by subject—for example, by customer, vendor, product, price level, and region. This arrangement differs from transactional systems, where data are organized by business process such as order entry, inventory control, and accounts receivable.
- *Use online analytical processing.* Typically, organizational databases are oriented toward handling transactions. That is, databases use *online transaction processing* (OLTP), where business transactions are processed online as soon as they occur. The objectives are speed and efficiency, which are critical to a successful internet-based business operation. In contrast, data warehouses and data marts, which are designed to support decision makers but not OLTP, use online analytical processing (OLAP), which involves the analysis of accumulated data by end users. We consider OLAP in greater detail in Chapter 12.
- *Integrated.* Data are collected from multiple systems and are then integrated around subjects. For example, customer data may be extracted from internal (and external) systems and then integrated around a customer identifier, thereby creating a comprehensive view of the customer.
- *Time variant.* Data warehouses and data marts maintain historical data; that is, data that include time as a variable. Unlike transactional systems, which maintain only recent data (e.g., for the last day, week, or month), a warehouse or mart may store years of data. Organizations use historical data to detect deviations, trends, and long-term relationships.
- *Nonvolatile.* Data warehouses and data marts are nonvolatile—that is, users cannot change or update the data. Therefore, the warehouse or mart reflects history, which, as we just saw, is critical for identifying and analyzing trends. Warehouses and marts are updated, but through IT-controlled load processes rather than by users.
- *Multidimensional.* Typically, the data warehouse or mart uses a multidimensional data structure. Recall that relational databases store data in two-dimensional tables. In contrast, data warehouses and marts store data in more than two dimensions. For this reason, the data are said to be stored in a **multidimensional structure**. A common representation for this multidimensional structure is the *data cube*.

The data in data warehouses and marts are organized by *business dimensions*, which are subjects such as product, geographic area, and time period that represent the edges of the data cube. If you look ahead to Figure 5.6 for an example of a data cube, you see that the product dimension is composed of nuts, screws, bolts, and washers; the geographic area dimension is composed of East, West, and Central; and the time period dimension is composed of 2019, 2020, and 2021. Users can view and analyze data from the perspective of these business dimensions. This analysis is intuitive because the dimensions are presented in business terms that users can easily understand.

data warehouse

A repository of historical data that are organized by subject to support decision makers in the organization.

data mart A low-cost, scaled-down version of a data warehouse that is designed for the end-user needs in a strategic business unit (SBU) or a department.

multidimensional structure

Storage of data in more than two dimensions; a common representation is the data cube.

A Generic Data Warehouse Environment

The environment for data warehouses and marts includes the following:

- Source systems that provide data to the warehouse or mart
- Data-integration technology and processes that prepare the data for use
- Different architectures for storing data in an organization's data warehouse or data marts
- Different tools and applications for a variety of users. (You will learn about these tools and applications in Chapter 12.)
- *Metadata* (data about the data in a repository), data quality, and governance processes that ensure that the warehouse or mart meets its purposes

Figure 5.4 depicts a generic data warehouse or data mart environment. Let's drill down into the component parts.

Source Systems There is typically some “organizational pain point”—that is, a business need—that motivates a firm to develop its Business Intelligence (BI) capabilities (BI tools and capabilities are discussed in Chapter 12). Working backward, this pain leads to information requirements, BI applications, and requirements for source system data. These data requirements can range from a single source system, as in the case of a data mart, to hundreds of source systems, as in the case of an enterprise-wide data warehouse.

Modern organizations can select from a variety of source systems, including operational/transactional systems, enterprise resource planning (ERP) systems, website data, third-party data (e.g., customer demographic data), and more. The trend is to include more types of data (e.g., sensing data from RFID tags). These source systems often use different software packages (e.g., IBM, Oracle), and they store data in different formats (e.g., relational, hierarchical).

A common source for the data in data warehouses is the company's operational databases, which can be relational databases. To differentiate between relational databases and multidimensional data warehouses and marts, imagine your company manufactures four products—nuts, screws, bolts, and washers—and has sold them in three territories—East, West, and Central—for the previous three years—2022, 2023, and 2024. In a relational

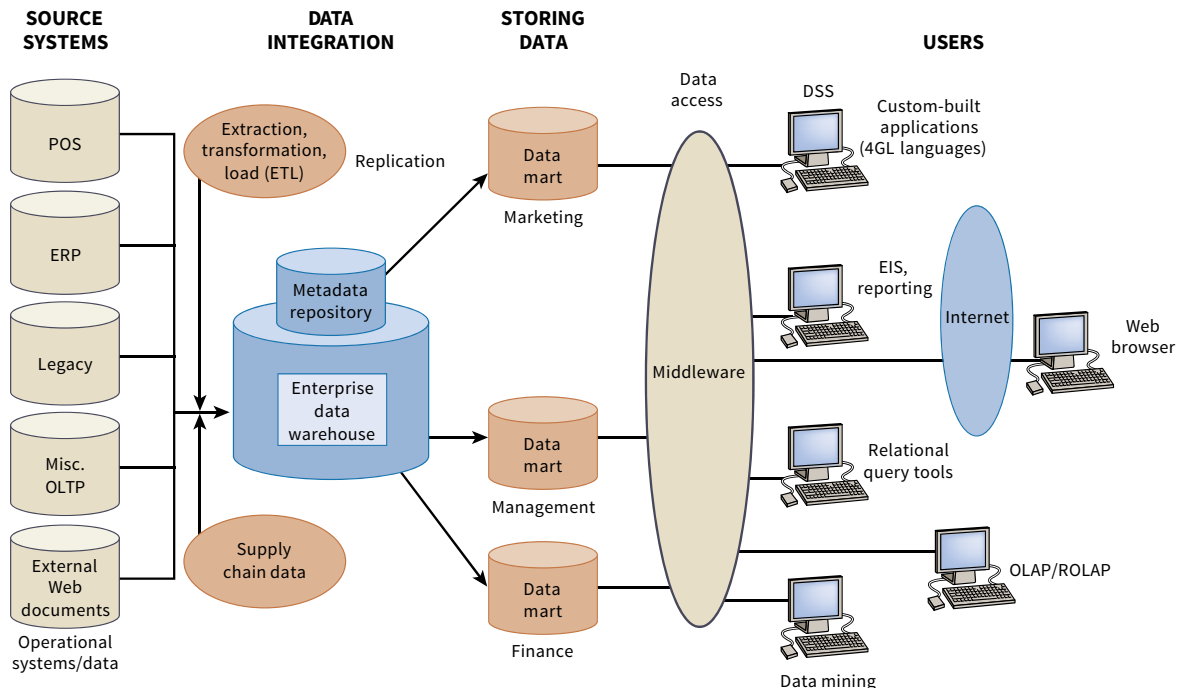


FIGURE 5.4 Data warehouse framework.

database, these sales data would resemble **Figure 5.5(a)** through **(c)**. In a multidimensional database, in contrast, these data would be represented by a three-dimensional matrix (or data cube), as depicted in **Figure 5.6**. This matrix represents sales *dimensioned by* products, regions, and year. Notice that Figure 5.5(a) presents only sales for 2022. Sales for 2023 and 2024 are presented in Figure 5.5(b) and (c), respectively. **Figure 5.7(a)** through **(c)** illustrates the equivalence between these relational and multidimensional databases.

(a) 2022			(b) 2023			(c) 2024		
Product	Region	Sales	Product	Region	Sales	Product	Region	Sales
Nuts	East	50	Nuts	East	60	Nuts	East	70
Nuts	West	60	Nuts	West	70	Nuts	West	80
Nuts	Central	100	Nuts	Central	110	Nuts	Central	120
Screws	East	40	Screws	East	50	Screws	East	60
Screws	West	70	Screws	West	80	Screws	West	90
Screws	Central	80	Screws	Central	90	Screws	Central	100
Bolts	East	90	Bolts	East	100	Bolts	East	110
Bolts	West	120	Bolts	West	130	Bolts	West	140
Bolts	Central	140	Bolts	Central	150	Bolts	Central	160
Washers	East	20	Washers	East	30	Washers	East	40
Washers	West	10	Washers	West	20	Washers	West	30
Washers	Central	30	Washers	Central	40	Washers	Central	50

FIGURE 5.5 Relational databases.

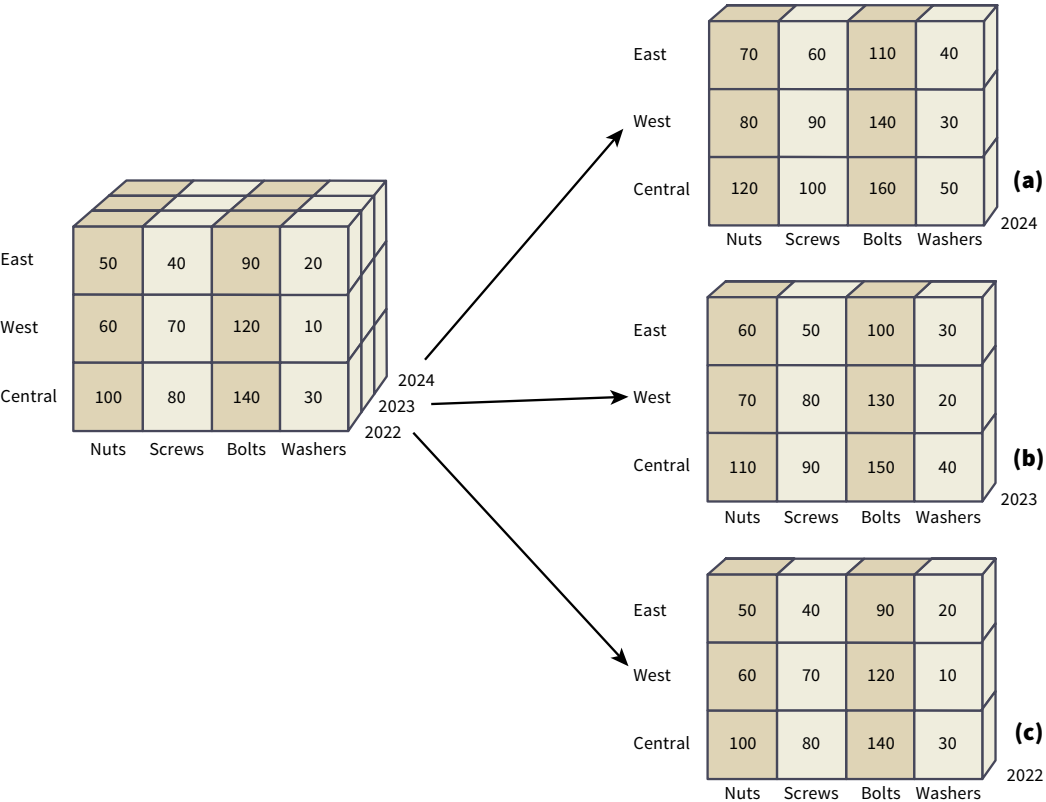


FIGURE 5.6 Data cube.

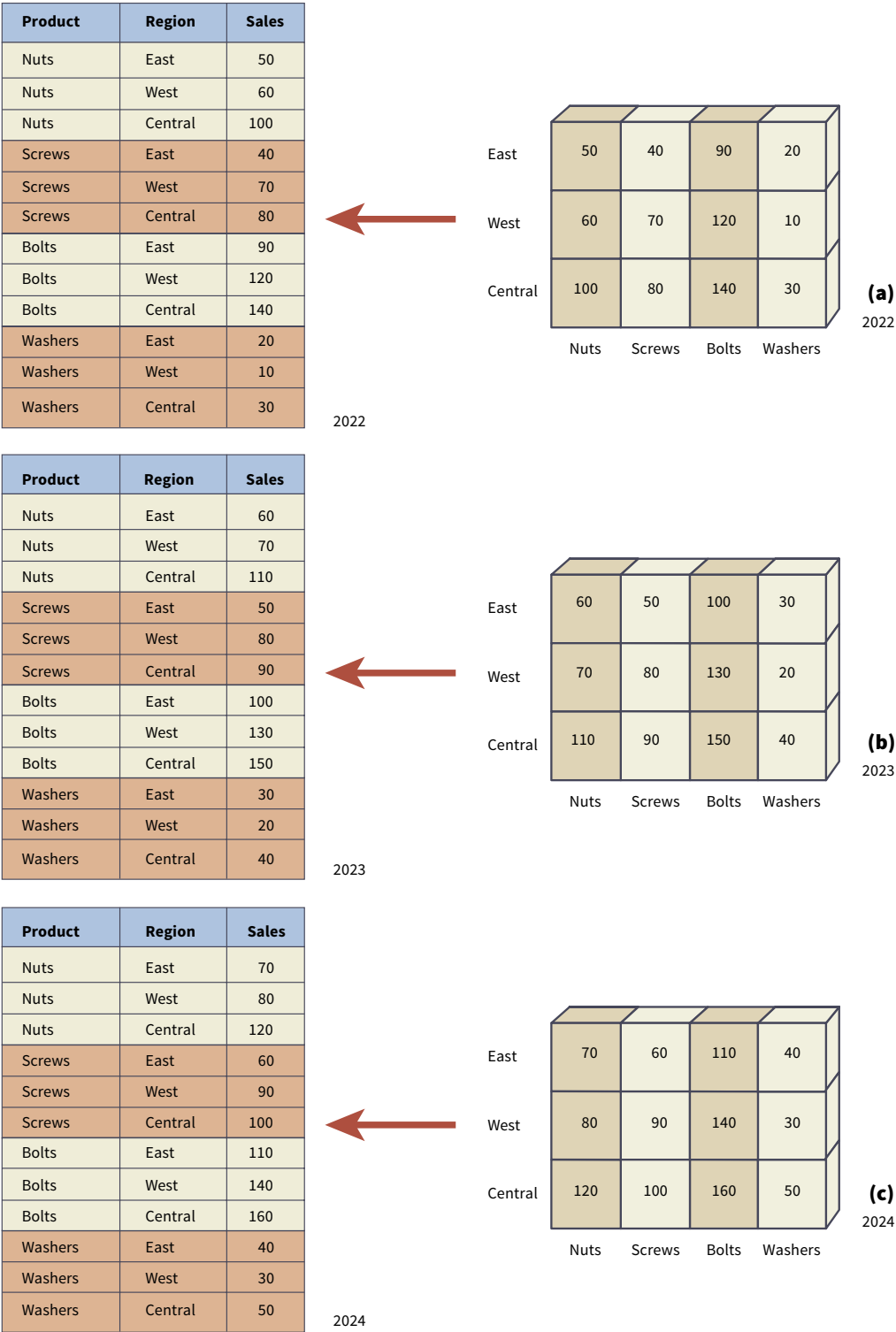


FIGURE 5.7 Equivalence between relational and multidimensional databases.

Unfortunately, many source systems that have been in use for years contain “bad data”—for example, missing or incorrect data—and are poorly documented. As a result, data-profiling software should be used at the beginning of a warehousing project to better understand the data. Among other things, this software can provide statistics on missing data, identify possible primary and foreign keys, and reveal how derived values—for example, $\text{column 3} = \text{column 1} + \text{column 2}$ —are calculated. Subject area database specialists such as marketing and human resources personnel can also assist in understanding and accessing the data in source systems.

Organizations need to address other source systems issues as well. For example, many organizations maintain multiple systems that contain some of the same data. These enterprises need to select the best system as the source system. Organizations must also decide how granular, or detailed, the data should be. For example, does the organization need daily sales figures or data for individual transactions? The conventional wisdom is that it is best to store data at a highly granular level because someone will likely request those data at some point.

Data Integration In addition to storing data in their source systems, organizations need to extract the data, transform them, and then load them into a data mart or warehouse. This process is often called ETL, although the term *data integration* is increasingly being used to reflect the growing number of ways that source system data can be handled. For example, in some cases, data are extracted, loaded into a mart or warehouse, and then transformed (i.e., ELT rather than ETL).

Data extraction can be performed either by handwritten code such as SQL queries or by commercial data-integration software. Most companies employ commercial software. This software makes it relatively easy to (1) specify the tables and attributes in the source systems that are to be used; (2) map and schedule the movement of the data to the target, such as a data mart or warehouse; (3) make the required transformations; and, ultimately, (4) load the data.

After the data are extracted, they are transformed to make them more useful. For example, data from different systems may be integrated around a common key, such as a customer identification number. Organizations adopt this approach to create a 360-degree view of all of their interactions with their customers. As an example of this process, consider a bank. Customers can engage in a variety of interactions: visiting a branch, banking online, using an ATM, obtaining a car loan, and more. The systems for these touch points—defined as the numerous ways that organizations interact with customers, such as email, the Web, direct contact, and the telephone—are typically independent of one another. To obtain a holistic picture of how customers are using the bank, the bank must integrate the data from the various source systems into a data mart or warehouse.

Other kinds of transformations also take place. For example, format changes to the data may be required, such as using *male* and *female* to denote gender, as opposed to 0 and 1 or M and F. Aggregations may be performed, say on sales figures, so that queries can use the summaries rather than recalculating them each time. Data-cleansing software may be used to clean up the data; for example, eliminating duplicate records for the same customer.

Finally, data are loaded into the warehouse or mart during a specified period known as the “load window.” This window is becoming smaller as companies seek to store ever-fresher data in their warehouses. For this reason, many companies have moved to real-time data warehousing, where data are moved using data-integration processes from source systems to the data warehouse or mart almost instantly. For example, within 15 minutes of a purchase at Walmart, the details of the sale have been loaded into a warehouse and are available for analysis.

Storing the Data Organizations can choose from a variety of architectures to store decision-support data. The most common architecture is *one central enterprise data warehouse*, without data marts. Most organizations use this approach because the data stored in the warehouse are accessed by all users, and they represent the single version of the truth.

Another architecture is *independent data marts*. These marts store data for a single application or a few applications, such as marketing and finance. Organizations that employ this architecture give only limited thought to how the data might be used for other applications or by other functional areas in the organization. Clearly this is a very application-centric approach to storing data.

The independent data mart architecture is not particularly effective. Although it may meet a specific organizational need, it does not reflect an enterprise-wide approach to data management. Instead, the various organizational units create independent data marts. Not only are these marts expensive to build and maintain, but they often contain inconsistent data. For example, they may have inconsistent data definitions such as: What is a customer? Is a particular individual a potential or a current customer? They might also use different source systems, which can have different data for the same item, such as a customer address (if the customer had moved). Although independent data marts are an organizational reality, larger companies have increasingly moved to data warehouses.

Still another data warehouse architecture is the *hub and spoke*. This architecture contains a central data warehouse that stores the data plus multiple dependent data marts that source their data from the central repository. Because the marts obtain their data from the central repository, the data in these marts still comprise the *single version of the truth* for decision-support purposes.

The dependent data marts store the data in a format that is appropriate for how the data will be used and for providing faster response times to queries and applications. As you have learned, users can view and analyze data from the perspective of business dimensions and measures. This analysis is intuitive because the dimensions are presented in business terms that users can easily understand.

Companies have reported hundreds of successful data-warehousing applications. You can read client success stories and case studies at the websites of vendors such as NCR Corp. (www.ncr.com) and Oracle (www.oracle.com). For a more detailed discussion, visit the Data Warehouse Institute (www.tdwi.org). The benefits of data warehousing include the following:

- End users can access needed data quickly and easily through Web browsers because these data are located in one place.
- End users can conduct extensive analysis with data in ways that were not previously possible.
- End users can obtain a consolidated view of organizational data.

These benefits can improve business knowledge, provide competitive advantage, enhance customer service and satisfaction, facilitate decision making, and streamline business processes.

Despite their many benefits, data warehouses and data marts have some limitations. An emerging solution is a data lake or a data lakehouse. **Figure 5.8** compares data warehouses and data lakes. You will notice that the data lake can handle more than structured data and employs artificial intelligence and machine learning to extract value from the data. IT's About Business 5.2 highlights some of these limitations and considers another emerging solution: data lakehouses.

data lake A central repository that stores all of an organization's data, regardless of their source or format.

Data Warehouses versus Data Lakes		
	Data Warehouse	Data Lake
Data Types	Structured, processed data from operational databases, applications, and transactional systems	Structured, semi-structured, and unstructured data from sensors, apps, websites, etc.
Purpose	Predefined purpose for business intelligence, batch reporting, and data visualization	May not have a predefined purpose; typically used for artificial intelligence, machine learning, deep analysis, and discovery
Users	Data engineers, business analysts, data analysts	Data engineers and data scientists
Benefits	Categorized historical data stored in a single repository with ease of access for the end user	Data stored in their native format, allowing flexibility for data scientists to analyze and develop modes from diverse data sources

FIGURE 5.8 Comparison of Data Warehouses and Data Lakes

IT's About Business 5.2

MIS Data Lakes and Lakehouses

Most large organizations have an enterprise data warehouse (EDW), which contains data that have been cleaned and prepared for analysis through a process known as *extract, transform, and load* (ETL). It is crucial to execute this process accurately because analysis performed on inaccurate data will produce poor reports. EDWs are the primary mechanism in many organizations for performing analytics, reporting, and operations.

Despite their benefits to organizations, EDWs do have problems too. Specifically, they require organizations to design the data model—called the *schema*—before they load any data into the EDW. A database schema defines the structure of the database and the data contained within that database. For example, in the case of relational databases, the schema specifies the database's tables and fields. The schema also describes the content and structure of the physical data stored. These descriptions are called metadata, the data about the data that help users understand the data contained in the database.

Because the structure of EDWs is defined by the schema, they are relatively inflexible and can answer only a limited number of questions. Furthermore, EDWs are not designed to use unstructured data, such as streaming data from sensors (see the Internet of Things in Chapter 8) or social media data such as blog postings, product reviews, TikTok videos, Tweets, and photographs.

EDWs are also too rigid to be effective with Big Data due to the volume, variety, and velocity with which Big Data moves. As a result of these problems, organizations have realized that EDWs cannot meet all their business needs.

The emergence of systems such as Apache Hadoop (www.hadoop.apache.org) has enabled organizations to implement parallel searches on large data repositories and thus to speed up data operations significantly. The ability to handle large, unstructured data sets provided the impetus for creating data lakes. A **data lake** is a central repository that stores all of an organization's data, regardless of the source or format of those data. Data lakes receive data in any form, from structured to unstructured. Structured data, such as POS transaction data and inventory data, can be easily analyzed by both data lakes and EDWs.

Unlike an EDW, however, a data lake can also analyze unstructured data such as social media posts, videos, pictures, and PDF files. A significant advantage of the data lake is that the data do not have to be consistent. For example, organizations might maintain the same type of information in different data formats, depending on where the data originate.

Organizations do not have to transform the data before entering them into the data lake as they would for an EDW. The data structure is unknown when the data are fed into the data lake. Instead, it is discovered only when the data are read, meaning that users do not model the data until they use them. This process is more flexible, making it easier for users to discover and enter new data sources. The artificial intelligence and machine learning capabilities of a data lake make it an excellent tool for providing much-needed organizational insights.

Data lakes provide many benefits for organizations:

- Organizations can derive value from unlimited types of data.
- Organizations have no limits on how they can query the data.
- Organizations do not create data silos. Instead, data lakes provide a unified view of data across the organization.

To load data into a data lake, organizations should take these steps:

- Define the incoming data from a business perspective.
- Document the context, origin, and frequency of the incoming data.
- Classify the incoming data's security level (public, internal, sensitive, restricted).
- Document the creation, usage, privacy, regulatory, and encryption business rules that apply to the incoming data.
- Identify the owner (sponsor) of the incoming data.
- Identify the data steward(s) who monitor and maintain the data sets.

After organizations follow these steps, they load all the data into a large table. Each data piece—a customer's name, a photograph, or a Facebook post—is placed in an individual cell. Metadata tags connect all the data in the data lake, so it does not matter where the data are located, where they came from, or how they are formatted. Organizations can add or change these tags as requirements evolve. They can also assign multiple tags to the same piece of data. Because the rules for storing the data do not need to be defined in advance, there is no need for expensive and time-consuming data modelling.

Organizations can also protect sensitive information by specifying who has access to the data in each cell and under what circumstances the data are loaded. For example, a retail operation might make cells containing customers' names and contact data available to sales and customer service. At the same time, however, it might make the cells having more sensitive, personally identifiable information or financial data available only to the finance department. In that way, when users run queries on the data, their access rights restrict which data they can view.

There are many examples of data lakes in practice. Let's consider how L'Oréal (www.lorealparis.com) employs its data lake.

POM **MKT** L'Oréal, a 100-year-old cosmetics industry leader, owns more than 40 brands. The company must analyze vast amounts of data, including 7 billion products manufactured annually, 50 million data points created daily, and 500 patents filed each year. The firm relies on scientists and marketing professionals to work together to create several thousand new formulas every year. The company must also ensure that its products are safe for humans. This process requires analyzing data about product formulas and raw materials as well as consumers' experiences with and feelings toward the new formulas.

L'Oréal employed Talend (www.talend.com), a leading cloud-based data integration company (see Technology Guide 3 for information about cloud-based systems), to create a data lake on Microsoft Azure. The platform integrates structured laboratory data with often raw and unstructured data, such as images of models using L'Oréal cosmetics. The data are available in real time, and the data lake is refreshed several times daily.

ACCT L'Oréal developed its first application for the finance department to address the economic management of research. The application used data from their data lake to display performance indicators for research-related activities and their associated costs, such as tests for product certification.

L'Oréal's next application addressed research into the impact of its products on the human microbiome, which consists of the genetic material of all the microbes—bacteria, fungi, protozoa,

and viruses—that live on and inside the human body. Another application involves products that can counter the effects of pollution on the skin. These are complex, unstructured questions that require the type of analysis that data lakes offer.

Despite the benefits offered by data lakes, organizations continue to use EDWs in addition to data lakes because they must ask both “small data” and “big data” questions. A small data question would be: “What is the total revenue for the northeast region in 2020?” An EDW can quickly and easily answer this question because the data are well defined. A Big Data question would be: “Describe the detailed customer relationship over the past three years for a high-value customer who has moved her business to another firm.” This question is more appropriate for a data lake because the variables are unclear and will probably include unstructured data such as email messages and audio clips. It would be complicated or nearly impossible to answer with an EDW.

This approach requires that organizations maintain two systems for two types of data analysis. However, it is never recommended as a best practice to store data in two data sets in two formats. This disparity has given rise to a new concept called the *data lakehouse*. (Think of a lakehouse as a combination of the warehouse and the lake, not as a small structure that oversees the lake.) The data lakehouse combines the structured query capabilities of an EDW and the unstructured AI and machine-learning capabilities of the data lake. Essentially, it enables a single system to meet both operational and strategic needs.

Let’s examine how the Canadian Broadcasting Corporation (CBC) implemented a data lakehouse to reduce the time it takes to gain insight from data, expedite workflows, and lower operational costs.

As a part of CBC’s mandate, the organization should “inform, enlighten and entertain” its vast and diverse audience. To accomplish this mission, CBC strives to improve and personalize its digital broadcast radio services. To that end, it needs to extract from its data, insights related to predicting subscribers’ churn, their content consumption, and how different types of content are related to “stickiness.”

However, CBC faced issues with its data repositories, as not only were they complex, but they also made it difficult for CBC employees to access and explore data. In order to gain insight from its stored data, CBC’s teams of data analysis needed to have access to how subscribers access content in terms of their geolocation, the types of devices they use, their interactions with different programs and contents, etc. However, CBC’s teams struggled to access these data. In addition, the huge amounts of data required for different analyses further slowed down and complicated the job of the firm’s data analysis teams.

To overcome these issues, CBC implemented a data lakehouse platform from Databricks, which brought about a myriad of benefits for the firm. The data lakehouse made it possible for CBC employees to have easy and immediate access to the data they required. Building on the capabilities of the data lakehouse, CBC’s data engineers can build data pipelines that feed their visual dashboards (see Chapter 12), which are regularly updated by running quick SQL queries, thereby reducing the time to extract insight from weeks to minutes.

The simplicity of infrastructure, accessibility of data, and near real-time insights have enabled CBC to streamline its operations and provide relevant information and insight to its employees and decision makers, who then use these insights to create differentiated, high-value services for CBC’s audience.

Questions

1. Discuss the advantages and disadvantages of enterprise data warehouses.
2. Describe the advantages and disadvantages of data lakes.
3. Why don’t organizations use enterprise data warehouses to manage Big Data?
4. Describe the advantages and disadvantages of data lakehouses.

Sources: Compiled from S. Gibson, “The Rise of the Data Lakehouse: A New Era of Data Value,” *CIO*, August 18, 2022; M. Segal, “Data Mart vs Data Warehouse vs Database vs Data Lake,” *zuar.com*, December 28, 2021; A. Thusoo, “Data Lakes and Data Warehouses: The Two Sides of a Modern Cloud Data Platform,” *Forbes*, July 7, 2020; C. Foot, “Key Factors for Successful Data Lake Implementation,” *TechTarget*, July 6, 2020; V. Combs, “L’Oréal’s New Data Lake Holds 100 Years of Product Development Research,” *TechRepublic*, October 30, 2019; Matillion, “Essential Guide to Data Lakes,” *Matillion.com*, 2019; S. Woledge, “Data Lakes and Data Warehouses: Why You Need Both,” *Arcadia Data*, October 11, 2018; T. King, “Three Key Data Lake Trends to Stay on Top of This Year,” *Solutions Review*, May 11, 2018; T. Olavsrud, “6 Data Analytics Trends That Will Dominate 2018,” *CIO*, March 15, 2018; P. Tyaqi and H. Demirkan, “Data Lakes: The Biggest Big Data Challenges,” *Analytics Magazine*, September/October 2017; M. Hagstroem, M. Roggendorf, T. Saleh, and J. Sharma, “A Smarter Way to Jump into Data Lakes,” *McKinsey and Company*, August 2017; P. Barth, “The New Paradigm for Big Data Governance,” *CIO*, May 11, 2017; N. Mikhail, “Why Big Data Kills Businesses,” *Fortune*, February 28, 2017; “Architecting Data Lakes,” *Zaloni*, February 21, 2017; D. Kim, “Successful Data Lakes: A Growing Trend,” *The Data Warehousing Institute*, February 16, 2017; L. Hester, “Maximizing Data Value with a Data Lake,” *Data Science Central*, April 20, 2016; <https://www.databricks.com/customers/cbc-radio-canada>, accessed May 4, 2023.

Metadata It is important to maintain data about the data, known as *metadata*, in the data warehouse. Both the IT personnel who operate and manage the data warehouse and the users who access the data require metadata. IT personnel need information about data sources; database, table, and column names; refresh schedules; and data-usage measures. Users’ needs include data definitions, report and query tools, report distribution information, and contact information for the help desk.

Data Quality The quality of the data in the warehouse must meet users’ needs. If it does not, then users will not trust the data and ultimately will not use them. Most organizations find that the quality of the data in source systems is poor and must be improved before the

data can be used in the data warehouse. Some of the data can be improved with data-cleansing software. The better, long-term solution, however, is to improve the quality at the source system level. This approach requires the business owners of the data to assume responsibility for making any necessary changes to implement this solution.

To illustrate this point, consider the case of a large hotel chain that wanted to conduct targeted marketing promotions using Canadian postal code data it collected from its guests when they checked in. When the company analyzed the postal code data, it discovered that many of the postal codes were Z1Z 1Z1. How did this error occur? The answer is that the clerks were not asking customers for their postal codes, but they needed to enter something to complete the registration process. A short-term solution to this problem was to conduct the marketing campaign using city and province data instead of postal codes. The long-term solution was to make certain the clerks entered the actual postal codes. The latter solution required the hotel managers to assume responsibility for making certain their clerks entered the correct data.

Governance To ensure that BI is meeting their needs, organizations must implement *governance* to plan and control their BI activities. Governance requires that people, committees, and processes be in place. Companies that are effective in BI governance often create a senior-level committee composed of vice presidents and directors who (1) ensure that the business strategies and BI strategies are in alignment, (2) prioritize projects, and (3) allocate resources. These companies also establish a middle management-level committee that oversees the various projects in the BI portfolio to ensure that these projects are being completed in accordance with the company's objectives. Finally, lower-level operational committees perform tasks such as creating data definitions and identifying and solving data problems. All these committees rely on the collaboration and contributions of business users and IT personnel.

Users Once the data are loaded in a data mart or warehouse, they can be accessed. At this point, the organization begins to obtain business value from BI; all prior stages constitute creating BI infrastructure.

There are many potential BI users, including IT developers; frontline workers; analysts; information workers; managers and executives; and suppliers, customers, and regulators. Some of these users are *information producers*, whose primary role is to create information for other users. IT developers and analysts typically fall into this category. Other users—including managers and executives—are *information consumers*, because they use information created by others.

Before you go on...

1. Differentiate between data warehouses and data marts.
2. Describe the characteristics of a data warehouse.
3. What are three possible architectures for data warehouses and data marts in an organization?

5.5 Knowledge Management

LEARNING OBJECTIVE

Describe the benefits and challenges of implementing knowledge management systems in organizations.

As we have noted throughout this text, data and information are vital organizational assets. Knowledge is a vital asset as well. Successful managers have always valued and used intellectual assets. These efforts may not have been systematic, however, and they may not have

ensured that knowledge was shared and dispersed in a way that benefited the overall organization. Moreover, industry analysts estimate that most of a company's knowledge assets are not housed in relational databases. Instead, they are dispersed in email, word-processing documents, spreadsheets, presentations on individual computers, and in people's heads. This arrangement makes it extremely difficult for companies to access and integrate this knowledge. The result is frequently less effective decision making.

Concepts and Definitions

knowledge management (KM) A process that helps organizations identify, select, organize, disseminate, transfer, and apply information and expertise that are part of the organization's memory and that typically reside within the organization in an unstructured manner.

intellectual capital (or intellectual assets) Other terms for knowledge.

Knowledge management (KM) is a process that helps organizations manipulate important knowledge that comprises part of the organization's memory, usually in an unstructured format. For an organization to be successful, knowledge, as a form of capital, must exist in a format that can be exchanged among persons. It must also be able to grow.

Knowledge In the information technology context, knowledge is distinct from data and information. As you learned in Chapter 1, data are a collection of facts, measurements, and statistics; information is organized or processed data that are timely and accurate. Knowledge is information that is *contextual*, *relevant*, and *useful*. Simply put, knowledge is information in action. **Intellectual capital (or intellectual assets)** is another term for knowledge.

To illustrate, a bulletin listing all of the courses offered by your university during one semester would be considered *data*. When you register, you process the data from the bulletin to create your schedule for the semester. Your schedule would be considered *information*. Awareness of your work schedule, your major, your desired social schedule, and characteristics of different faculty members could be construed as *knowledge*, because it can affect the way you build your schedule. You see that this awareness is contextual and relevant (to developing an optimal schedule of classes) as well as useful (it can lead to changes in your schedule). The implication is that knowledge has strong experiential and reflective elements that distinguish it from information in a given context. Unlike information, knowledge can be used to solve a problem.

Numerous theories and models classify different types of knowledge. In the next section, we will focus on the distinction between explicit knowledge and tacit knowledge.

explicit knowledge The more objective, rational, and technical types of knowledge.

tacit knowledge The cumulative store of subjective or experiential learning, which is highly personal and hard to formalize.

Explicit and Tacit Knowledge **Explicit knowledge** deals with more objective, rational, and technical knowledge. In an organization, explicit knowledge consists of the policies, procedural guides, reports, products, strategies, goals, core competencies, and IT infrastructure of the enterprise. In other words, explicit knowledge is the knowledge that has been codified (documented) in a form that can be distributed to others or transformed into a process or a strategy. A description of how to process a job application that is documented in a firm's human resources policy manual is an example of explicit knowledge.

In contrast, **tacit knowledge** is the cumulative store of subjective or experiential learning. In an organization, tacit knowledge consists of an organization's experiences, insights, expertise, know-how, trade secrets, skill sets, understanding, and learning. It also includes the organizational culture, which reflects the past and present experiences of the organization's people and processes, as well as the organization's prevailing values. Tacit knowledge is generally imprecise and costly to transfer. It is also highly personal. Finally, because it is unstructured, it is difficult to formalize or codify, in contrast to explicit knowledge. A salesperson who has worked with particular customers over time and has come to know their needs quite well would possess extensive tacit knowledge. This knowledge is typically not recorded. In fact, it might be difficult for the salesperson to put into writing, even if they were willing to share it.

Knowledge Management Systems

The goal of knowledge management is to help an organization make the most productive use of the knowledge it has accumulated. Historically, management information systems have focused on capturing, storing, managing, and reporting explicit knowledge. Organizations

now realize they need to integrate explicit and tacit knowledge into formal information systems. **Knowledge management systems (KMSs)** refer to the use of modern information technologies—the internet, intranets, extranets, and databases—to systematize, enhance, and expedite knowledge management both within one firm and among multiple firms. KMSs are intended to help an organization cope with turnover, rapid change, and downsizing by making the expertise of the organization’s human capital widely accessible.

Organizations can realize many benefits with KMSs. Most importantly, they make *best practices*—the most effective and efficient ways accomplishing business processes—readily available to a wide range of employees. Enhanced access to best-practice knowledge improves overall organizational performance. For example, account managers could make available their tacit knowledge about how best to manage large accounts. The organization could then use this knowledge when it trains new account managers. Other benefits include enhanced customer service, more efficient product development, and improved employee morale and retention.

At the same time, however, implementing effective KMSs presents several challenges. First, employees must be willing to share their personal tacit knowledge. To encourage this behaviour, organizations must create a knowledge management culture that rewards employees who add their expertise to the knowledge base. Second, the organization must continually maintain and upgrade its knowledge base. Specifically, it must incorporate new knowledge and delete old, outdated knowledge. Finally, companies must be willing to invest in the resources needed to carry out these operations.

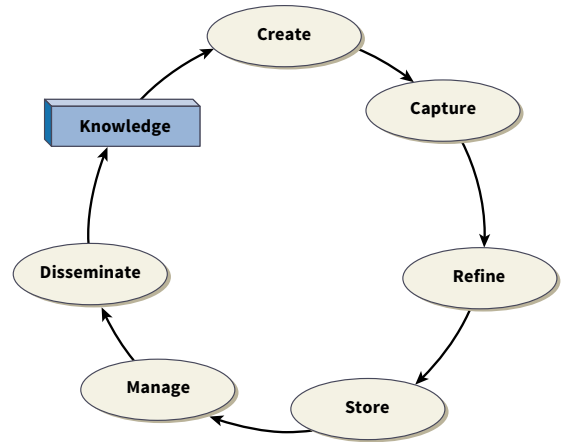


FIGURE 5.9 The knowledge management system cycle.

knowledge management systems (KMSs) Information technologies used to systematize, enhance, and expedite intra- and interfirm knowledge management.

The KMS Cycle

A functioning KMS follows a cycle that consists of six steps (see **Figure 5.9**). The reason the system is cyclical is that knowledge is dynamically refined over time. The knowledge in an effective KMS is never finalized because the environment changes over time and knowledge must be updated to reflect these changes. The cycle works as follows:

1. *Create knowledge.* Knowledge is created as people determine new ways of doing things or develop know-how. Sometimes external knowledge is brought in.
2. *Capture knowledge.* New knowledge must be identified as valuable and be presented in a reasonable way.
3. *Refine knowledge.* New knowledge must be placed in context so that it is actionable. This is where tacit qualities (human insights) must be captured along with explicit facts.
4. *Store knowledge.* Useful knowledge must then be stored in a reasonable format in a knowledge repository so that other people in the organization can access it.
5. *Manage knowledge.* Like a library, the knowledge must be kept current. Therefore, it must be reviewed regularly to verify that it is relevant and accurate.
6. *Disseminate knowledge.* Knowledge must be made available in a useful format to anyone in the organization who needs it, anywhere and anytime.

Before you go on...

1. What is knowledge management?
2. What is the difference between tacit knowledge and explicit knowledge?
3. Describe the knowledge management system cycle.

5.6 Appendix: Fundamentals of Relational Database Operations

LEARNING OBJECTIVE

Understand the processes of querying a relational database, entity–relationship modelling, and normalization and joins.

Many operations are possible with relational databases. In this section, we discuss three of these operations: query languages, normalization, and joins.

As you have seen in this chapter, a relational database is a collection of interrelated two-dimensional tables consisting of rows and columns. Each row represents a record, and each column (or field) represents an attribute (or characteristic) of that record. Every record in the database must contain at least one field that uniquely identifies that record so that it can be retrieved, updated, and sorted. This identifier field, or group of fields, is called the *primary key*. In some cases, locating a particular record requires the use of secondary keys. A secondary key is another field that has some identifying information, but typically does not uniquely identify the record. A foreign key is a field (or group of fields) in one table that matches the primary key value in a row of another table. A foreign key is used to establish and enforce a link between two tables.

These related tables can be joined when they contain common columns. The uniqueness of the primary key tells the DBMS which records are joined with others in related tables. This feature allows users great flexibility in the variety of queries they can make. Despite these features, however, the relational database model has some disadvantages. Because large-scale databases can be composed of many interrelated tables, the overall design can be complex, leading to slow search and access times.

Query Languages

The most commonly performed database operation is searching for information. **Structured query language (SQL)** is the most popular query language used for interacting with a database. SQL allows people to perform complicated searches by using relatively simple statements or keywords. Typical keywords are SELECT (to choose a desired attribute), FROM (to specify the table or tables to be used), and WHERE (to specify conditions to apply in the query).

To understand how SQL works, imagine that a university wants to know the names of students who will graduate with a GPA of between 3.40 and 3.60 in May 2024. (Refer to Figure 5.3 in this chapter.) The university IT staff would query the student relational database with an SQL statement such as:

```
SELECT Student_Name
FROM Student_Database
WHERE Grade_Point_Average >= 3.40 and Grade_Point_Average < 3.60.
```

The SQL query would return John Jones and Juan Rodriguez.

Another way to find information in a database is to use **query by example (QBE)**. In QBE, the user fills out a grid or template—also known as a *form*—to construct a sample or a description of the data desired. Users can construct a query quickly and easily by using drag-and-drop features in a DBMS such as Microsoft Access. Conducting queries in this manner is simpler than keying in SQL commands.

Entity–Relationship Modelling

Designers plan and create databases through the process of **entity–relationship modelling** using an **entity–relationship (ER) diagram**. There are many approaches to ER diagramming. You will see one particular approach here. The good news is that if you are

structured query language

The most popular query language for requesting information from a relational database.

query by example A method to obtain information from a relational database by filling out a grid or template—also known as a form—to construct a sample or a description of the data desired.

entity–relationship (ER) modelling

The process of designing a database by organizing data entities to be used and identifying the relationships among them.

entity–relationship (ER) diagram

Document that shows data entities and attributes and relationships among them.

familiar with one version of ER diagramming, then you will be able to easily adapt to any other version.

ER diagrams consist of entities, attributes, and relationships. To properly identify entities, attributes, and relationships, database designers first identify the business rules for the particular data model. **Business rules** are precise descriptions of policies, procedures, or principles in any organization that stores and uses data to generate information. Business rules are derived from a description of an organization's operations, and help to create and enforce business processes in that organization. Keep in mind that *you* determine these business rules, not the MIS department.

Entities are pictured in rectangles, and relationships are described on the line between two entities. The attributes for each entity are listed, and the primary key is underlined. The **data dictionary** provides information on each attribute, such as its name; if it is a key, part of a key, or a non-key attribute; the type of data expected (alphanumeric, numeric, dates, etc.); and valid values. Data dictionaries can also provide information on why the attribute is needed in the database; which business functions, applications, forms, and reports use the attribute; and how often the attribute should be updated.

ER modelling is valuable because it allows database designers to communicate with users throughout the organization to ensure that all entities and the relationships among the entities are represented. This process underscores the importance of taking all users into account when designing organizational databases. Notice that all entities and relationships in our example are labelled in terms that users can understand.

Relationships illustrate an association between entities. The *degree of a relationship* indicates the number of entities associated with a relationship. A *unary relationship* exists when an association is maintained within a single entity. A *binary relationship* exists when two entities are associated. A *ternary relationship* exists when three entities are associated. In this chapter, we discuss only binary relationships because they are the most common. Entity relationships may be classified as one-to-one, one-to-many, or many-to-many. The term *connectivity* describes the relationship classification.

Connectivity and cardinality are established by the business rules of a relationship. *Cardinality* refers to the maximum number of times an instance of one entity can be associated with an instance in the related entity. **Figure 5.10** displays the cardinality symbols. Note that there are four possible cardinality symbols: mandatory single, optional single, mandatory many, and optional many.

Let's look at an example from a university. An *entity* is a person, place, or thing that can be identified in the users' work environment. For example, consider student registration at a university. Students register for courses, and they also register their cars for parking permits. In this example, STUDENT, PARKING PERMIT, CLASS, and PROFESSOR are entities. Recall that an instance of an entity represents a particular student, parking permit, class, or professor. Therefore, a particular STUDENT (James Smythe, 8023445) is an instance of the STUDENT entity; a particular parking permit (91778) is an instance of the PARKING PERMIT entity; a particular class (76890) is an instance of the CLASS entity; and a particular professor (Margaret Wilson, 390567) is an instance of the PROFESSOR entity.

Entity instances have *identifiers*, or *primary keys*, which are attributes (attributes and identifiers are synonymous) that are unique to that entity instance. For example, STUDENT instances can be identified with Student Identification Number, PARKING PERMIT instances can be identified with Permit Number, CLASS instances can be identified with Class Number, and PROFESSOR instances can be identified with Professor Identification Number.

Entities have attributes, or properties, that describe the entity's characteristics. In our example, examples of attributes for STUDENT are Student Name and Student Address. Examples of attributes for PARKING PERMIT are Student Identification Number and Car Type. Examples of attributes for CLASS are Class Name, Class Time, and Class Place. Examples of attributes for PROFESSOR are Professor Name and Professor Department. (Note that each course at this university has one professor—no team teaching.)

Why is Student Identification Number an attribute of both the STUDENT and PARKING PERMIT entity classes? That is, why do we need the PARKING PERMIT entity class? If you consider all interlinked university systems, the

business rules Precise descriptions of policies, procedures, or principles in any organization that stores and uses data to generate information.

data dictionary A collection of definitions of data elements; data characteristics that use the data elements; and the individuals, business functions, applications, and reports that use these data elements.

relationships Operators that illustrate an association between two entities.

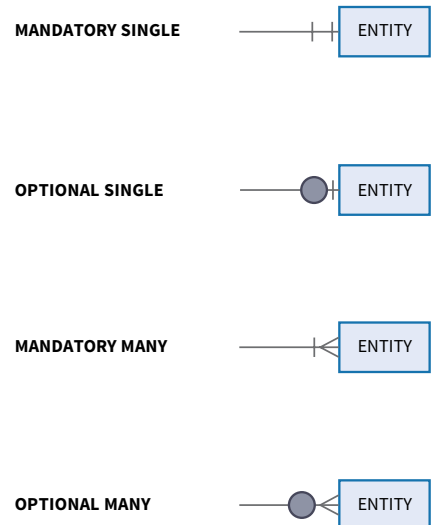


FIGURE 5.10 Cardinality symbols.

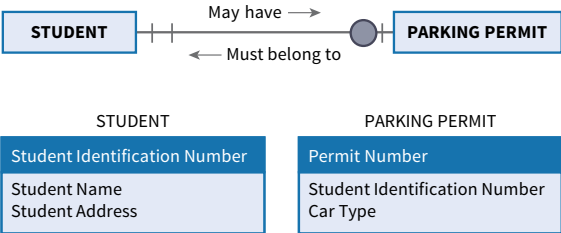


FIGURE 5.11 One-to-one relationship.

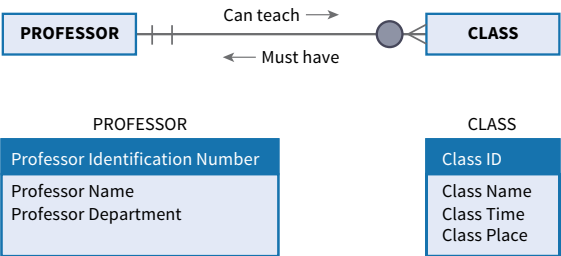


FIGURE 5.12 One-to-many relationship.

PARKING PERMIT entity class is needed for other applications, such as fee payments, parking tickets, and external links to the provincial Department of Motor Vehicles.

Let's consider the three types of binary relationships in our example.

In a *one-to-one (1:1)* relationship, a single-entity instance of one type is related to a single-entity instance of another type. In our university example, STUDENT–PARKING PERMIT is a 1:1 relationship. The business rule at this university represented by this relationship is: students may register only one car at this university. Of course, students do not have to register a car at all. That is, a student can have only one parking permit but does not need to have one.

Note that the relationship line on the PARKING PERMIT side shows a cardinality of optional single. A student can have, but does not have to have, a parking permit. On the STUDENT side of the relationship, only one parking permit can be assigned to one student, resulting in a cardinality of mandatory single. See Figure 5.11.

The second type of relationship, *one-to-many (1:M)*, is represented by the CLASS–PROFESSOR relationship in Figure 5.12. The business rule at this university represented by this relationship is: at this university, there is no team teaching. Therefore, each class must have only one professor. On the

other hand, professors may teach more than one class. Note that the relationship line on the PROFESSOR side shows a cardinality of mandatory single. In contrast, the relationship line on the CLASS side shows a cardinality of optional many.

The third type of relationship, *many-to-many (M:M)*, is represented by the STUDENT–CLASS relationship. Most database management systems do not support many-to-many relationships. Therefore, we use *junction* (or *bridge*) *tables*, so that we have two one-to-many relationships. The business rule at this university represented by this relationship is: students can register for one or more classes, and each class can have one or more students (see Figure 5.13). In this example, we create the REGISTRATION table as our junction table. Note that Student ID and Class ID are foreign keys in the REGISTRATION table.

Let's examine the following relationships:

- The relationship line on the STUDENT side of the STUDENT–REGISTRATION relationship shows a cardinality of mandatory single.
- The relationship line on the REGISTRATION side of the STUDENT–REGISTRATION relationship shows a cardinality of optional many.
- The relationship line on the CLASS side of the CLASS–REGISTRATION relationship shows a cardinality of optional single.
- The relationship line on the REGISTRATION side of the CLASS–REGISTRATION relationship shows a cardinality of mandatory single.

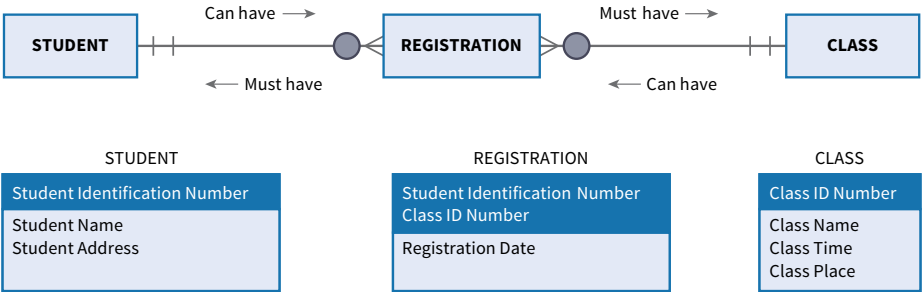


FIGURE 5.13 Many-to-many relationship.

Order Number	Order Date	Customer ID	Customer F Name	Customer L Name	Customer Address	Postal Code	Pizza Code	Pizza Name	Quantity	Price	Total Price
1116	1/9/24	16421	Rob	Penny	123 Main St.	T1Y 4K5	P	Pepperoni	1	\$11.00	\$41.00
							MF	Meat Feast	1	\$12.00	
							V	Vegetarian	2	\$9.00	
1117	2/9/24	17221	Beth	Jones	41 Oak St.	T1Y 3J3	HM	Ham and Mushroom	3	\$10.00	\$56.00
							MF	Meat Feast	1	\$12.00	
							TH	The Hawaiian	1	\$14.00	

FIGURE 5.14 Raw data gathered from orders at the pizza shop.

Normalization and Joins

To use a relational database management system efficiently and effectively, the data must be analyzed to eliminate redundant data elements. **Normalization** is a method for analyzing and reducing a relational database to its most streamlined form to ensure minimum redundancy, maximum data integrity, and optimal processing performance. Data normalization is a methodology for organizing attributes into tables so that redundancy among the non-key attributes is eliminated. The result of the data normalization process is a properly structured relational database.

Data normalization requires a list of all the attributes that must be incorporated into the database and a list of all defining associations, or functional dependencies, among the attributes. **Functional dependencies** are a means of stating that the value of one particular attribute is associated with a specific single value of another attribute. For example, for Student Number 05345 at a university, exactly one Student Name, John C. Jones, is associated with it. That is, Student Number is referred to as the determinant because its value *determines* the value of the other attribute. We can also say that Student Name is functionally dependent on Student Number.

As an example of normalization, consider a pizza shop. This shop takes orders from customers on a form. Figure 5.13 shows a table of non-normalized data gathered by the pizza shop. This table has two records, one for each order being placed. Because there are several pizzas on each order, the order number and customer information appear in multiple rows. Several attributes of each record have null values. A null value is an attribute with no data in it. For example, Order Number has four null values. Therefore, this table is not in first normal form. The data drawn from that form are shown in **Figure 5.14**.

In our example, ORDER, CUSTOMER, and PIZZA are entities. The first step in normalization is to determine the functional dependencies among the attributes. The functional dependencies in our example are shown in **Figure 5.15**.

In the normalization process, we will proceed from non-normalized data, to first normal form, second normal form, and then third normal form. (There are additional normal forms, but they are beyond the scope of this book.)

Figure 5.16 shows the data in *first normal form*. The attributes under consideration are listed in one table and primary keys have been established. Our primary keys are Order Number, Customer ID, and Pizza Code. In first normal form, each ORDER has to repeat the order number, order date, customer first name, customer last name, customer address, and customer postal code. This data file contains repeating groups and describes multiple entities. That is, this relation has data redundancy and a lack of data integrity; the flat file would be difficult to use in various applications that the pizza shop might need.

normalization A method for analyzing and reducing a relational database to its most streamlined form to ensure minimum redundancy, maximum data integrity, and optimal processing performance.

functional dependency A means of stating that the value of one particular attribute is associated with, or determines, a specific single value of another attribute.

Order Number	→	Order Date
Order Number	→	Quantity
Order Number	→	Total Price
Customer ID	→	Customer F Name
Customer ID	→	Customer L Name
Customer ID	→	Customer Address
Customer ID	→	Postal Code
Customer ID	→	Total Price
Pizza Code	→	Pizza Name
Pizza Code	→	Price

FIGURE 5.15 Functional dependencies in pizza shop example.

Order Number	Order Date	Customer ID	Customer F Name	Customer L Name	Customer Address	Postal Code	Pizza Code	Pizza Name	Quantity	Price	Total Price
1116	1/9/24	16421	Rob	Penny	123 Main St.	T1Y 4K5	P	Pepperoni	1	\$11.00	\$41.00
1116	1/9/24	16421	Rob	Penny	123 Main St.	T1Y 4K5	MF	Meat Feast	1	\$12.00	\$41.00
1116	1/9/24	16421	Rob	Penny	123 Main St.	T1Y 4K5	V	Vegetarian	2	\$9.00	\$41.00
1117	2/9/24	17221	Beth	Jones	41 Oak St.	T1Y 3J3	HM	Ham and Mushroom	3	\$10.00	\$56.00
1117	2/9/24	17221	Beth	Jones	41 Oak St.	T1Y 3J3	MF	Meat Feast	1	\$12.00	\$56.00
1117	2/9/24	17221	Beth	Jones	41 Oak St.	T1Y 3J3	TH	The Hawaiian	1	\$14.00	\$56.00

FIGURE 5.16 First normal form for data from pizza shop.

Consider the table in Figure 5.16 and notice the very first column (labelled Order Number). This column contains multiple entries for each order—three rows for Order Number 1116 and three rows for Order Number 1117. These multiple rows for an order are called *repeating groups*. The table in Figure 5.16 also contains multiple entities: ORDER, CUSTOMER, and PIZZA. Therefore, we move on to second normal form.

To produce second normal form, we break the table in Figure 5.16 into smaller tables to eliminate some of its data redundancy. Second normal form does not allow partial functional dependencies. That is, in a table in second normal form, every non-key attribute must be functionally dependent on the entire primary key of that table. Figure 5.17 shows the data from the pizza shop in second normal form.

Order Number	Order Date	Customer ID	Customer F Name	Customer L Name	Customer Address	Postal Code	Total Price
1116	1/9/24	16421	Rob	Penny	123 Main St.	T1Y 4K5	\$41.00
1116	1/9/24	16421	Rob	Penny	123 Main St.	T1Y 4K5	\$41.00
1116	1/9/24	16421	Rob	Penny	123 Main St.	T1Y 4K5	\$41.00
1117	2/9/24	17221	Beth	Jones	41 Oak St.	T1Y 3J3	\$56.00
1117	2/9/24	17221	Beth	Jones	41 Oak St.	T1Y 3J3	\$56.00
1117	2/9/24	17221	Beth	Jones	41 Oak St.	T1Y 3J3	\$56.00

Order Number	Pizza Code	Quantity
1116	P	1
1116	MF	1
1116	V	2
1117	HM	3
1117	MF	1
1117	TH	1

Pizza Code	Pizza Name	Price
P	Pepperoni	\$11.00
MF	Meat Feast	\$12.00
V	Vegetarian	\$9.00
HM	Ham and Mushroom	\$10.00
TH	The Hawaiian	\$14.00

FIGURE 5.17 Second normal form for data from pizza shop.

ORDER				CUSTOMER				
Order Number	Order Date	Customer ID	Total Price	Customer ID	Customer F Name	Customer L Name	Customer Address	Postal Code
1116	1/9/24	16421	\$41.00	16421	Rob	Penny	123 Main St.	T1Y 4K5
1117	1/9/24	17221	\$56.00	17221	Beth	Jones	41 Oak St.	T1Y 3J3

ORDER-PIZZA			PIZZA		
Order Number	Pizza Code	Quantity	Pizza Code	Pizza Name	Price
1116	P	1	P	Pepperoni	\$11.00
1116	MF	1	MF	Meat Feast	\$12.00
1116	V	2	V	Vegetarian	\$9.00
1117	HM	3	HM	Ham and Mushroom	\$10.00
1117	MF	1	TH	The Hawaiian	\$14.00
1117	TH	1			

FIGURE 5.18 Third normal form for data from pizza shop.

If you examine Figure 5.17, you will see that second normal form has not eliminated all the data redundancy. For example, each Order Number is duplicated three times, as are all customer data. In *third normal form*, non-key attributes are not allowed to define other non-key attributes. That is, third normal form does not allow transitive dependencies in which one non-key attribute is functionally dependent on another. In our example, customer information depends on both Customer ID and Order Number. **Figure 5.18** shows the data from the pizza shop in third normal form. Third normal form structure has these important points:

- It is completely free of data redundancy.
- All foreign keys appear where needed to link related tables.

Let's look at the primary and foreign keys for the tables in third normal form:

- *The ORDER relation:* The primary key is Order Number and the foreign key is Customer ID.
- *The CUSTOMER relation:* The primary key is Customer ID.
- *The PIZZA relation:* The primary key is Pizza Code.
- *The ORDER-PIZZA relation:* The primary key is a composite key, consisting of two foreign keys, Order Number and Pizza Code.

Now consider an order at the pizza shop. The tables in third normal form can produce the order in the following manner by using the join operation (see **Figure 5.19**). The **join operation** combines records from two or more tables in a database to obtain

join operation A database operation that combines records from two or more tables in a database.

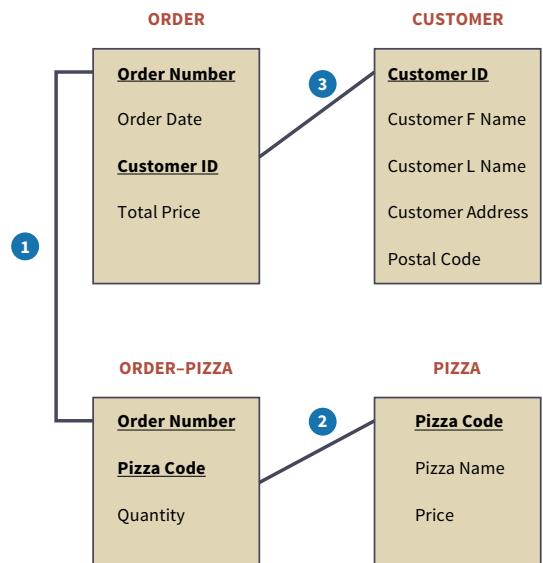


FIGURE 5.19 The join process with the tables of third normal form to produce an order.

information that is located in different tables. In our example, the join operation combines records from the four normalized tables to produce an ORDER. Here is how the join operation works:

- The ORDER relation provides the Order Number (the primary key), Order Date, and Total Price.
- The primary key of the ORDER relation (Order Number) provides a link to the ORDER–PIZZA relation (the link numbered 1 in Figure 5.19).
- The ORDER–PIZZA relation supplies the Quantity to ORDER.
- The primary key of the ORDER–PIZZA relation is a composite key that consists of Order Number and Pizza Code. Therefore, the Pizza Code component of the primary key provides a link to the PIZZA relation (the link numbered 2 in Figure 5.19).
- The PIZZA relation supplies the Pizza Name and Price to ORDER.
- The Customer ID in ORDER (a foreign key) provides a link to the CUSTOMER relation (the link numbered 3 in Figure 5.19).
- The CUSTOMER relation supplies the Customer F Name, Customer L Name, Customer Address, and Postal Code to ORDER.

At the end of this join process, we have a complete ORDER. Normalization is beneficial when maintaining databases over a period of time. One example is the likelihood of having to change the price of each pizza. If the pizza shop increases the price of the Meat Feast from \$12.00 to \$12.50, this process is one easy step in Figure 5.19. The price field is changed to \$12.50 and the ORDER is automatically updated with the current value of the price.

Before you go on...

1. What is structured query language?
2. What is query by example?
3. What is an entity? An attribute? A relationship?
4. Describe one-to-one, one-to-many, and many-to-many relationships.
5. What is the purpose of normalization?
6. Why do we need the join operation?

What's in IT for me?

ACCT For the Accounting Major

The accounting function is intimately concerned with keeping track of an organization's transactions and internal controls. Modern databases enable accountants to perform these functions more effectively. Databases help accountants manage the flood of data in today's organizations so that they can keep their firms in compliance with the standards imposed by Bill 198.

Accountants also play a role in justifying the costs of creating a knowledge base and then auditing its cost-effectiveness. Also, if you work for a large CPA company that provides management services or sells knowledge, then you will most likely use some of your company's best practices, which are stored in a knowledge base.

FIN For the Finance Major

Financial managers make extensive use of computerized databases that are external to the organization, such as CompuStat and Dow

Jones, to obtain financial data on organizations in their industry. They can use these data to determine if their organization meets industry benchmarks in return on investment, cash management, and other financial ratios.

Financial managers who produce the organization's financial status reports are also closely involved with Bill 198. Databases help these managers comply with the law's standards.

MKT For the Marketing Major

Databases help marketing managers access data from the organization's marketing transactions, such as customer purchases, to plan targeted marketing campaigns and evaluate the success of previous campaigns. Knowledge about customers can make the difference between success and failure. In many databases and knowledge bases, the vast majority of information and knowledge concerns customers, products, sales, and marketing. Marketing managers regularly use an organization's knowledge base, and they often participate in creating that base.

POM For the Production/Operations Management Major

Production/operations personnel access organizational data to determine optimal inventory levels for parts in a production process. Past production data enable production/operations management (POM) personnel to determine the optimal configuration for assembly lines. Firms also collect quality data that inform them not only about the quality of finished products but also about quality issues with incoming raw materials, production irregularities, shipping and logistics, and after-sale use and maintenance of the products.

Knowledge management is extremely important for running complex operations. The accumulated knowledge regarding scheduling, logistics, maintenance, and other functions is very valuable. Innovative ideas are critical for improving operations, and they can be supported by knowledge management.

HRM For the Human Resources Management Major

Organizations maintain extensive data on employees including gender, age, race, current and past job descriptions, and performance evaluations. HR personnel access these data to provide reports to government agencies regarding compliance with federal employment equity guidelines. HR managers also use these data to evaluate hiring practices and salary structures and to manage any discrimination grievances or lawsuits brought against the firm.

Databases help HR managers to assist employees as companies turn over more and more decisions about health care and retirement planning to the employees themselves. Employees can use databases for help in selecting the optimal mix among these critical choices.

HR managers also need to use a knowledge base frequently to find out how past cases were handled. Consistency in how employees

are treated is important, among other reasons, because it protects the company against legal actions. In addition, training for building, maintaining, and using the knowledge system is sometimes the responsibility of the HR department. Finally, the HR department might be responsible for compensating employees who contribute their knowledge to the knowledge base.

MIS For the MIS Major

The MIS function manages the organization's data as well as the databases. MIS database administrators standardize data names by using the data dictionary. This process ensures that all users understand which data are in the database. Database personnel also help users access needed data and generate reports with query tools.

For all Business Majors (Appendix: Section 5.6)

All business majors will have to manage data in their professional work. One way to manage data is through the use of databases and database management systems. It is likely that you will need to obtain information from your organization's databases. You will probably use structured query language to obtain this information. Furthermore, as your organization plans and designs its databases, it will most likely use entity-relationship diagrams. You will provide much of the input for these diagrams. For example, you will describe the entities that you use in your work, the attributes of those entities, and the relationships among them. You will also help database designers as they normalize database tables by describing how the normalized tables relate to one another (e.g., through the use of primary and foreign keys). Finally, you will assist database designers as they plan their join operations to provide you with the information that you need when that information is stored in multiple tables.

Summary

5.1 Discuss ways that common challenges in managing data can be addressed using data governance.

The following are three common challenges in managing data:

- Data are scattered throughout organizations and are collected by many individuals using various methods and devices. These data are frequently stored in numerous servers and locations and in different computing systems, databases, formats, and human and computer languages.
- Data come from multiple sources.
- Information systems that support particular business processes impose unique requirements on data, which results in repetition and conflicts across an organization.

One strategy for implementing data governance is master data management. Master data management gives companies the ability to store, maintain, exchange, and synchronize a consistent, accurate, and timely "single version of the truth" for the company's core master data. Master data management manages data gathered from across an organization, data from multiple sources, and data across business processes within an organization.

5.2 Discuss the advantages and disadvantages of relational databases.

Relational databases enable people to compare information quickly by row or column. Users can also easily retrieve items by finding the point of intersection of a particular row and column. However, large-scale relational databases can be composed of numerous interrelated tables, making the overall design complex, with slow search and access times.

5.3 Define *Big Data* and its basic characteristics.

Big Data is composed of high-volume, high-velocity, and high-variety information assets that require new forms of processing in order to enhance decision making, lead to insights, and optimize business processes. Big Data has three distinct characteristics that distinguish it from traditional data: volume, velocity, and variety.

- **Volume:** Big Data consists of vast quantities of data.
- **Velocity:** Big Data flows into an organization at incredible speeds.
- **Variety:** Big Data includes diverse data in differing formats.

5.4 Explain the elements necessary to successfully implement and maintain data warehouses.

To successfully implement and maintain a data warehouse, an organization must:

- Link source systems that provide data to the warehouse or data mart.
- Prepare the necessary data for the data warehouse using data integration technology and processes.
- Decide on an appropriate architecture for storing data in the data warehouse or data mart.
- Select the tools and applications for the variety of organizational users.
- Establish appropriate metadata, data quality, and governance processes to ensure that the data warehouse or data mart meets its purposes.

5.5 Describe the benefits and challenges of implementing knowledge management systems in organizations.

Organizations can realize many benefits with KMSs, including:

- Best practices are readily available to a wide range of employees
- Customer service is improved
- Product development becomes more efficient
- Employee morale and retention are enhanced

Challenges to implementing KMSs include:

- Employees must be willing to share their personal tacit knowledge.
- Organizations must create a knowledge management culture that rewards employees who add their expertise to the knowledge base.
- The knowledge base must be continually maintained and updated.
- Companies must be willing to invest in the resources needed to carry out these operations.

5.6 Understand the processes of querying a relational database, entity-relationship modelling, and normalization and joins.

The most commonly performed database operation is requesting information. *Structured query language* is the most popular query language used for this operation. SQL allows people to perform complicated searches by using relatively simple statements or keywords. Typical keywords are SELECT (to specify a desired attribute), FROM (to specify the table to be used), and WHERE (to specify conditions to apply in the query).

Another way to find information in a database is to use *query by example*. In QBE, the user fills out a grid or template—also known as a *form*—to construct a sample or a description of the data desired. Users can construct a query quickly and easily by using drag-and-drop features in a DBMS such as Microsoft Access. Conducting queries in this manner is simpler than keying in SQL commands.

Designers plan and create databases through the process of **entity-relationship modelling**, using an **entity-relationship diagram**. ER diagrams consist of entities, attributes, and relationships. Entities are pictured in boxes, and relationships are represented as lines. The attributes for each entity are listed, and the primary key is underlined.

ER modelling is valuable because it allows database designers to communicate with users throughout the organization to ensure that all entities and the relationships among the entities are represented. This process underscores the importance of taking all users into account when designing organizational databases. Notice that all entities and relationships in our example are labelled in terms that users can understand.

Normalization is a method for analyzing and reducing a relational database to its most streamlined form to ensure minimum redundancy, maximum data integrity, and optimal processing performance. When data are *normalized*, attributes in each table depend only on the primary key.

The *join operation* combines records from two or more tables in a database to produce information that is located in different tables.

Key Terms

attribute 130
Big Data 132
business rules 151
data dictionary 151
data file (also table) 128
data governance 127
data lake 144
data mart 139
data model 130
data silo 124
data warehouse 139
database management system (DBMS) 129
entity 130
entity-relationship (ER) diagram 150

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relationships 151
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structured data 131
structured query language 150
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tacit knowledge 148
transactional data 127
unstructured data 131

Discussion Questions

1. Is Big Data really a problem on its own, or are the use, control, and security of the data the true problems? Provide specific examples to support your answer.
2. What are the implications of having incorrect data points in your Big Data? What are the implications of incorrect or duplicated customer data? How valuable are decisions that are based on faulty information derived from incorrect data?
3. Explain the difficulties involved in managing data.
4. What are the problems associated with poor-quality data?
5. What is master data management? What does it have to do with high-quality data?
6. Explain why master data management is so important in companies that have multiple data sources.
7. Describe the advantages and disadvantages of relational databases.
8. Explain why it is important to capture and manage knowledge.
9. Compare and contrast tacit knowledge and explicit knowledge.
10. Draw the entity–relationship diagram for a company that has departments and employees. In this company, a department must have at least one employee, and company employees may work in only one department.
11. Draw the entity–relationship diagram for library patrons and the process of checking out books.
12. You are working at a doctor's office. You gather data on the following entities: PATIENT, PHYSICIAN, PATIENT DIAGNOSIS, and TREATMENT. Develop a table for the entity PATIENT VISIT. Decide on the primary keys and/or foreign keys that you want to use for each entity.
13. Read the following article: S. Kliff and M. Sanger-Katz, "Bottleneck for U.S. Coronavirus Response: The Fax Machine," *New York Times*, July 13, 2020. Describe which of the problems in managing data (Section 5.1) were emphasized by the COVID-19 pandemic.

Problem-Solving Activities

1. Access various employment websites (e.g., www.monster.ca and www.dice.com) and find several job descriptions for a database administrator. Are the job descriptions similar? What are the salaries offered in these positions?
2. Access the websites of several real estate companies. Find the sites that take you through a step-by-step process for buying a home; that provide virtual reality tours of homes in your price range (say, \$600,000 to \$750,000) and location; that provide mortgage and interest rate calculators; and that offer financing for your home. Do the sites require you to register to access their services? Can you request that an email be sent to you when properties you might be interested in become available? How does the process outlined influence your likelihood of selecting this company for your real estate purchase?
3. It is possible to find many websites that provide demographic information. Access several of these sites and see what they offer. Do the sites differ in the types of demographic information they offer? If so, how? Do the sites require a fee for the information they offer? Would demographic information be useful to you if you wanted to start a new business? If so, how and why?
4. Search the Web for the article "Why Big Data and Privacy Are Often at Odds," by 7wData. What points does this article present concerning the delicate balance between shared data and customer privacy?
5. Access the websites of IBM (www.ibm.com), Microsoft (www.microsoft.com), and Oracle (www.oracle.com), and trace the capabilities of their latest data management products, including Web connections.
6. Access the website for the Gartner Group (www.gartner.com). Examine the company's research studies pertaining to data management. Prepare a report on the state of the art.
7. Diagram a knowledge management system cycle for a fictional company that sells customized T-shirts to students.
8. Visit www.bigcloud.global/5-brilliant-ted-talks-about-big-data. Watch one of the 5 talks and summarize the main points. Do you agree with the talk? Why or why not?
9. Visit www.databricks.com. Explain how the platform provides solutions for the industry of your choice.

Closing Case

Personal Financial Management with Wealthica

To manage their personal finances, some people rely on manual approaches. However, this can easily become a cumbersome task if one has multiple bank accounts, retirement plans, health saving accounts, and investments with multiple brokers. It is a laborious task to log into each one to see how one's account has performed

and, even then, it will be very challenging, if not impossible, to see them side by side and compare how each one stacks up. Wealthica (www.wealthica.com), Canada's leading financial data aggregator, helps individuals overcome these obstacles. The Montreal-based company was founded in 2015 and, as of April 2023, was tracking over \$25 billion in assets, including shares and bonds, real estate, cryptocurrencies, and more.

But how does Wealthica help individuals? We know that it often makes sense to have a diverse portfolio of investments that is spread across multiple financial institutions because doing so can help lower risks and preserve your capital. However, when it comes to keeping track of one's assets and net worth, people might be confused by all the reports provided by financial institutions. Receiving multiple reports for a single asset, complex bank statements, and other performance indicators can make it difficult for individuals to get a good understanding of what is going on with their various assets and investments.

This is where Wealthica comes to help. Wealthica gives users a consolidated, 360-degree view of their various assets on the dashboard and an aggregated view of their net worth and investment performance. Users can analyze their portfolios with consolidated reports that are updated regularly and as a result also compare the performance of different financial institutions. These reports can be exported and then further analyzed with Google Sheet or MS Excel. Consequently, Wealthica's data aggregation tool can be used for various purposes such as accessing and monitoring transactions, tracking investment performance, portfolio management, and succession planning.

By aggregating consumers' financial data from different institutions, Wealthica enables its users to monitor their investment performance over different periods of time (e.g., last 7 days, 30 days, 90 days, 6 months, or 12 months). In addition, the balance sheet add-on consolidates users' assets and debts per asset type and thus provides an accurate view of their net worth. Wealthica also provides an income report for income investors. If a source of income is not in Canadian dollars, then the system applies the most accurate exchange rate to convert it and better consolidate it with Canadian income. Wealthica also provides many other reports such as a fees report (i.e., the fees paid to different institutions over time), realized gains report (i.e., gains and losses realized over time), performance report (i.e., rate of return of your portfolio), and coin tracking (i.e., cryptocurrency investments).

But how does Wealthica get access to users' balances, investments, transactions, etc? Obviously, individuals first need to create an account and connect it to their accounts at different financial institutions. To establish a secure connection with these institutions, retrieve users' investment portfolio, and collect their financial data, Wealthica either uses Application Programming Interfaces

(APIs) or users' credentials. An API is a software intermediary that enables two apps to communicate with each other. Some Canadian brokerage institutions such as Questrade and Wealthsimple allow API access. However, at the time of writing this case (i.e., April 2023), most Canadian banks (e.g., TD, CIBC, Scotia) do not allow API access. This means that Wealthica needs to collect investment data through their portals by using users' credentials. Note that, to eliminate the possibility of unauthorized transactions, Wealthica's access to users' bank accounts is read-only.

In order for Wealthica to be able to use APIs to gain access to consumers' banking data, Canada would need to adopt the open banking framework. Open banking is the practice of providing third-party financial service providers such as Wealthica with open access to consumers' banking, transactions, and other financial data from banks and non-bank financial institutions through APIs. While open banking has several benefits, both for consumers and for financial institutions, it comes with the risk of violating consumers' privacy and jeopardizing the security of their funds.

Questions

1. What is a data aggregator?
2. What are the benefits of financial data aggregators for consumers?
3. What are the benefits of financial data aggregators for financial service providers?

Source: Compiled from "Wealthica Now Aggregating \$25B in Assets," *Canada Newswire*, April 05, 2023; "How financial data aggregation is improving the financial system," *Pinwheelapi.com*, June 12, 2022; M. Leclair, "Banking Connectivity gets a Reliability Boost; New TD, Scotiabank and CIBC Login Options Now Available," *Wealthica.com*, January 13, 2023; "The Ultimate Wealthica Review: Personal Capital of Canada," *Genymoney.ca*, June 1, 2022; The Investopedia Team, "Open Banking: Definition, How It Works, and Risks," *Investopedia*, April 04, 2022; P. Correia, "Wealthica Review," *loanscanada.ca*, December 8, 2021; "Wealthica Review: Net Worth and Portfolio Tracking for Canadians," *Tawcan.com*, November 2, 2020; H. Johnson, "I use the free version of Personal Capital, a financial planning website, every month — here's why I can't stop," *Business Insider*, January 18, 2019; "Wealthica, a Montreal-based fintech startup, aims to consolidate and analyse all your investments in one place," *fintank.chappuishalder.com*, 2016; www.wealthica.com/security, accessed on April 6, 2023.

Telecommunications and Networking

CHAPTER OUTLINE

LEARNING OBJECTIVES

6.1 What Is a Computer Network?

6.1 Compare and contrast the major types of networks.

6.2 Network Fundamentals

6.2 Describe wireline communications media and transmission technologies.

6.3 The Internet and the World Wide Web

6.3 Describe the most common methods for accessing the internet.

6.4 Network Applications: Discovery

6.4 Explain the impact that discovery network applications have had on business and everyday life.

6.5 Network Applications: Communication

6.5 Explain the impact that communication network applications have had on business and everyday life.

6.6 Network Applications: Collaboration

6.6 Explain the impact that collaboration network applications have had on business and everyday life.

6.7 Network Applications: Educational

6.7 Explain the impact that educational network applications have had on business and everyday life.

Opening Case

Still Trying to Close the Digital Divide among Canada's First Nations

The digital divide in Canada is a growing concern because, in an increasingly digitalized society, those who do not have the skills to use digital devices miss out on a large part of our modern world. Some of those most affected by the digital divide are elderly, Indigenous, low income, and immigrant populations. In addition, the recent COVID-19 pandemic has worsened the digital divide. Those who do not have digital devices or reliable internet service can no longer perform simple tasks that were once done in person. Stores, job applications, even homework for students have all gone online.

For decades, social analysts have used the term *digital divide* to refer to the gap between populations who have access to current

information and communications technologies and those who do not. Today, the digital divide persists between people with broadband internet access and those without. In Canada, high-speed internet is defined as having download speeds of at least 50 megabits per second (Mbps) and upload speeds of 10 Mbps.

A recent report by the Auditor General of Canada indicated that, although 91 percent of Canadian households had access to high-speed internet in 2021, only 59.5 percent of people living in rural and remote areas enjoyed the same access. That number was even lower for First Nations reserves, with only 42.9 percent of households having access to high-speed internet. According to Nation2Nation Forum, a platform where Indigenous leaders can share their perspectives on economic development and major projects, some First Nations communities, especially in Northern British Columbia, are

still using unreliable dial-up internet connections, while other areas don't even have cellphone service. In Manitoba, only 2 percent of First Nations households have high-speed internet access, and the number drops to 1.7 percent in Saskatchewan. This gap has serious economic and social consequences for First Nations and everyone affected by the digital divide in Canada.

The reason for this digital divide is not straightforward. There are multiple reasons why it exists. One of the first reasons is that it is far more cost-effective for internet service providers (ISPs) to deliver broadband to high-density metropolitan areas than to low-density rural areas. As a result, rural areas have traditionally had low bandwidth or none at all. In addition, however, a legacy of discrimination against First Nations communities may have prevented them from accessing reliable high-speed internet services.

To address this deficiency, all levels of government in Canada have announced over \$3 billion dollars of programs to provide broadband internet to underserved rural and First Nations communities. One example is the Universal Broadband Fund (UBF), which will provide up to \$750 million over its first five years to support projects to build or upgrade access and transport infrastructure to deliver fixed and mobile wireless broadband internet access services in eligible underserved areas across Canada. Provinces are also trying to do their part. For example, the government of British Columbia has provided \$190 million in funding for the Connecting British Columbia program.

From the technology point of view, in many of these First Nations and rural areas, a combination of physical and wireless networks would be cheaper and more practical than a single technology solution based on, for example, a region's geography and population density. Let's examine the various technologies that can provide broadband internet access.

- *Fibre-optic cable* consists of thin strands of glass fibres that transmit information through pulses of light generated by lasers. Fibre optics provides very high bandwidth connections.
- *Fixed wireless* (see Chapter 8) is the operation of wireless communication devices that connect two fixed locations with a wireless link. Fixed wireless networks use fibre backhauls. A *backhaul* is the transport of data from a wireless network to a wireline network.
- *5G home internet* (see Chapter 8) is a type of fixed wireless internet service. Providers install an indoor or outdoor 5G receiver at your home to pick up the signal from a local wireless hub. A *wireless hub* is a site that provides wireless internet access, for example, via Wi-Fi. An example of a wireless hub is a restaurant that offers free Wi-Fi to its customers. The hub is the Wi-Fi antenna itself.
- *Satellite internet access* (see Chapter 8) can be provided via geostationary communication satellites that can deliver broadband internet access to remote areas. New satellite constellations are being developed in low-earth orbit to enable low-latency (very little delay in transmission) internet access.
- *Microsoft's Rural Airband initiative* involves the use of television white spaces (unused television frequencies) to deliver broadband internet access over unused broadcast frequencies.
- Another solution is *do-it-yourself*. For example, Bruce Buffalo, a resident of one of the four Cree Nation reserves in the Maskwacis region in Alberta, built two rooftop internet hotspots to provide internet access to the area's 7,582 residents. He used a couple of radios, antennas, external cables, and a computer, and the hotspot can be accessed by anyone passing within a 600-metre radius.

However, not all the solutions to the digital divide in First Nations communities are technical. The Indigenous Connectivity Institute, for example, has made five key recommendations to the governments of Canada and the United States for action to try to reduce the digital divide gap among First Nations communities:

- Support a new Indigenous task force on telecommunications and work proactively with Indigenous rights-holders in future consultations and funding processes.
- Take a First Mile First approach on future government-funded projects, meaning that a system's design should reflect the unique conditions and strengths of each Indigenous community.
- Strengthen regulatory mechanisms to hold government and industry accountable for their use of funds, and for their responsibility to act in the best interest of the local community.
- Acknowledge Indigenous rights to govern and manage the spectrum over traditional territories, in support of improving services such as climate change monitoring, food security, health and safety—especially pertaining to missing and murdered Indigenous people—mental health and wellness, education, and economic development.
- Work with colleges and technical organizations to develop the digital workforce capacity of Indigenous people.

Similarly, the TMU Leadership Lab has issued five recommendations to address the digital divide in Canada, many of which directly affect First Nations. These include developing a nationwide strategy; subsidizing the provision of internet services to people with less means; exploring new public funding models that invest in community-based and owned networks; delivering activities to increase digital literacy, and access to devices and software, for underserved and vulnerable communities; and improving internet accessibility for people with disabilities.

As Stewart Muir, the founder of the Indigenous Partnerships Success Showcase, said, "In a world where the digital economy is growing and constantly changing, not having a fast and reliable Internet access means falling further and further behind." There are great hopes that increased digital broadband access to Indigenous communities will result in additional economic prosperity. Canada's Indigenous economy is expected to triple in the coming years and reach \$100 billion by 2025.

Questions

1. List several reasons why it is so difficult to eliminate the digital divide in Canada.
2. Of the five recommendations by the TMU Leadership Lab to end the digital divide, which three, in your opinion, would be most effective for First Nations? Support your answer.

Sources: Compiled from WALA Staff, "Several Rural Communities to Benefit from Grants to Expand Broadband Internet Access," *WALA*, August 27, 2022; A. Wilkins, "Rural Broadband Access Aided by University of Georgia Mapping Program," *Chattanooga Times Free Press*, August 18, 2022; J. Brodtkin, "This Man Built His Own ISP. Now He's Getting \$2.6M to Expand It," *Ars Technica*, August 11, 2022; R. Tracy and A. DeBarros, "Why Rural Americans Keep Waiting for Fast Internet, Despite Billions Spent," *Wall Street Journal*, June 15, 2022; C. McNally, "What Is Fixed Wireless Internet?" *Reviews.org*, February 17, 2022; A. Carr, "Microsoft and an Army of Tiny Telecoms Are Part of a Plan to Wire Rural America," *Bloomberg BusinessWeek*, September 22, 2021; B. Gray, "ACORN Wants to Close the Digital Divide," *The Toronto Star*, April 6, 2022; D. Hedley, "Community,

Industry and Policy Leaders Call for Action to Conquer Canada's Indigenous Digital Divide," *Indigenous Connectivity Institute*, University of Calgary, January 23, 2023; J. Mike, "How the Pandemic Exposed the Depth of the Digital Divide," *The Toronto Star*, November 22, 2022; K. Peesker, "Partnering to Strengthen Connectivity and Digital Readiness along B.C.'s Coastal Communities," *Microsoft News Centre Canada*, November 16, 2021; M. Klyne, "Canada's Digital Divide Hurts Indigenous and Rural Communities: Senator Klyne," *SenCa+ Magazine*, February 8, 2023; P. Sehgal, "Canadian Funders Say Bridging

Canada's Digital Divide Needs to Be Prioritized to Address Urgent Social Issues," *ITWorld Canada*, April 13, 2022; S. Balsara, "The First Nations Technology Council Releases New Report with Findings to Increase Indigenous leadership in Tech," *ITWorld Canada*, January 13, 2023; 2023 Indigenous Partnerships Success Showcase, "Fixing the Digital Disconnect in First Nations Communities," *Indigenoussuccess.ca*, February 23, 2023; N. Abdelaal and S. Andrey, "Overcoming Digital Divides: What We Heard and Recommendations," *Leadership Lab*, Toronto Metropolitan University, January 26, 2022.

Introduction

You probably know that networks are essential in your personal life, but there are three other fundamental points about network computing you need to know. First, in modern organizations, computers do not work in isolation. Rather, they constantly exchange data with one another. Second, this exchange of data—facilitated by telecommunications technologies—provides companies with many significant advantages. Third, this exchange can take place over any distance and over networks of any size.

Without networks, the computer on your desk would be merely another productivity-enhancement tool, just as the typewriter once was. The power of networks, however, turns your computer into an amazingly effective tool for accessing information from thousands of sources, thereby making both you and your organization more productive. Regardless of the type of organization (profit/not-for-profit, large/small, global/local) or industry (manufacturing, financial services, health care), networks in general, and the internet in particular, have transformed—and will continue to transform—the way we do business.

Networks support new and innovative ways of doing business, from marketing to supply chain management to customer service to human resources management. In particular, the internet and private *intranets*—networks located within a single organization that use internet software and TCP/IP protocols—have enormous impacts on our lives, both professionally and personally.

For all organizations, regardless of size, having a telecommunications and networking system is no longer simply a source of competitive advantage. Rather, it is necessary for survival.

Computer networks are essential to modern organizations, for many reasons. First, networked computer systems enable organizations to become more flexible so they can adapt to rapidly changing business conditions. Second, networks enable companies to share hardware, computer applications, and data across the organization and among different organizations. Third, networks make it possible for geographically dispersed employees and workgroups to share documents, ideas, and creative insights. This sharing encourages teamwork, innovation, and more efficient and effective interactions. Networks are also a critical link between businesses, their business partners, and their customers.

Clearly, networks are essential tools for modern businesses. But, why do *you* need to be familiar with networks? The simple fact is that, if you operate your own business or you work in a business, then you cannot function without networks. You will need to communicate rapidly with your customers, business partners, suppliers, employees, and colleagues. Until about 1990, you would have used the postal service or the telephone system with voice or fax capabilities for business communication. Today, however, the pace of business is much faster—almost real time. To keep up with this incredibly fast pace, you will need to use computers, email, messaging, the internet, smartphones, and other mobile devices. Furthermore, all of these technologies will be connected through networks to enable you to communicate, collaborate, and compete on a global scale.

Networking and the internet are the foundations for commerce in the twenty-first century. Recall that one key objective of this book is to help you become an informed user of information systems. Knowledge of networking is an essential component of modern business literacy.

We simply cannot overemphasize the global importance of the internet. It has been said that the internet is truly the nervous system of our world. A key point here is that people should have access to broadband internet for the system to be truly useful in today's world. (See the chapter's opening case and the example below.)

For instance, Rogers Communications, one of Canada's major mobile and internet service providers, suffered a major network outage leaving over 10 million wireless and 2.23 million

retail internet subscribers across the country without internet service. It was the second major outage for Rogers in little more than a year, and it affected banks, emergency services, retail stores, ATM machines—everything that relied on internet service to function. Rogers' internet outage also affected other internet service providers that relied on its network to function. TekSavvy, a smaller internet service provider in Ontario and Quebec, reported that the internet services it provides to its customers were being slowed down and disrupted because of the Rogers network blackout. This incident was so notorious that the federal Industry Minister, François-Philippe Champagne, had to meet with Rogers CEO Tony Staffieri and other telecom company leaders to express the government's discontent and remind the telecom industry of the importance of improving the reliability of their networks across Canada.

You begin this chapter by learning what a computer network is and by identifying the various types of networks. You will then study network fundamentals. Next, you will turn your attention to the basics of the internet and the World Wide Web. Finally, you will conclude by examining the many network applications available to individuals and organizations—that is, what networks help you do.

6.1 What Is a Computer Network?

LEARNING OBJECTIVE

Compare and contrast the major types of networks.

computer network A system that connects computers and other devices through communications media so that data and information can be transmitted among them.

bandwidth A network's transmission capacity, stated in bits per second.

broadband Transmission capacity of a communications medium that is faster than 25 Mbps.

A **computer network** is a system that connects computers and other devices (e.g., printers) through communications media so that data and information can be transmitted among them. Voice and data communication networks are continually becoming faster—that is, their bandwidth is increasing—and cheaper. **Bandwidth** refers to a network's transmission capacity; it is stated in bits per second. Bandwidth ranges from narrowband (relatively low transmission capacity) to broadband (relatively high network capacity).

The telecommunications industry itself has difficulty defining the term *broadband*. The Canadian Radio-television and Telecommunications Commission (CRTC; www.crtc.gc.ca) rules define **broadband** as the transmission capacity of a communications medium (discussed later in this chapter) that is faster than 50 megabits per second (Mbps) for download—the transmission speed for material coming to you from an internet server, such as a movie streamed from Netflix—and 10 Mbps for upload—the transmission speed for material that you upload to an internet server such as a Facebook post or YouTube video.

Interestingly, some telecom companies feel that the definition of broadband should be increased to 100 Mbps for download. This definition remains fluid, however, and it will undoubtedly continue to change to reflect greater transmission capacities in the future.

You are likely familiar with certain types of broadband connections such as *digital subscriber line (DSL)* and cable to your home and dorm. DSL and cable fall within the range of transmission capacity mentioned here and are thus defined as broadband connections.

The various types of computer networks range from small to worldwide. They include (from smallest to largest): personal area networks (PANs), local area networks (LANs), metropolitan area networks (MANs), wide area networks (WANs), and the ultimate WAN, the internet. PANs are short-range networks—typically a few metres—that are used for communication among devices close to one person. They can be wired or wireless. (You will learn about wireless PANs in Chapter 8.) MANs are relatively large networks that cover a metropolitan area. MANs fall between LANs and WANs in size. WANs typically cover large geographical areas; in some cases, they can span the entire planet and reach from Earth to Mars and beyond.

Local Area Networks

Regardless of their size, networks represent a compromise among three objectives: speed, distance, and cost. Typically, organizations must select two of the three. To cover long distances, organizations can have fast communication if they are willing to pay for it or inexpensive communication if they are willing to accept slower speeds. A third possible combination of

the three tradeoffs is fast, inexpensive communication with distance limitations. This is the idea behind local area networks.

A **local area network (LAN)** connects two or more devices in a limited geographical region, usually within the same building, so that every device on the network can communicate with every other device. Most LANs today use Ethernet (discussed later in this chapter). **Figure 6.1** illustrates an Ethernet LAN that consists of four computers, a server, and a printer, all of which are connected through a shared cable. Every device in the LAN has a *network interface card (NIC)* that allows the device to physically connect to the LAN's communications medium. This medium is typically an unshielded twisted-pair wire (UTP).

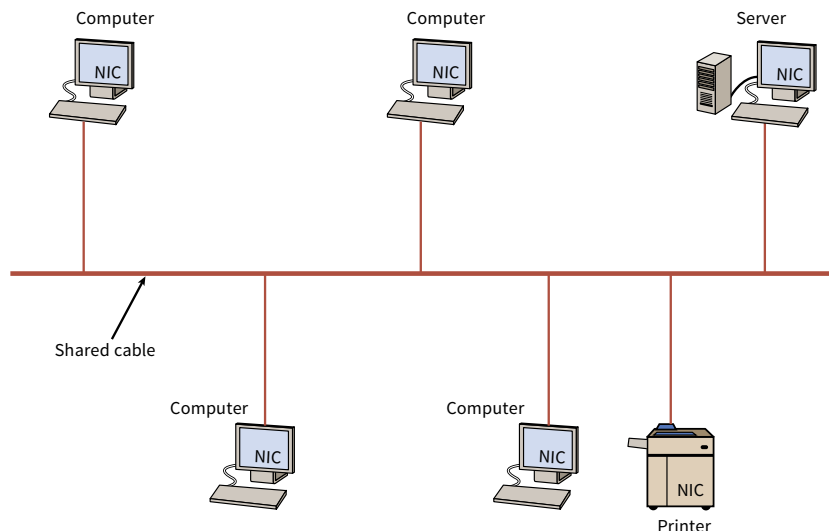


FIGURE 6.1 Ethernet local area network.

Although it is not required, many LANs have a **file server** or **network server**. The server typically contains various software and data for the network. It also houses the LAN's network operating system, which manages the server and routes and manages communications on the network.

Wide Area Networks

When businesses have to transmit and receive data beyond the confines of the LAN, they use wide area networks. The term *wide area network* did not even exist until local area networks appeared. Before that time, what we call a wide area network today was simply called a network.

A **wide area network (WAN)** is a network that covers a large geographical area. WANs typically connect multiple LANs. They are generally provided by common carriers such as telephone companies and the international networks of global communications services providers. Examples of these providers in Canada include Rogers (www.rogers.com), Bell Canada (www.bell.ca), and TELUS (www.telus.com); others include AT&T (www.att.com) in the United States, Deutsche Telekom in Germany (www.telekom.com), and NTT Communications in Japan (<http://www.ntt.com/en/index.html>).

WANs have large capacities, and they typically combine multiple channels (e.g., fibre-optic cables, microwave, and satellite). WANs also contain **routers**—communications processors that route messages from a LAN to the internet, across several connected LANs, or across a WAN such as the internet. As we saw, the internet is an example of a WAN.

Enterprise Networks

Organizations today have multiple LANs and may have multiple WANs. All of these networks are interconnected to form an **enterprise network**. **Figure 6.2** displays a model of enterprise computing. Note that the enterprise network in the figure is a backbone network. Corporate

local area network (LAN)

A network that connects communications devices in a limited geographic region, such as a building, so that every user device on the network can communicate with every other device.

file server (also called network server)

A computer that contains various software and data files for a local area network as well as the network operating system.

network server See **file server**.

wide area network (WAN)

A network, generally provided by common carriers, that covers a wide geographical area.

router A communications processor that routes messages from a LAN to the internet, across several connected LANs, or across a wide area network such as the internet.

enterprise network An organization's network, which is composed of multiple interconnected LANs and WANs.

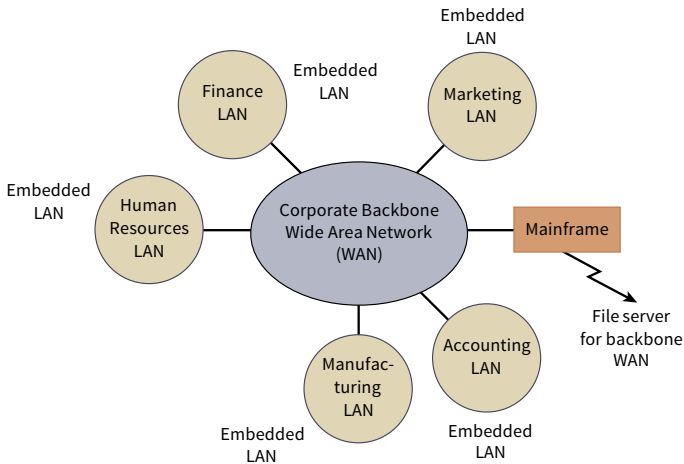


FIGURE 6.2 Enterprise network.

backbone networks

High-speed central networks to which multiple smaller networks (e.g., LANs and smaller WANs) connect.

backbone networks are high-speed central networks to which multiple smaller networks (such as LANs and smaller WANs) connect. The LANs are called *embedded LANs* because they connect to the backbone WAN.

Unfortunately, traditional networks can be rigid and lack the flexibility to keep pace with increasing business networking requirements. The reason for this problem is that the functions of traditional networks are distributed across physical routers and devices (i.e., hardware). Therefore, to implement changes, each network device must be configured individually. In some cases, devices must be configured manually. *Software-defined networks (SDNs)* are an emerging technology that is becoming increasingly important to help organizations manage their data flows across their enterprise networks. With SDNs, decisions that control how network traffic flows across network devices are managed centrally by software. The software dynamically adjusts data flows to meet business and application needs.

Think of traditional networks as the road system of a city in 1920. Data packets are the cars that travel through the city. A traffic officer (physical network device) controls each intersection and directs traffic by recognizing the turn signals and the size and shape of the vehicles passing through the intersection. The officers can direct only the traffic at their intersection. They do not know the overall traffic volume in the city nor do they know traffic movements across the city. Therefore, it is difficult to control the city's traffic patterns as a whole and to manage peak-hour traffic. When problems occur, the city must communicate with each individual officer by radio.

Now think of an SDN as the road system of a modern city. Each traffic officer is replaced by a traffic light and a set of electronic vehicle counters, which are connected to central monitoring and control software. With this system, the city's traffic can be instantly and centrally controlled. The control software can direct traffic differently at various times of the day (say, rush hours). The software monitors traffic flow and automatically changes the traffic lights to help traffic flow through the city with minimal disruption.

Before you go on . . .

1. What are the primary business reasons for using networks?
2. What are the differences between LANs and WANs?
3. Describe an enterprise network.

6.2

Network Fundamentals

LEARNING OBJECTIVE

Describe wireline communications media and transmission technologies.

In this section, you will learn the basics of how networks actually operate. You begin by studying wireline communications media, which enable computers in a network to transmit and receive data. You will conclude this section by looking at network protocols and the types of network processing.

Today, computer networks communicate through *digital signals*, which are discrete pulses that are either on or off, representing a series of *bits* (0s and 1s). This quality allows digital signals to convey information in a binary form that can be interpreted by computers.

The public telephone system (called “plain old telephone service” or POTS) was originally designed as an analogue network to carry voice signals or sounds in an analogue wave format. *Analogue signals* are continuous waves that transmit information by altering the amplitude and frequency of the waves. POTS requires *dial-up modems* to convert signals from analogue to digital and vice versa. Dial-up modems are almost extinct in most parts of the developed world today.

Cable modems are modems that operate over coaxial cable—for example, cable TV. They offer broadband access to the internet or to corporate intranets. Cable modem speeds vary widely. Most providers offer bandwidth between 1 and 6 Mbps for downloads (from the internet to a computer) and between 128 and 768 thousand bits per second (Kbps) for uploads. Cable modem services share bandwidth among subscribers in a locality. That is, the same cable line connects to many households. Therefore, when large numbers of neighbours access the internet at the same time, cable speeds can decrease significantly.

DSL modems operate on the same lines as voice telephones and dial-up modems. DSL modems always maintain a connection, so an internet connection is immediately available.

Communications Media and Channels

Communicating data from one location to another requires some form of pathway or medium. A **communications channel** is such a pathway. It is composed of two types of media: cable (twisted-pair wire, coaxial cable, or fibre-optic cable) and broadcast (microwave, satellite, radio, or infrared).

Wireline media or **cable media** use physical wires or cables to transmit data and information. Twisted-pair wire and coaxial cables are made of copper, and fibre-optic cable is made of glass. The alternative is communication over **broadcast media** or **wireless media**. The key to mobile communications in today’s rapidly moving society is data transmissions over electromagnetic media—the “airwaves.” In this section, you will study the three wireline channels. **Table 6.1** summarizes the advantages and disadvantages of each channel. You will become familiar with wireless media in Chapter 8.

TABLE 6.1 Advantages and Disadvantages of Wireline Communications Channels

Channel	Advantages	Disadvantages
Twisted-pair wire	Inexpensive Widely available Easy to work with	Slow (low bandwidth) Subject to interference Easily tapped (low security)
Coaxial cable	Higher bandwidth than twisted-pair Less susceptible to electromagnetic interference	Relatively expensive and inflexible Easily tapped (low to medium security) Somewhat difficult to work with
Fibre-optic cable	Very high bandwidth Relatively inexpensive Difficult to tap (good security)	Difficult to work with (difficult to splice)

Twisted-Pair Wire The most prevalent form of communications wiring, **twisted-pair wire**, is used for almost all business telephone wiring. As the name suggests, it consists of strands of copper wire twisted in pairs (see **Figure 6.3**). Twisted-pair wire is relatively inexpensive to purchase, widely available, and easy to work with. However, it also has some significant disadvantages. Specifically, it is relatively slow for transmitting data, it is subject to interference from other electrical sources, and it can be easily tapped by unintended recipients to gain unauthorized access to data.

Coaxial Cable **Coaxial cable** (**Figure 6.4**) consists of insulated copper wire. Compared with twisted-pair wire, it is much less susceptible to electrical interference, and it can carry much more data. For these reasons, it is

communications

channel Pathway for communicating data from one location to another.

wireline media See **cable media**.

cable media (also called wireline media) Communications channels that use physical wires or cables to transmit data and information.

broadcast media (also called wireless media) Communications channels that use electromagnetic media (the “airwaves”) to transmit data.

wireless media See **broadcast media**.

twisted-pair wire A communications medium consisting of strands of copper wire twisted together in pairs.

coaxial cable Insulated copper wire; used to carry high-speed data traffic and television signals.

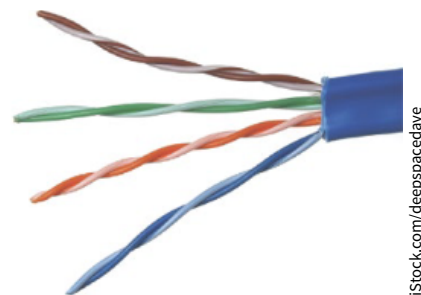


FIGURE 6.3 Twisted-pair wire.

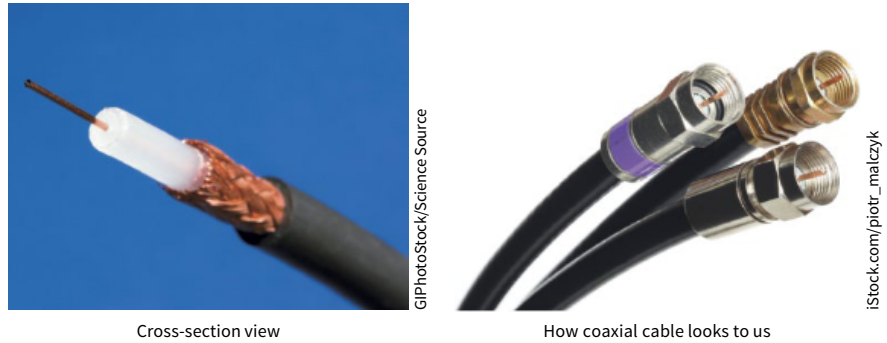


FIGURE 6.4 Two views of coaxial cable.

commonly used to carry high-speed data traffic as well as television signals (thus the term *cable TV*). However, coaxial cable is more expensive and more difficult to work with than twisted-pair wire. It is also somewhat inflexible.

fibre-optic cable A communications medium consisting of thousands of very thin filaments of glass fibres, surrounded by cladding, that transmit information through pulses of light generated by lasers.

Fibre Optics **Fibre-optic cable** (Figure 6.5) consists of thousands of very thin filaments of glass fibres that transmit information through pulses of light generated by lasers. The fibre-optic cable is surrounded by cladding, a coating that prevents the light from leaking out of the fibre.

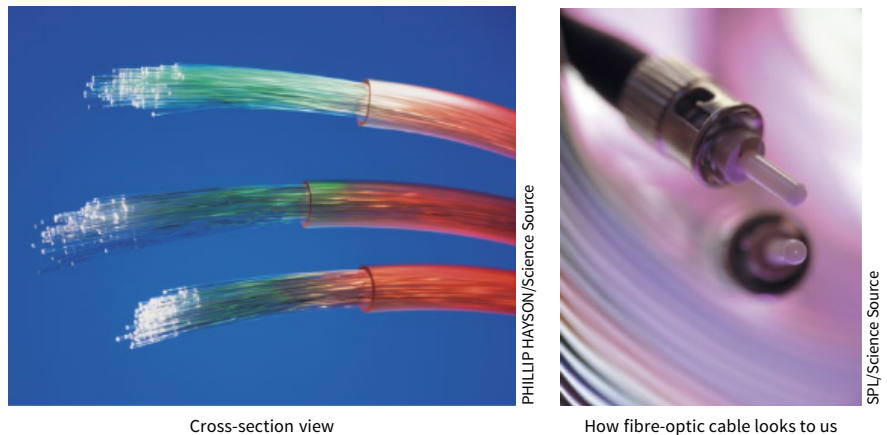


FIGURE 6.5 Two views of a fibre-optic cable.

Fibre-optic cables are significantly smaller and lighter than traditional cable media. They can also transmit far more data, and they provide greater security from interference and tapping. Fibre-optic cable is typically used as the backbone for a network, whereas twisted-pair wire and coaxial cable connect the backbone to individual devices on the network. As of April 2023, approximately 1,300,000 kilometres of 400 undersea fibre-optic cables carry over 98 percent of all transoceanic data. In 2022, Equiano, Google's latest subsea fibre-optic cable connecting Europe and Africa, became operational. Equiano is purported to be able to transmit data between the two continents at 144 terabits (trillions of bits) per second. Another example is MAREA, a fibre-optic cable connecting the United States and Spain that became operational in 2019 and holds the record transfer speed achieved on undersea cable, at 260 terabits per second.

Network Protocols

Computing devices that are connected to the network must access and share the network to transmit and receive data. These devices are often referred to as *nodes* of the network. They work together by adhering to a common set of rules and procedures—known as a

protocol—that enable them to communicate with one another. The two major protocols are the Ethernet and Transmission Control Protocol/Internet Protocol.

Ethernet A common LAN protocol is **Ethernet**. Many organizations use 100-gigabit Ethernet, through which the network provides data transmission speeds of 100 gigabits (100 billion bits) per second. As of April 2023, the categories of Ethernet cable are as follows:

- *Cat 5e (Cat 5 enhanced)* is the most common type of Ethernet cable. It is low-cost and supports up to 1,000 Mbps (1 Gbps). Furthermore, Cat 5e reduces crosstalk, which is unwanted transfer of signals between cables, for a more consistent connection.
- *Cat 6* supports the same speeds as Cat 5e but can provide shielding. Shielding is a thin protective barrier around the wires inside the Ethernet cable, which further protects them from crosstalk and interference. Not all Cat 6 cables have this feature.
- *Cat 6a (Cat 6 augmented)* supports speeds up to 10,000 Mbps (10 Gbps). All Cat 6a and higher cables have more effective shielding that can virtually eliminate crosstalk.
- *Cat 7 and Cat 7a (Cat 7 augmented)* offer only slightly higher bandwidth than Cat 6a.
- *Cat 8* supports speeds up to 40,000 Mbps (40 Gbps).

Transmission Control Protocol/Internet Protocol The **Transmission Control Protocol/Internet Protocol (TCP/IP)** is the protocol of the internet. TCP/IP uses a suite of protocols, the primary ones being the Transmission Control Protocol (TCP) and the Internet Protocol (IP). The TCP performs three basic functions: (1) it manages the movement of data packets (see further on) between computers by establishing a connection between the computers, (2) it sequences the transfer of packets, and (3) it acknowledges the packets that have been transmitted. The **Internet Protocol (IP)** is responsible for disassembling, delivering, and reassembling the data during transmission.

Before data are transmitted over the internet, they are divided into small, fixed bundles called *packets*. The transmission technology that breaks up blocks of text into packets is called **packet switching**. Each packet carries the information that will help it reach its destination—the sender’s IP address, the intended recipient’s IP address, the number of packets in the message, and the sequence number of the particular packet within the message. Each packet travels independently across the network and can be routed through different paths in the network. When the packets reach their destination, they are reassembled into the original message.

It is important to note that packet-switching networks are reliable and fault tolerant. For example, if a path in the network is very busy or is broken, packets can be rerouted around that path dynamically (“on the fly”). Also, if one or more packets do not get to the receiving computer, then only those specific packets need to be resent.

Why do organizations use packet switching? The main reason is to achieve reliable end-to-end message transmission over sometimes-unreliable networks that may have short-acting or long-acting problems.

The packets use the TCP/IP protocol to carry their data. TCP/IP functions in four layers (see **Figure 6.6**). The *application layer* enables client application programs to access the other layers, and it defines the protocols that applications use to exchange data. One of these application protocols is the **Hypertext Transfer Protocol (HTTP)**, which defines how messages are formulated and how they are interpreted by their receivers. (We discuss hypertext in Section 6.3.) The *transport layer* provides the application layer with communication and packet services. This layer includes TCP and other protocols. The *internet layer* is responsible for addressing, routing, and packaging data packets. The IP is one of the protocols in this layer. Finally, the *network interface layer* places packets on, and receives them from, the network medium, which can be any networking technology.

protocol The set of rules and procedures that govern transmission across a network.

ethernet A common local area network protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP) A file transfer protocol that can send large information files across sometimes unreliable networks with the assurance that the data will arrive uncorrupted.

Internet Protocol (IP) A set of rules responsible for disassembling, delivering, and reassembling packets over the internet.

packet switching The transmission technology that divides blocks of text into packets.

Hypertext Transfer Protocol (HTTP) The communications standard used to transfer pages across the WWW portion of the internet; it defines how messages are formulated and transmitted.

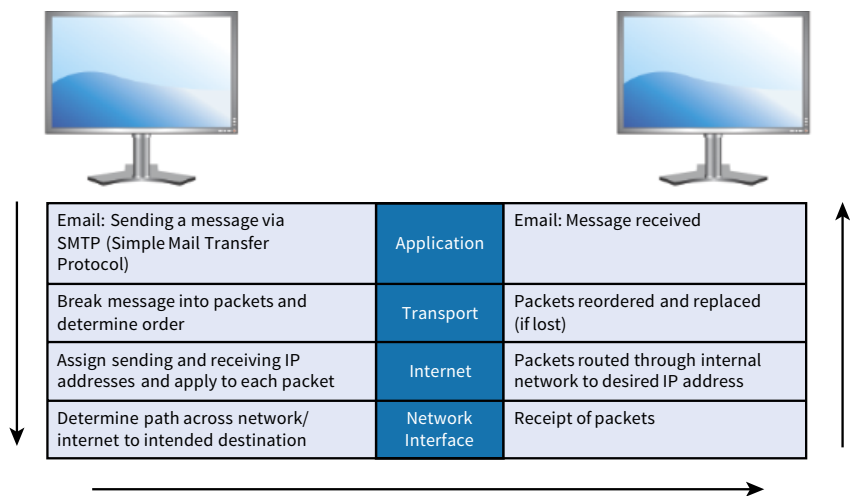


FIGURE 6.6 The four layers of the TCP/IP reference model.

Two computers using TCP/IP can communicate even if they use different hardware and software. Data sent from one computer to another proceed downward through all four layers, beginning with the sending computer’s application layer and going through its network interface layer. After the data reach the receiving computer, they travel up the layers.

TCP/IP enables users to send data across sometimes-unreliable networks with the assurance that the data will arrive uncorrupted. TCP/IP is very popular with business organizations because of its reliability and the ease with which it can support intranets and related functions.

Let’s look at an example of packet switching across the internet. Figure 6.7 illustrates a message being sent from Toronto to Calgary over a packet-switching network. Note that the different coloured packets travel by different routes to reach their destination in Calgary, where they are reassembled into the complete message. Note that the different coloured packets travel by different routes to reach their destination in Calgary, where they are reassembled into the complete message.

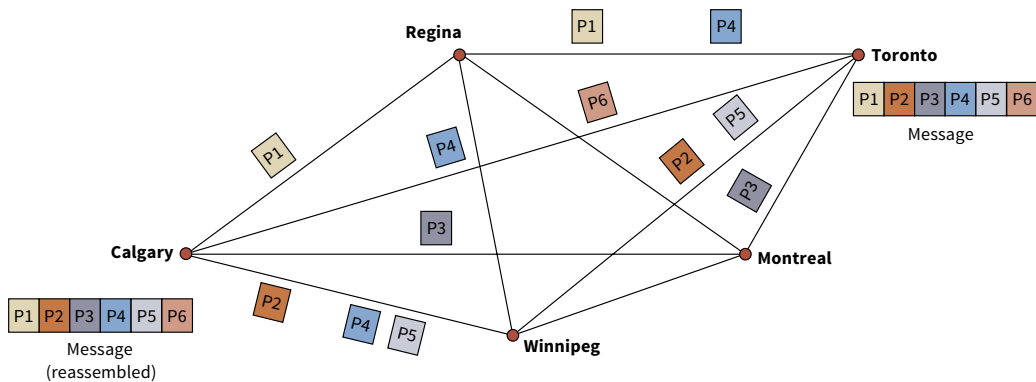


FIGURE 6.7 Packet switching.

Types of Network Processing

Organizations typically use multiple computer systems across the firm. **Distributed processing** divides processing work among two or more computers. This process enables computers in different locations to communicate with one another through telecommunications links. A common type of distributed processing is client/server processing. A special type of client/server processing is peer-to-peer processing.

Client/Server Computing **Client/server computing** links two or more computers in an arrangement in which some machines, called **servers**, provide computing services for user PCs, called **clients**. Usually, an organization performs the bulk of its processing or application and data storage on suitably powerful servers that can be accessed by less powerful client machines. The client requests applications, data, or processing from the server, which acts on these requests by “serving” the desired commodity.

Client/server computing leads to the idea of “fat” clients and “thin” clients. As discussed in Technology Guide 1, *fat clients* have large storage and processing power and therefore can run local programs (such as Microsoft Office) if the network goes down. In contrast, *thin clients* may have no local storage and only limited processing power. Thus, they must depend on the network to run applications. For this reason, they are of little value when the network is not functioning.

Peer-to-Peer Processing **Peer-to-peer (P2P) processing** is a type of client/server distributed processing in which each computer acts as *both* a client and a server. Each computer can access (as assigned for security or integrity purposes) all files on all other computers.

There are three basic types of peer-to-peer processing. The first type accesses unused CPU power among networked computers. An application of this type is SETI@home (<http://setiathome.ssl.berkeley.edu>), which used home computers to search for extra-terrestrial intelligence. These applications are from open-source projects, and they can be downloaded at no cost.

The second form of peer-to-peer is real-time, person-to-person collaboration, such as Microsoft SharePoint Workspace. This product provides P2P collaborative applications that use buddy lists to establish a connection and allow real-time collaboration within the application.

The third peer-to-peer category is advanced search and file sharing. This category is characterized by natural language searches of millions of peer systems. It enables users to discover other users, not just data and Web pages. One example of this category is BitTorrent.

BitTorrent (www.bittorrent.com) is a free open-source, peer-to-peer file-sharing application that simplifies the problem of sharing large files by dividing them into tiny pieces, or “torrents.” BitTorrent addresses two of the biggest problems of file sharing: (1) downloading bogs down when many people access a file at once; and (2) some people leech, meaning they download content but refuse to share it. BitTorrent eliminates the bottleneck by enabling all users to share little pieces of a file at the same time—a process called *swarming*. The program prevents leeching because users must upload a file while they download it. Thus, the more popular the content, the more efficiently it travels over a network.

distributed processing

Network architecture that divides processing work among two or more computers that are linked together in a network.

client/server computing

Form of distributed processing in which some machines (servers) perform computing functions for end-user PCs (clients).

servers Computers that provide access to various network services, such as printing, data, and communications.

clients Computers, such as users’ personal computers, that use any of the services provided by servers.

peer-to-peer (P2P) processing

A type of client/server distributed processing that allows two or more computers to pool their resources, making each computer both a client and a server.

Before you go...

1. Compare and contrast the three wireline communications channels.
2. Describe the various technologies that enable users to send high-volume data over any network.
3. Describe the Ethernet and TCP/IP protocols.

6.3

The Internet and the World Wide Web

LEARNING OBJECTIVE

Describe the most common methods for accessing the internet.

internet (the Net) A massive global WAN that connects approximately 1 million organizational computer networks in more than 200 countries on all continents.

internet backbone The primary network connections and telecommunications lines that link the computers and organizational nodes of the internet.

The **internet** (“the Net”) is a global WAN that connects approximately 1 million organizational computer networks in more than 200 countries on all continents (including Antarctica, although access is difficult there). It has become so widespread that it features in the daily routine of some 5 billion people.

The computers and organizational nodes on the internet can be of different types and makes. They are connected to one another by data communications lines of different speeds. The primary network connections and telecommunications lines that link the nodes are referred to as the **internet backbone**. The internet backbone is a fibre-optic network that is operated primarily by large telecommunications companies.

Many people mistakenly assume that internet traffic (data transmissions) occurs wirelessly. However, only 1 percent of internet traffic is carried by satellites. So, what does the internet actually look like?

The internet is quite tangible, consisting of underwater cables that total approximately 1,200,000 kilometres in length. These cables, which range in thickness from a garden hose (approximately 1.5 centimetres) to about 8 centimetres in diameter, come onshore at cable landing points.

From these points, the cables are buried underground and make their way to large data centres. (We discuss data centres in Technology Guide 3.) In Canada as well as in the United States, most of these underground cables are located along major roads and railways. In fact, one of the world’s most concentrated hubs in terms of internet connectivity is located in lower Manhattan in New York City. In Canada, an underwater fibre cable connects Toronto with New York through Lake Ontario. IT’s About Business 6.1 takes a detailed look at underwater fibre-optic cables provided by technology companies including Alphabet, Microsoft, Meta, and Amazon, as well as a group of Chinese enterprises.

IT’s About Business 6.1

MIS The Physical Structure of the Internet

The actual physical internet is made up of approximately 400 underwater fibre-optic cables—called *subsea cables*—that link countries across the oceans. These cables carry roughly 98 percent of international internet data and telephone traffic. Until recently, the vast majority of the undersea cables were installed, controlled, and used by telecommunications companies and governments.

Today, four giant technology companies—Microsoft, Alphabet, Meta, and Amazon—have become the dominant users of undersea cables. According to the subsea cable analysis firm TeleGeography (www.telegeography.com), by 2025 these four companies will likely be the primary financiers and owners of more than 30 long-distance undersea cables that will connect every continent except Antarctica.

These firms contend that they are laying these cables in order to increase bandwidth across the most developed parts of the world and to improve connectivity in underserved regions such as Africa. However, by building their own cable infrastructure, the companies are saving money that they would otherwise have had to pay other cable operators.

Subsea cabling is a challenging business, with multi-hundred-million-dollar capital costs, followed by continuous operational

upgrades. Today, companies use two models to lay undersea cables: partnerships and sole ownership.

Partnerships. Meta (formerly Facebook) works with global and local partners, as well as with other technology companies such as Microsoft, on all of its subsea cables. Many of these cables represent collaborations among rival tech companies. For example, the Marea cable, which extends more than 6,400 km between Bilbao, Spain, and Virginia, is partly owned by Microsoft, Meta, and Telxius, a subsidiary of Telefónica, the Spanish telecommunications company.

Sharing bandwidth and cables among competitors helps ensure that each company has capacity on more cables. This redundancy is essential for keeping the world’s internet operating when a cable is severed or damaged, events that occur about 200 times per year. Sharing is also critical to ensuring that cloud services are available almost all the time, something that cloud vendors explicitly promise in their agreements with customers.

These deals also serve another purpose. Reserving some capacity for telecom carriers is a strategy to prevent regulators from classifying these technology firms as telecommunications companies. Tech companies have long argued that they are not common carriers like the telecoms because they do not sell any of their bandwidth to make money. If they were classified as telecoms, then they would have to adhere to the regulations governing the operations of these types of companies.

Sole Ownership. In 2018, Google announced that it was planning new wholly owned transoceanic cables, which would make it the first large company other than the telecoms to do so. By 2022, the company was the sole owner of three undersea cables. The market research firm TeleGeography predicted that Google would own six undersea cables by 2023.

Google builds solely owned and operated undersea cables for two reasons. First, it needs them to speed up its own services, such as Google Search and YouTube, and make them more responsive. Second, it wants to gain a competitive edge in the battle for customers for its cloud services.

Making Landfall. The technology companies use partners for the landing parties in each country. (Google uses partners only for the landing parties in each country, while maintaining possession of the deepwater landing segments.) A *landing segment* is the location where an undersea cable makes landfall. A *landing party* is the terrestrial telecommunications company that the undersea cable connects with in a country. Partnering with foreign firms enables the technology companies to avoid being classified as landing parties, which are often subject to strict country-specific regulations. As a result, the companies concentrate most of their infrastructure investment in risk-free international waters.

The internet companies are offering traditional telecoms an alternative business model: the opportunity to play middleman between their cables and inland users, who will continue to depend on terrestrial cables in the interior of the continent. In exchange for paying much of the capital costs, technology firms acquire direct links to the national and regional networks that connect the new subsea cables to their users.

Africa

Africa, home to 1.4 billion people, is the last relatively unconnected populated continent. As a result, the technology companies are laying undersea cables to connect Africa with the rest of the world. The motivation for all of this activity is clear. The need for internet content is rapidly increasing in Africa (and globally), and existing cables simply are not adequate to deliver products to users. Further, with huge amounts of cash available, the tech companies are unwilling to wait for telecom companies to lay new cables.

In 2008, almost all African data traffic originated outside the continent, hosted on servers in Europe, America, and Asia. In 2022, Google completed its undersea cable, called Equiano, linking Africa and Europe. Industry analysts predict that in the West African nation of Nigeria alone, the Equiano cable will improve download speeds by 600 percent, reduce retail data prices by 21 percent, and create economic activity that will indirectly create 1.6 million jobs and add \$10 billion to the country's GDP. For South Africa, analysts forecast that by 2025 the cable will increase GDP by up to \$7 billion and indirectly contribute to the creation of 180,000 jobs.

Meanwhile, Meta's 2Africa cable has fully encircled the continent, connecting Africa, India, Pakistan, nearly all the Gulf States, and Europe. When the system is completed in 2024, it will be the longest undersea cable in the world, bringing internet connectivity to 33 countries that are home to 3 billion people.

With Equiano and 2Africa, Africa will finally have robust connections to the global internet. In addition to social media and internet searches (and the ads that monetize them), they will carry entire countries' health, governance, and security data. Because there are currently few large African data centres to store data regionally, these digital services will remain offshore.

Not to be outdone, in August 2022 Chinese companies completed the construction of an undersea fibre-optic cable known

as PEACE. The cable travels overland from China to Pakistan, where it submerges underwater and continues another 12,000 km through the Red Sea. At that point it branches north to France and south to South Africa. The cable will improve service for Chinese firms operating in Europe and Africa.

The Big Question

The involvement of Alphabet, Microsoft, Meta, and Amazon in the cable-laying industry has cut the cost of transmitting data across oceans for everyone—even their competitors—and helped increase the capacity to transmit data internationally. Google and Meta both state that their cables will benefit society as a whole. Google claims that its cables “interconnect humanity,” while Meta contends that 2Africa will ensure “everyone can benefit from the economic, educational, and social advantages of a digitally connected world.”

Despite these assertions, serious questions remain: Is it a good thing for the world's most powerful providers of internet services and marketplaces to own the infrastructure on which these services are delivered? Should big tech firms be allowed to vertically integrate all the way down to the internet's actual physical infrastructure? Once a cable is operational, could a company's network managers prioritize its own data traffic, ensuring that its cloud services remained reliable, and then tout that reliability to promote those services? If internet companies own their own fibre-optic networks, what kinds of public policy—if any—will keep their power in check?

There's another point: If internet companies control the cables, they could effectively dictate internet policy. The internet's initial promise was that it would *decentralize* telecommunications, releasing consumers from the monopoly grip of telecom companies. In the near future, however, a small group of huge corporations could tighten their hold on our online activity while rebuilding the internet itself. If the giants' cable building continues as planned, the future internet will be less a network of interconnected networks, as it was originally conceived and has developed, and more like a *supranet*, dominated by a few meganetworks operating upon their own global physical infrastructure.

Questions

1. Do we want the world's most powerful providers of internet services and marketplaces to also own the infrastructure on which these services are delivered? Why or why not? Support your answer.
2. If internet companies own their own fibre-optic networks, what kinds of public policy will keep these companies' power in check?

Sources: Compiled from D. Henrick, “Equiano Cable to Add Billions to South Africa's GDP,” *cainewssafrica.com*, September 2, 2022; “PEACE Completed Construction from Pakistan to France,” <http://www.peacecable.net/news/Detail/16641>, August 19, 2022; T. Page, “Google Equiano: Internet Giant Bets Big on Africa with Latest Megaproject,” *CNN*, August 8, 2022; “What Is Submarine Fibre Optic Cable? How Is It Laid?” *kvcable.com*, July 19, 2022; A. Blum and C. Baraka, “Sea Change,” *Rest of World*, May 10, 2022; I. Haynes, “Linking China to Europe and Africa, Huawei Undersea Cable Ends in Kenya,” *techzine.eu*, March 31, 2022; C. Mims, “Google, Amazon, Meta and Microsoft Weave a Fiber-Optic Web of Power,” *Wall Street Journal*, January 15, 2022; H. Fouquet and T. Seal, “China's Undersea Cable Is Dividing the Internet,” *Bloomberg BusinessWeek*, March 8, 2021; H. Fouquet, “China's 7,500-Mile Undersea Cable to Europe Fuels Feud,” *Bloomberg.com*, March 4, 2021; J. Griffiths, “The Global Internet Is Powered by Fast Undersea Cables. But They're Vulnerable,” *CNN*, July 26, 2019.

As a network of networks, the internet enables people to access data in other organizations and to communicate, collaborate, and exchange information around the world quickly, seamlessly, and inexpensively. Thus, the internet has become a necessity for modern businesses.

The internet originally grew out of an experimental project of the Advanced Research Project Agency (ARPA) of the U.S. Department of Defense. The project began in 1969 as the *ARPAnet*. Its purpose was to test the feasibility of a WAN over which researchers, educators, military personnel, and government agencies could share data, exchange messages, and transfer files.

Today, internet technologies are being used both within and among organizations. An **intranet** is a network that uses internet protocols so that users can take advantage of familiar applications and work habits. Intranets support discovery (easy and inexpensive browsing and searching), communication, and collaboration inside an organization.

In contrast, an **extranet** connects parts of different organizations' intranets. It also enables business partners to communicate securely over the internet using virtual private networks (VPNs) (explained in Chapter 4). Extranets offer limited accessibility to participating companies' intranets, as well as necessary interorganizational communications. They are widely used in the areas of business-to-business (B2B) electronic commerce (see Chapter 7) and supply chain management (SCM) (see Chapter 11).

No central agency manages the internet. Instead, the costs of its operation are shared among hundreds of thousands of nodes. Thus, the cost for any one organization is small. Organizations must pay a small fee if they wish to register their names, and they need to install their own hardware and software to operate their internal networks. Organizations are obliged to move any data or information that enters their organizational network, regardless of the source, to their destination, at no charge to the senders. The senders, of course, pay the telephone bills for using either the backbone or regular telephone lines.

Accessing the Internet

You can access the internet in several ways. From your place of work or your university, you can use your organization's LAN. A campus or company backbone connects all of the various LANs and servers in the organization to the internet. You can also log on to the internet from your home or on the road, using either wireline or wireless connections.

Connecting through an Online Service You can access the internet by opening an account with an internet service provider. An **internet service provider (ISP)** is a company that provides internet connections for a fee. Large Canadian ISPs include Bell Canada (www.bell.ca), Rogers Communications (www.rogers.com), TekSavvy (www.teksavvy.com), and TELUS (www.telus.com).

ISPs connect to one another through **network access points (NAPs)**. NAPs are exchange points for internet traffic. They determine how traffic is routed. NAPs are key components of the internet backbone. **Figure 6.8** shows a schematic of the internet in Canada. The red lines that link the main Canadian cities in the map represent the ultra-high-speed network and constitute the Canadian internet backbone; the same figure also shows little satellite dishes. These small satellites provide connectivity to the internet backbone for remote locations in Canada where a fibre-optic link is still not available.

Connecting through Other Means There have been several attempts to make access to the internet cheaper, faster, and easier. For example, terminals known as internet kiosks have been located in public places like libraries and airports (and even in convenience stores in some countries) for use by people who do not have their own computers. Accessing the internet from smartphones and tablets is common, and fibre-to-the-home (FTTH) is growing rapidly. FTTH involves connecting fibre-optic cable directly to individual homes. **Table 6.2** summarizes the various means of connecting to the internet. Satellite connections and Google Fiber are worth noting in more detail.

intranet A private network that uses internet software and TCP/IP protocols.

extranet A network that connects parts of the intranets of different organizations.

internet service provider (ISP) A company that provides internet connections for a fee.

network access points (NAPs) Computers that act as exchange points for internet traffic and determine how traffic is routed.

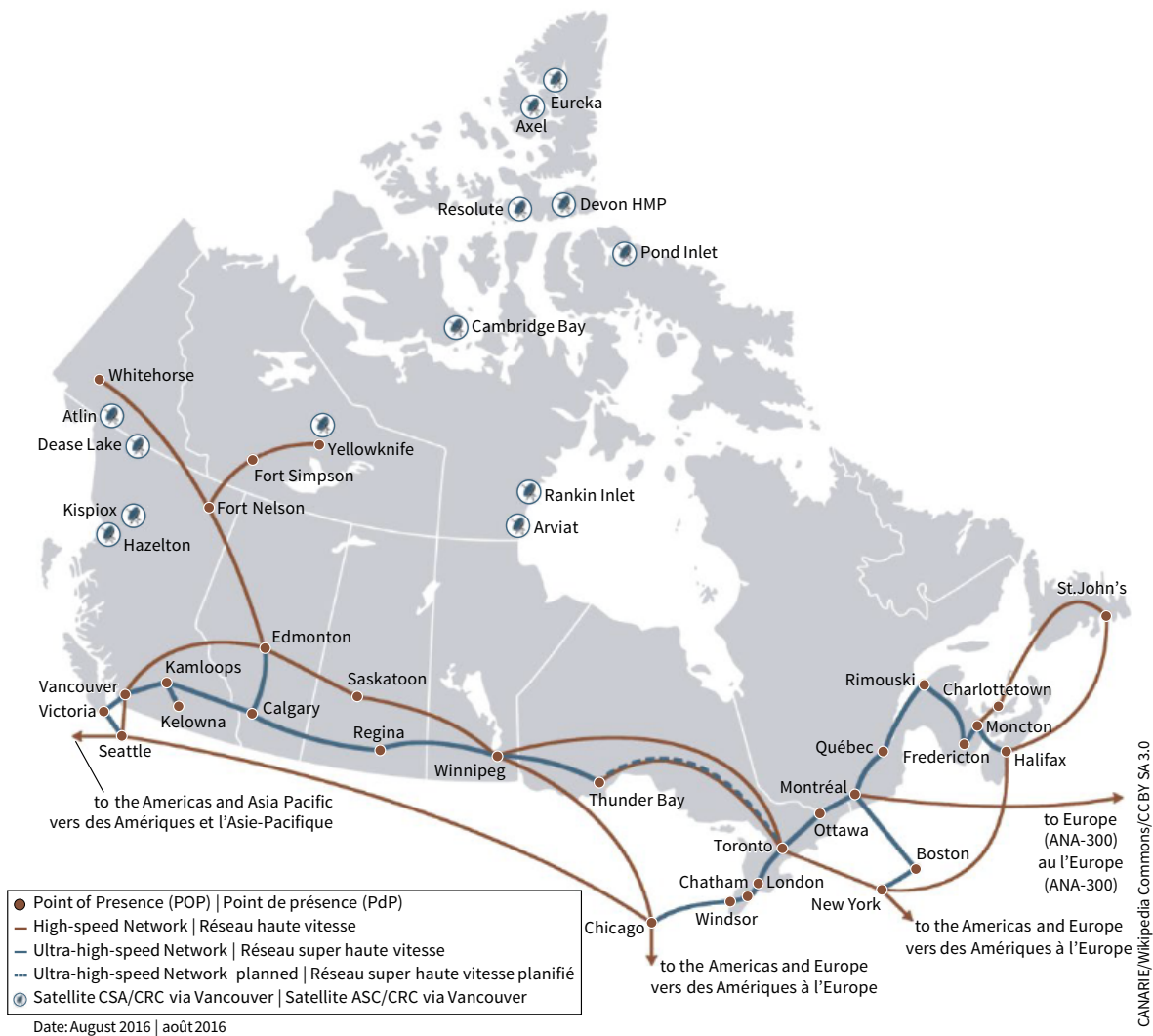


FIGURE 6.8 Canada's internet backbone.

TABLE 6.2 Internet Connection Methods

Service	Description
Dial-up	Access via a conventional telephone line. Still used in Canada where broadband is not available
DSL	Broadband access through telephone companies
Cable modem	Access over your cable TV coaxial cable.
Satellite	Access over radio wave satellite
Wireless	Access via Wi-Fi access points or cellphone network
Fibre-to-the-home (FTTH)	Broadband access via a fibre-optic cable

Connecting through Satellite See our discussion in Section 8.1.

Google Fiber (FTTH) Google Fiber (<http://fiber.google.com>) offers broadband services with both fibre-optic and fixed wireless technology in 11 cities across 9 states in the United States; however, it is not yet available in Canada. Google Fiber Webpass is a fixed wireless internet that runs on Ethernet inside buildings, doesn't require a modem, and is accessible in 15 metropolitan areas across the United States, but it is limited to apartments, condominiums, and businesses.

Google Fiber features no contracts, no data caps, upload and download speeds of 1 Gbps, and 1 terabyte of free cloud storage. The service costs US \$70 per month for 1-Gbps plans and US \$100 per month for 2-Gbps plans.

Google Fiber Webpass features optional contracts, no data caps, and download speeds of up to 1 Gbps, depending on the individual building set-up. Webpass customers have access to the 1-Gbps plan only, but they can receive a small discount for paying for a year of service upfront (US \$62.50 per month for a total of US \$750 if they pay upfront).

Addresses on the Internet Each computer on the internet has an assigned address, called the **Internet Protocol (IP) address** that distinguishes it from all other computers. The IP address consists of sets of numbers in four parts, separated by periods. For example, the IP address of one computer might be 135.62.128.91.

Currently, there are two IP addressing schemes. The first scheme, IPv4, is the most widely used. IP addresses using IPv4 consist of 32 bits, meaning that there are 2^{32} possibilities for IP addresses, or 4,294,967,296 distinct addresses. Note that the IP address in the preceding paragraph (135.62.128.91) is an IPv4 address. At the time that IPv4 was developed, there were not as many computers that needed addresses as there are today. Therefore, a new IP addressing scheme has been developed, IPv6, because we have run out of available IPv4 addresses.

IP addresses using IPv6 consist of 128 bits, meaning that there are 2^{128} possibilities for distinct IP addresses, which is an unimaginably large number. IPv6, which is replacing IPv4, will accommodate the rapidly increasing number of devices that need IP addresses, such as smartphones and devices that constitute the Internet of Things (see Section 8.4).

IP addresses must be unique so that computers on the internet know where to find one another. The Internet Corporation for Assigned Names and Numbers (ICANN) (www.icann.org) coordinates these unique addresses throughout the world, working on behalf of an international "multistakeholder community" composed primarily of technology companies.

Because numerical IP addresses are difficult to remember, most computers have names as well. ICANN accredits certain companies called *registrars* to register these names, which are derived from the **domain name system (DNS)**. The Canadian Internet Registration Authority (CIRA) manages the registration of .ca domain names. **Domain names** consist of multiple parts, separated by periods, that are read from right to left. For example, consider the domain name <https://www.lightspeedhq.com/pos/retail/apparel>. The scheme (https), also called a protocol, tells Web servers which protocol to use when accessing a website. www.lightspeedhq.com would be the domain name. The letters .com indicate that this is a commercial site. And the letters /pos/retail/apparel indicate the directories where the Web page is on the server.

A top-level domain (TLD) is the domain at the highest level in the internet's hierarchical Domain Name System. The top-level domain names are located in the root zone (rightmost zone) of the name. ICANN delegates management of most TLDs to responsible organizations. It also operates the Internet Assigned Numbers Authority (IANA), which is in charge of maintaining the DNS root zone. Today, IANA distinguishes among the following groups of TLDs:

- **Country-code top-level domains (ccTLD):** Two-letter domains established for countries or territories. For example, .ca is Canada's TLD, while .de stands for Germany, .it for Italy, and .ua for Ukraine.
- **Internationalized country code top-level domains (IDN ccTLD):** These are ccTLDs in non-Latin character sets (e.g., Arabic or Chinese).
- **Generic top-level domains (gTLD):** Top-level domains with three or more characters. gTLDs initially consisted of .gov, .edu, .com, .mil, .org, and .net. In late 2000, ICANN introduced .aero, .biz, .coop, .info, .museum, .name, and .pro.

Internet Protocol (IP)

address An assigned address that uniquely identifies a computer on the internet.

domain name system

(DNS) The system administered by the Internet Corporation for Assigned Names (ICANN) that assigns names to each site on the internet.

domain name The name assigned to an internet site, which consists of multiple parts, separated by periods, that are translated from right to left.

The following TLDs are particularly popular:

.com	Commercial sites
.org	Non-profit organizations
.net	Internet service and infrastructure organizations

The Future of the Internet

Researchers assert that if internet bandwidth is not improved rapidly, then within a few years, the internet will be able to function only at a much reduced speed. The internet is sometimes too slow for data-intensive applications such as full-motion video files (movies) and large medical files (X-rays). It is also unreliable and is not secure.

As a result, research networks in different countries are working toward developing new technologies to support the growing needs of the internet. In Canada, CANARIE Inc. (www.canarie.ca) is a not-for-profit organization supported by governments and the private sector with the goal of doing research and implementing advanced communication networks. CANARIE's most advanced network interconnects provincial research networks, universities, research centres, government research laboratories, and schools. CANARIE develops and deploys advanced network applications essential for national and international collaboration, such as remote medical diagnosis, digital libraries, distance education, online simulation, and virtual laboratories.

Internet2 (www.internet2.edu), is the U.S. equivalent of CANARIE. It is designed to be fast, always on, everywhere, natural, intelligent, easy, and trusted. Note that Internet2 is not a separate physical network from the internet. For more details, see the Internet2 website.

IT's About Business 6.2 shows a possible future for the internet, called the "splinternet."

IT's About Business 6.2

MIS The Splinternet

For most of its relatively short history, the internet has had very limited centralized planning and governance. In general, the internet today enables users to exchange ideas and information instantaneously and with minimal supervision, regardless of national boundaries.

The modern, open internet also provides a platform that nations can use to undertake information warfare, manipulate one another's citizens, and/or project their interests past their own national borders. Many nations frame their internet access policies to balance the destabilizing effects of the internet against its benefits for economic development, trade, productivity, and intellectual and cultural exchange. Even democracies need to balance the tradeoff between managing the internet and keeping it open. In Britain and South Korea, for example, internet service providers (ISPs) are required by law to limit access to pornography.

As a result, a global splinternet is forming. The *splinternet*, also known as *internet balkanization*, is a loosely connected set of national internets. There are many reasons for the emergence of the splinternet.

Some countries are unhappy with the Western coalition that has traditionally controlled the internet and its governance. For example, the actual operations of the internet *domain name system* (DNS) are conducted by a wide variety of organizations, but a majority of the "root servers" that function as the internet's foundational layer are operated by groups in the United States. The DNS is basically an internet phone book. For instance, when you type "google.ca" into your browser, your computer uses the DNS to

translate this domain name into an IP address, which identifies the correct server on the internet to send your request.

Many countries are unhappy with the fact that the internet was developed and engineered to ensure that anyone anywhere can send anything to anyone else. One reason is that these countries want more control over dissent. Another is that they are nervous about malicious software reaching military installations and critical power and water grids via the open internet. (Recall our discussion of SCADA attacks in Chapter 4.)

Another catalyst for nations to develop national internet control occurred in 2013 when Edward Snowden, a contractor with the U.S. National Security Agency (NSA), leaked a number of classified documents. The papers revealed that the NSA's PRISM program had been collecting information from users of social media sites and other Web services internationally. In fact, many heads of state such as German chancellor Angela Merkel of Germany and Brazilian president Dilma Rousseff were among those spied upon. These revelations caused Brazil to pass the Marco Civil da Internet law, which requires international companies to comply with Brazilian laws concerning data protection. Other nations have taken similar actions.

Within their own jurisdictions, countries are using their laws and regulatory powers to restrict digital activities. Specifically, many countries want to maintain sovereignty over their national data by implementing measures such as data privacy regulations and restrictions on data they deem inappropriate. As of August 2022, more than 30 regions or nations were imposing data sovereignty regulations including the European Union (EU), Brazil, China, and India.

These policies particularly impact social media platforms such as Facebook and Twitter. People around the world use these services, and governments are now insisting that social media sites respect local legislation and societal norms. Let's take a closer look at the leading proponents of the splinternet.

China

China opted out of the open internet by embedding a homegrown ISP and DNS infrastructure in the early 2000s. In addition, the country has allowed very few entry and exit points to and from the global internet to exist within its borders. China, therefore, has fewer digital borders to monitor.

China's internet is controlled by Golden Shield, a government monitoring and censorship program run by the Ministry of Public Security. One of its best-known components is the Great Firewall of China, a legal and technological structure that makes it difficult for citizens to access foreign media and social media sites. The country does not allow privately operated foreign internet platforms, including many social media platforms that can promote dissent, opposition, or subversive ideas, to operate within its borders.

The firewall also selectively blocks certain internet addresses, words, phrases, IP addresses, etc., as defined by the government. Although formidable, the firewall is not perfect because virtual private networks (VPNs) and censorship avoidance software such as Tor can circumvent it.

Russia

Russia has developed a national internet, known as RuNet, designed to be independent of the global internet and easier to defend against attacks from abroad. However, outside observers contend that the move is part of Russia's long tradition of trying to control the flow of information among its citizens.

Russia will have many problems if it decides to actually implement RuNet.

- It will be very difficult for Russia to identify the myriad access points that its citizens use to get online, including their laptops, smartphones, and iPads. Some Russians will use servers abroad, such as Google's Public DNS, which Russia will not be able to duplicate. Therefore, when Russian citizens try to access these servers, the connection will not work.
- If the authorities implement RuNet and require their ISPs to use it, Russian users might not notice that a website is censored unless they actively try to access that site. For example, a user trying to connect to Facebook.com could be redirected to vk.com, a Russian social media service that strongly resembles Facebook. Russian users might not be pleased as they wonder to what extent the information on vk.com is censored by their government.
- The internet is an essential component of the global economy. Therefore, disconnecting would seriously damage Russia's economy. For example, although many cloud vendors mirror (duplicate) their content in different regions, none of the major cloud services (Microsoft, Google, and Amazon Web Services) maintains data centres in Russia. As a result, Russia could have to create its own cloud service.
- Many Russian ISPs carry traffic on behalf of other ISPs, with reciprocal arrangements that these ISPs carry traffic for Russian ISPs. If Russia implements its disconnection project incorrectly, then a large amount of traffic going in and out of the country will simply be lost.

- The disconnection process will be technically difficult and very expensive.
- Even if a disaster does not occur—such as banking, hospital, or aviation facilities failing to connect—many websites could stop working. Most Web pages rely on multiple servers to function, which may exist in different parts of the world. If Russia disconnects, then users may no longer have access to these servers.
- Other consequences have arisen with the Russian invasion of Ukraine.

- First, the European Union is trying to remove certain Russian outlets from the internet. For instance, the EU is banning the state-owned RT television network and the Sputnik news agency, suggesting that not only should these sites be blocked, but that search engines and social networks should hide or delete any post repeating content from these sites.

- Second, in February 2022 the Ukrainian government called on ICANN to suspend Russia's access to the DNS system, effectively removing .ru sites from the internet. ICANN rejected the proposal because it has no legal power over the DNS system.

As of October 2022, the question of whether the Kremlin intends to fully cut Russia off from the global internet remained unresolved.

Other Countries

Not all countries fall completely into the category of either the "global and open internet" or a "sovereign and controlled internet." Since 2015, several countries, called *digital deciders*—Israel, Brazil, Ukraine, South Korea, and India, among others—have moved toward a more sovereign and controlled internet. They have a variety of reasons for their actions, but quite a few of those countries are dealing with similar contexts. Specifically, Ukraine, Israel, and South Korea, all of which face perpetual conflict with other nations, have discovered that those nations are turning the internet into yet another destructive weapon.

In mid-2022, the Canadian government, and the governments of the United States, Britain, Australia, and New Zealand, required all telecom companies operating in their countries to dismantle and remove any internet and telecommunications infrastructure provided by Chinese telecom equipment makers Huawei and ZTE.

Results

A future splinternet could take one of two forms. First, we could see a major splintering of the internet that would involve technically incompatible protocols used by different countries. This type could likely be managed because technicians could probably find a way relatively quickly to bridge the different protocols.

The second form of splintering would be to continue using technically compatible protocols, but to have different nations' governing bodies managing internet services internally. Managing this type of splintering would involve politics rather than technology and could therefore be much more difficult than the first type.

The splinternet is already a threat to businesses that operate in multiple countries. If a business does nothing to respond, it may find its applications and services cut off from valuable customers in certain countries and regions. Further, firms will face large fines if they fail to comply with national and local internet regulations.

To determine whether your company is at risk, consider these questions:

- Does the company have an international data strategy?
- Can the company manage data movement specific to certain regions, including the EU? India? China? Russia? Other regions?
- Can the company quickly respond to important national or regional regulatory changes?
- Can the company avoid being blocked from operating in other nations or regions by instantly changing its data management settings?

If firms cannot answer “yes” to each of these questions, then their international operations are at risk. Consequently, they must modernize their IT operations and data mobility strategies to align with the new splinternet reality.

Questions

1. What are the advantages of the splinternet to a nation? Provide examples to support your answer.
2. What are the disadvantages of the splinternet to a nation? Provide examples to support your answer.
3. What are the advantages of the splinternet to you as an individual? Provide examples to support your answer.
4. What are the disadvantages of the splinternet to you as an individual? Provide examples to support your answer.

Sources: Compiled from L. Newman, “Russia Takes a Big Step toward Internet Isolation,” *Wired*, January 5, 2020; C. Cimpanu, “Russia Successfully Disconnected from the Internet,” *ZDNet*, December 23, 2019; “Russia’s Law That Lets It Disconnect from the Internet Comes into Force Today,” *MIT Technology Review*, November 1, 2019; Z. Doffman, “Putin Begins Installing Equipment to Cut Russia’s Access to World Wide Web,” *Forbes*, September 24, 2019; T. Merritt, “Top 5 Things to Know about the Splinternet,” *TechRepublic*, October 7, 2019; J. Kim, “The Splinternet Is Here and Your Company Needs to Be Ready,” *TheNextWeb*, June 10, 2019; J. Sherman, “Russia and Iran Plan to Fundamentally Isolate the Internet,” *Wired*, June 6, 2019; J. Roberts, “The Splinternet Is Growing,” *Fortune*, May 29, 2019; “Iran Says Its Internet Almost Ready to Shield Country from ‘Harmful’ Internet,” *Radio Farda*, May 20, 2019; S. Adey, “Russia Is the Latest Country to Try to Find Ways to Police Its Online Borders, Sparking the End of the Internet as We Know It,” *BBC News*, May 15, 2019; N. Hodge and M. Ilyushina, “Putin Signs Law to Create an Independent Russian Internet,” *CNN*, May 1, 2019; C. Jee, “Russia Wants to Cut Itself Off from the Global Internet. Here’s What That Really Means,” *MIT Technology Review*, March 21, 2019; “Russia Must Build Own Internet in Case of Foreign Disruption: Putin,” *Reuters*, February 20, 2019; L. Matsakis, “What Happens if Russia Cuts Itself Off from the Internet,” *Wired*, February 12, 2019; K. Finley, “California Could Soon Have Its Own Version of the Internet,” *Wired*, December 29, 2018; R. Morgus, J. Woolbright, and J. Sherman, “The Digital Deciders,” *New America*, October 23, 2018; M. Daoudi, “Beware the SplinterNet—Why Three Recent Events Should Have Businesses Worried,” *Forbes*, July 12, 2018; D. Alba, “The World May Be Headed for a Fragmented ‘Splinternet,’” *Wired*, July 7, 2017; B. Moscovitz, “The Reasons Why a Free and Open Internet Could Spell the Web’s Downfall,” *Quartz Media*, April 4, 2017; A. Mendoza, “Analyst: Huawei and ZTW Expulsion in Canada May Contribute to Splinternet,” *CommsWire*, May 23, 2022.

The World Wide Web

Many people equate the internet with the World Wide Web. However, they are not the same thing. The internet functions as a transport mechanism, whereas the World Wide Web is an application that uses those transport functions. Other applications, such as email, also run on the internet.

The **World Wide Web (the Web or WWW)** is a system of universally accepted standards for storing, retrieving, formatting, and displaying information through a client/server architecture. The Web handles all types of digital information, including text, hypermedia, graphics, and sound. It uses graphical user interfaces (GUIs) (explained in Technology Guide 2), so it is very easy to navigate. Let’s look at the different forms of the Web.

Surface Web. The *surface web*—also known as the *visible web*—is the collection of websites that we are all familiar with and use constantly. Surface websites are indexed by traditional search engines. They track user information, install cookies, and share Internet Protocol data. Examples of surface web content are YouTube, Wikipedia, and basically everything that we can see on the results page of any search engine. Estimates are that the surface web comprises 10 to 16 percent of the information that is on the internet.

Deep Web. The *deep web* refers to the collection of websites that cannot be indexed by traditional search engines. Deep web content does not appear on the results pages of search engines because it exists behind passwords, firewalls, and paywalls and it requires credentials to access. Deep web content includes databases, webmail pages, registration-required content, online banking pages, medical and financial records, personal files, and other forms of untracked internet communication. Estimates are that the deep web comprises 80 to 90 percent of information on the internet.

Dark Web. The *Dark Web* is a network of websites, servers, forums, and communication tools that require encryption technologies to access and therefore cannot be indexed on traditional search engines. Compared to the surface web and the deep web, the Dark Web comprises a very small amount of information. Security experts believe that 10,000 to 100,000 active sites exist on the Dark Web.

World Wide Web (the Web or WWW) A system of universally accepted standards for storing, retrieving, formatting, and displaying information through a client/server architecture; it uses the transport functions of the internet.

To access these sites, users must employ Tor, an acronym for The Onion Router. Tor is free, open-source software that helps keep the source and destination of internet traffic anonymous by sending each computer's IP address through a network of similarly encrypted IP addresses. Each computer knows only the immediate sender and the next recipient.

Users can also employ Tails, a portable and disposable Linux-based operating system that operates from a flash drive. Tails adds a layer of security to activities on the Dark Web. Despite Tor and Tails, however, there is no guarantee of complete anonymity on the Dark Web.

People and organizations use the Dark Web for both legitimate and criminal purposes. Criminals exploit the Dark Web's anonymity to sell arms, drugs, people (slavery), and stolen data.

On the positive side, the United Nations, the Electronic Frontier Foundation, and news organizations can use the Dark Web to protect dissidents, informants, and sources in oppressive countries. That is, on the Dark Web, whistleblowers, activists, journalists, and other concerned citizens can share sensitive information that they could not share publicly because they would risk political persecution or retribution from their governments, employers, or criminal organizations.

Other legitimate Dark Web users include corporate IT departments and law enforcement agencies. Corporations monitor and search the Dark Web for stolen data and compromised accounts. Law enforcement agencies hunt criminals on the Dark Web. For example, the United Nations law enforcement department, the Office on Drugs and Crime, monitors the Dark Web and shares relevant data with both the public and global police organizations such as Europol and the FBI.

Hypertext is the underlying concept defining the structure of the World Wide Web. Hypertext is the text displayed on a computer display or other electronic device with references, called *hyperlinks*, to other text that the reader can immediately access, or where text can be revealed progressively at additional levels of detail. A **hyperlink** is a connection from a hypertext file or document to another location or file, typically activated by clicking on a highlighted word or image on the screen, or by touching the screen.

Organizations that wish to offer information through the Web must establish a *home page*, which is a text and graphical screen display that usually welcomes the user and provides basic information on the organization that has established the page. In most cases, the home page will lead users to other pages. All the pages of a particular company or individual are collectively known as a **website**. Most Web pages provide a way to contact the organization or the individual. The person in charge of an organization's website is its *webmaster*.

To access a website, the user must specify a **uniform resource locator (URL)**, which points to the address of a specific resource on the Web. For example, the URL for Microsoft is <http://www.microsoft.com>. Recall that HTTP stands for *hypertext transfer protocol*. The remaining letters in this URL—www.microsoft.com—indicate the domain name that identifies the Web server that stores the website.

Users access the Web primarily through software applications called browsers. **Browsers** provide a graphical front end that enables users to point and click their way across the Web, a process called *surfing*. Web browsers became a means of universal access because they deliver the same interface on any operating system on which they run. As of May 2023, Google Chrome was the most widely used browser, followed by Apple Safari, Microsoft Edge, and Firefox.

The World Wide Web has evolved since Professor Tim Berners-Lee wrote the original computer code for it in 1989. Since then, the Web has evolved from Web 0.0 to Web 3.0 today, with Web 4.0 and Web 5.0 still in the conceptual stage. We will also describe a new form of the Web developed by Professor Berners-Lee.

Each new version of the World Wide Web has transformed the ways in which users interact with data, information, organizations, and one another. The Web has also transformed the ways in which organizations conduct business. Let's examine how it has evolved since its invention in 1989.

Web 0.0: The Development of the Web (1989–1990). In 1989, Tim Berners-Lee, a British scientist at the European Organization for Nuclear Research (CERN), invented the World Wide Web—the very first Web browser—and developed the basic protocols and algorithms that enabled the Web to expand globally. His original specifications for uniform resource locators (URLs), hypertext transfer protocol (HTTP), and hypertext markup language (HTML) were the basic building blocks of the Web. The Web was introduced to the public in 1990.

Web 1.0: The Read-Only Web (1990–2000). Web 1.0 gave users information, which was typically presented by organizations. For example, firms used static websites to display product information and directions to their closest brick-and-mortar store location.

hypertext Text displayed on a computer display with references, called hyperlinks, to other text that the reader can immediately access.

hyperlink A connection from a hypertext file or document to another location or file, typically activated by clicking on a highlighted word or image on the screen or by touching the screen.

website Collectively, all the Web pages of a particular company or individual.

uniform resource locator (URL) The set of letters that identifies the address of a specific resource on the Web.

browsers Software applications through which users primarily access the Web.

With this version of the Web, users searched for and found information. It was generally not interactive and users were basically content consumers.

Web 2.0: The Social (Read-Write) Web (2000–2010). Whereas Web 1.0 connected users with information, Web 2.0 connects people with people. With Web 2.0, users are able to create and upload content. Thus, internet users became participants and were able to interact with one another and with websites. They could collaborate on ideas, share information, and generate or create information that would be available to other users around the world.

Web 3.0: The Semantic (Read-Write-Execute) Web (2010–2020). Web 3.0 attempts to represent knowledge in a format that allows computers to automatically reach conclusions and make decisions utilizing certain reasoning capabilities. Two major applications underlie Web 3.0: semantic markup and Web services. *Semantic markup* is a method of structuring HTML so that it provides the meaning of the information in Web pages and Web applications rather than just its appearance. A *Web service* is an application designed to support machine-to-machine interaction over the internet.

By combining semantic markup and Web services, Web 3.0 provides for machine-readable content, developed so that applications can directly interact with one another. Web applications can also interpret information for humans.

As we look at Web 4.0 and Web 5.0 as of October 2022, keep in mind that we are speculating, because these versions of the Web are still being developed.

Web 4.0: The Symbiotic Web (2020–2030). Web 4.0 will be the open, intelligent Web. The goal of the symbiotic Web is to enable humans and machines to interact in symbiosis. A *symbiotic relationship* between humans and machines is one in which humans and machines improve each other. Humans have capabilities such as compassion, intuition, and value judgement. Machines demonstrate learning, discovery, and fact checking. These capabilities complement and magnify each other.

Web 5.0 (2030 and beyond). Web 5.0, referred to as the *telepathic web*, could emerge with technologies such as neural (brain) implants, which could give humans the ability to communicate with the Web through their thoughts. Web 5.0 could also see the emergence of intelligent virtual assistants that predict your needs from your behaviours without requiring many cues.

The Inrupt Project: A New Direction for Web Evolution. In 2018, Tim Berners-Lee launched his Inrupt project (<https://inrupt.com>). While the Web will continue to evolve as advanced technologies such as artificial intelligence emerge, Berners-Lee is developing a new model for Web evolution.

Along with other researchers, Berners-Lee designed Inrupt to decentralize the Web and take back power from platforms that have profited from centralizing it. As we have noted in previous chapters, the “bargain” with platforms such as Google and Amazon allows users to access the platforms’ services in exchange for users’ data. Inrupt is designed to redirect the balance of power from Web platforms to Web users.

Inrupt utilizes Solid, a decentralized Web platform built by Berners-Lee and other researchers at MIT (www.mit.edu). Inrupt differs from current versions of the Web in that all data that users access, create, or upload exist within each user’s Solid pod. Each user will have a Solid identity and a Solid pod; that is, their personal online data store. The pods give users control over their applications and data on the Web.

With Inrupt, users can allow others to access some of their data for particular services if they want to and move their data from one app to another instead of surrendering control over them. Inrupt could also use blockchain technology (see Chapter 7), which offers a means of independently verifying personal identity. This verification respects privacy better than the accounts that users maintain on various platforms.

Before you go on . . .

1. Describe the various ways that you can connect to the internet.
2. Identify each part of an internet address.
3. Describe the difference between the internet and the World Wide Web.
4. What are the functions of browsers?

6.4

Network Applications: Discovery

LEARNING OBJECTIVE

Explain the impact that discovery network applications have had on business and everyday life.

Now that you have a working knowledge of what networks are and how you can access them, the key question is: How do businesses use networks to improve their operations? In the next four sections of this chapter, we explore four network applications: discovery, communication, collaboration, and education. These applications, however, are merely a sampling of the many network applications that are currently available to users. Even if these applications formed an exhaustive list today, they would not do so tomorrow, when inevitably something new will be developed. Furthermore, classifying network applications is difficult because there will always be borderline cases. For example, telecommuting combines communication and collaboration.

The internet enables users to access, or *discover*, information located in databases all over the world. By browsing and searching data sources on the Web, users can apply the internet's discovery capability to areas ranging from education to government services to entertainment to commerce. Although having access to all this information is a great benefit, it is critically important to realize that there is no quality assurance for information on the Web. The Web is truly democratic in that *anyone* can post information to it. Therefore, the fundamental rule about information on the Web is "User beware!"

Think about discovery in 1960. How would you have found information? You would probably have had to go to the library to check out a physical book. Contrast that process with how you would discover that information today. In fact, the overall trends in discovery have been:

- In the past, you had to go to the information (the library). Today, the information comes to you through the internet.
- In the past, only one person at a time could have the information (the book they checked out of the library). Today, the information is available to multiple users at the same time.
- In the past, you may have had to have your book translated if it were written in a different language. Today, automatic translation software tools are improving very rapidly.

However, there is a downside to the process of discovery. In June 2019, a crash outside Denver, Colorado, blocked the main access road to the Denver International Airport. Google Maps suggested a detour to many of the drivers trying to reach the airport.

The detour led some 100 drivers to a narrow dirt road near the airport. Unfortunately, the road ended up in a muddy, empty, privately owned field. Some cars in the front of the line became stuck in the mud. The narrow road allowed passage of only one car at a time, so cars at the back of the line had to turn around, one at a time, to untangle the mess.

Google's response? "While we always work to provide the best directions, issues can arise due to unforeseen circumstances."

Moral of the story: don't follow discovery applications blindly!

The Web's major strength—the vast stores of information it contains—also presents a major challenge. The amount of information on the Web can be overwhelming, and it doubles approximately every year. As a result, navigating through the Web and gaining access to necessary information are becoming more and more difficult. To accomplish these tasks, people are increasingly using search engines and portals.

Search Engines and Metasearch Engines

search engine A computer program that searches for specific information by keywords and reports the results.

A **search engine** is a computer program that searches for specific information by keywords and then reports the results. A search engine maintains an index of billions of Web pages. It uses that index to find pages that match a set of user-specified keywords. Such indexes are created and updated by *webcrawlers*, which are computer programs that browse the Web and create a copy of all visited pages. Search engines then index these pages to provide fast searches.

In mid-2023, four search engines accounted for almost all searches in Canada. They are, in order, Google (www.google.ca), accounting for almost 90 percent of all searches; followed by Microsoft's Bing (www.bing.com), with just over 5 percent and Yahoo (www.yahoo.com) and DuckDuckGo (www.duckduckgo.com), each accounting for about 0.5 percent of all searches. The leading search engine in China is Baidu (www.baidu.com), which claims approximately 75 percent of the Chinese market.

Visual search uses real-world images (e.g., screenshots, internet images, or photographs) as the basis for online searches. Modern visual search technology uses artificial intelligence (see Chapter 14) to understand the content and context of these images and return a list of related results. Approximately three-quarters of U.S. internet users search for visual content prior to making a purchase. Leading visual search apps include Pinterest Lens, Google Lens, Bing Visual Search, Amazon Camera Search, eBay Image Search, and CamFind.

You can also use a metasearch engine. **Metasearch engines** search several engines at once and then integrate the findings to answer users' queries. Examples are Metacrawler (www.metacrawler.com), Mamma (www.mamma.com), KartOO (www.kartoo.com), and Dogpile (www.dogpile.com).

metasearch engine A computer program that searches several engines at once and integrates the findings of the various search engines to answer queries posted by users.

Publication of Material in Foreign Languages

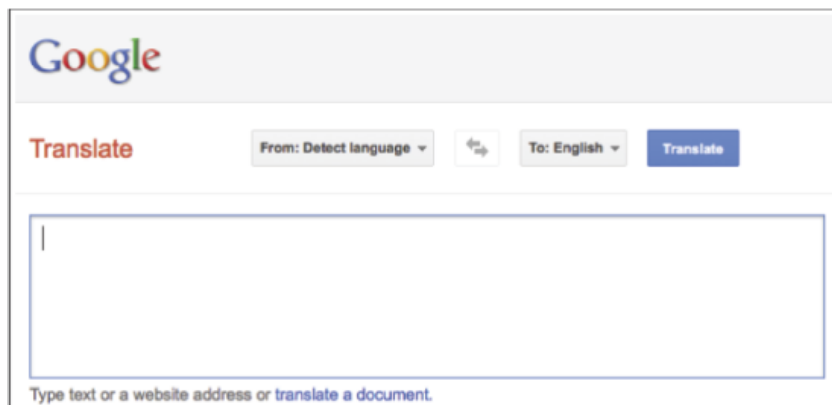
The World Bank (www.worldbank.org) estimates that 80 percent of online content is available in 1 of only 10 languages: English, Chinese, Spanish, Japanese, Arabic, Portuguese, German, French, Russian, and Korean. Roughly 3 billion people speak one of these as their first language. However, more than 50 percent of all online content is written in English, which is understood by only 21 percent of the world's population. Consider India, whose citizens speak roughly 425 languages and dialects. Industry analysts estimate that less than 0.1 percent of all Web content is composed in Hindi, the first language of approximately 260 million people.

So not only is there a huge amount of information on the internet, but it is also written in many languages. How, then, do you access this information? The answer is that you use an *automatic translation* of Web pages. This kind of translation is available to and from all major languages, and its quality is improving over time.

Companies invest resources to make their websites accessible in multiple languages as a result of the global nature of the business environment. In other words, multilingual websites are now a competitive necessity. When companies are disseminating information around the world, getting that information correct is essential. It is not enough for companies to translate Web content. They must also localize that content and be sensitive to the needs of the people in local markets.

Translation services are expensive. Companies supporting 10 languages can spend US \$200,000 annually to localize information and another US \$50,000 to maintain their websites. Translation budgets for major multinational companies can total millions of dollars.

Some major translation products are Microsoft's Translator app (<https://translator.microsoft.com>), Google Translate (<https://translate.google.com>) (see Figure 6.9),



Source: Google LLC

FIGURE 6.9 Google Translate. (Google and the Google logo are registered trademarks of Google Inc., used with permission.)

and Skype Translator (<https://www.skype.com/en/features/skype-translator/>), as well as products and services available at Trados (www.sdltrados.com) and Systran S.A. (www.systransoft.com). Google Translate and Microsoft Translator are free, based on machine learning (see Chapter 14); they instantly translate words, phrases, and Web pages between English and over 100 other languages.

Portals

portal A Web-based personalized gateway to information and knowledge that provides information from disparate information systems and the internet, using advanced searching and indexing techniques.

commercial (public)

portal A website that offers fairly routine content for diverse audiences. It offers customization only at the user interface.

affinity portal A website that offers a single point of entry to an entire community of affiliated interests.

Most organizations and their managers encounter information overload. Information is scattered across numerous documents, email messages, and databases at multiple locations and in multiple systems. Finding relevant, accurate information is often time-consuming and may require users to access multiple systems.

MIS One solution to this problem is to use *portals*. A **portal** is a Web-based, personalized gateway to information and knowledge that provides relevant information from different IT systems and the internet using advanced searching and indexing techniques. After reading the next section, you will be able to distinguish among four types of portals: commercial, affinity, corporate, and industrywide. The four types of portals are differentiated by the audiences they serve.

A **commercial (public) portal** is the most popular type of portal on the internet. It is intended for broad, diverse audiences, and it offers routine content, some of it in real time (e.g., a stock ticker). Examples are Yahoo Canada (<https://ca.yahoo.com>) and The Loop (www.theloop.ca).

MKT In contrast, an **affinity portal** offers a single point of entry to an entire community of affiliated interests, such as a hobby group or a political party. Your university most likely has an affinity portal for its alumni. **Figure 6.10** displays the affinity portal for York University alumni. Other examples of affinity portals are www.bee.community and treecanada.ca.

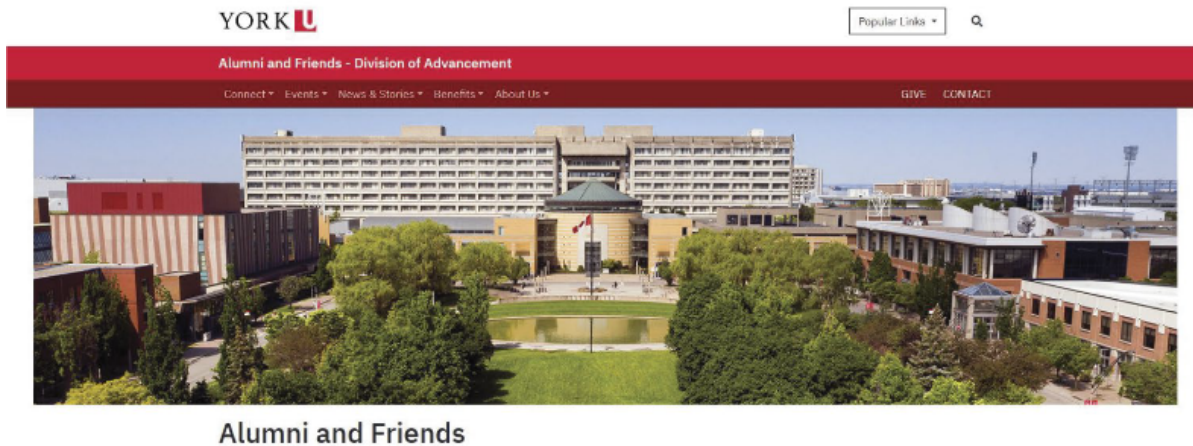


FIGURE 6.10 York University Alumni Affinity Portal.

corporate portal A website that provides a single point of access to critical business information located both inside and outside an organization.

industrywide portal A Web-based gateway to information and knowledge for an entire industry.

MIS As the name suggests, a **corporate portal** offers a personalized, single point of access through a Web browser to critical business information located inside and outside an organization. These portals are also known as *enterprise portals*, *information portals*, and *enterprise information portals*. Besides making it easier to find needed information, corporate portals offer customers and employees self-service opportunities.

Whereas corporate portals are associated with a single company, an **industrywide portal** serves entire industries. An example is the Canadian Trucking Alliance (<http://cantruck.ca>), a portal for the trucking industry and the trucking community, including professional drivers,

Source: <http://alumniandfriends.yorku.ca/> (Courtesy of York University).

owners/operators, and trucking companies. The portal provides drivers with personalized Web-based email, access to applications to leading trucking companies in Canada, and discussions of issues of interest. The portal also provides a large database of trucking jobs and general information related to the trucking industry

Before you go on . . .

1. Differentiate between search engines and metasearch engines.
2. What are some reasons why publication of material in several languages is so important?
3. Describe the various reasons why portals are useful to us.

6.5 Network Applications: Communication

LEARNING OBJECTIVE

Explain the impact that communication network applications have had on business and everyday life.

The second major category of network applications is communication. There are many types of communication technologies, including email, call centres, chat rooms, and voice. Furthermore, we discuss an interesting application of communication: telecommuting. (Note: You will read about other types of communication—blogging and microblogging—in Chapter 9.)

Electronic Mail

Electronic mail (email) is the largest-volume application running over the internet. Studies have found that almost all companies conduct business transactions through email, and the vast majority confirm that email is tied to their means of generating revenue. At the same time, however, the amount of email that managers receive has become overwhelming. The problem is that too much email can actually make a business less productive.

Web-Based Call Centres

MKT Effective personalized customer contact is becoming an important aspect of Web-based customer support. Such service is provided through *Web-based call centres*, also known as *customer care centres*. For example, if you need to contact a software vendor for technical support, you will usually be communicating with the vendor's Web-based call centre, using email, a telephone conversation, or a simultaneous voice and Web session. Web-based call centres are sometimes located in foreign countries such as India. Such *offshoring* is an important issue for Canadian companies. (We discuss offshoring in Chapter 13.)

Significantly, some companies are moving their call centre operations back to their country of origin, for several reasons. First, they believe they have less control of their operations when the centres are located overseas. They must depend on the vendor company to uphold their standards, such as quality of service. A second difficulty is language differences, which can create serious communication problems. Third, companies that manage sensitive information risk breaching customer confidentiality and security. Finally, call centre representatives typically work with many companies. As a result, they may not deliver the same level of customer services that each company requires.

Electronic Chat Rooms

Electronic chat refers to an arrangement in which participants exchange conversational messages in real time in a *chat room*. Chat programs allow you to send messages to people who are connected to the same channel of communication at the same time as you are. Anyone can join in the conversation. Messages are displayed on your screen as they arrive.

There are two major types of chat programs. The first type is Web-based, which allows you to send messages to internet users by using a Web browser and visiting a Web chat site (e.g., Facebook Messenger, <https://www.facebook.com/messenger/>). The second type is email-based (text only). It is called *Internet Relay Chat* (IRC). A business can use IRC to interact with customers, provide online experts to answer questions, and so on.

Voice Communication

internet telephony (Voice-over-Internet Protocol, or VoIP) The use of the internet as the transmission medium for telephone calls.

The plain old telephone service (POTS) has been largely replaced by internet telephony. With **internet telephony**, also known as **Voice-over-Internet Protocol** or **VoIP**, phone calls are treated as just another kind of data. That is, your analogue voice signals are digitized, sectioned into packets, and then sent over the internet.

Consider Skype (www.skype.com; now owned by Microsoft), which provides several VoIP services free of charge: voice and video calls to users who also have Skype; calls between Skype and landline or mobile phone numbers; wireless hotspot network access; instant messaging; text messaging; voice mail; one-to-one and group chats; and conference calls.

Unified Communications

In the past, organizational networks for wired and wireless data, voice communications, and videoconferencing operated independently, and the IT department managed each network separately. This arrangement increased costs and reduced productivity.

unified communications Common hardware and software platform that simplifies and integrates all forms of communications—voice, email, instant messaging, location, and videoconferencing—across an organization.

Unified communications (UC) simplifies and integrates all forms of communications—voice, voice mail, fax, chat, email, instant messaging, short message service, presence (location) services, and videoconferencing—on a common hardware and software platform. *Presence services* enable users to know where their intended recipients are and if they are available, in real time.

UC unifies all forms of human and computer communications into a common user experience. For example, UC allows an individual to receive a voice mail message and then read it in their email inbox. In another example, UC enables users to seamlessly collaborate with another person on a project, regardless of where the user is located. One user could quickly locate the other user by accessing an interactive directory, determining whether that user is available, engaging in a text messaging session, and then escalating the session to a voice call or even a video call, all in real time.

Teleconferencing and Video Conferencing

teleconferencing The use of electronic communication that allows two or more people at different locations to have a simultaneous conference.

Teleconferencing is the use of electronic communication technology that enables two or more people at different locations to hold a conference. There are several types of teleconferencing. The oldest and simplest is a telephone conference call, during which several people talk to one another from multiple locations. The biggest disadvantage of conference calls is that participants cannot communicate face to face, nor can they view graphs, charts, and pictures at other locations.

videoconference A virtual meeting in which participants in one location can see and hear participants at other locations and can share data and graphics by electronic means.

To overcome these shortcomings, organizations are increasingly turning to video teleconferencing, or videoconferencing. In a **videoconference**, participants in one location can see participants, documents, and presentations at other locations. The latest version of videoconferencing, called *telepresence*, enables participants to seamlessly share data, voice, pictures, graphics, and animation by electronic means. Conferees can also transmit data along with voice and video, which allows them to work together on documents and to exchange computer files.

Telepresence systems range from high-end on-premise systems to cloud-based systems. (We discuss on-premise computing and cloud computing in Technology Guide 3.) High-end on-premise systems are expensive and require dedicated rooms with large high-definition screens to show people sitting around conference tables (see [Figure 6.11](#)). These systems have advanced audio capabilities that let everyone talk at once without cancelling out any voices. Such systems also require technical staff to operate and maintain. An example of a high-end system is Cisco's TelePresence IX5000 Series system (www.cisco.com).

Dedicated rooms where telepresence meetings take place are not particularly useful when so many employees work remotely. As a result, companies such as Zoom (www.zoom.us), CiscoWebex (www.webex.com), Fuze (www.fuze.com), and BlueJeans Network (www.bluejeans.com) offer telepresence systems that utilize cloud computing. The cloud delivery model enables Fuze and BlueJeans to provide systems that are less expensive and more flexible, and require fewer in-house technical staff to operate and maintain. Any of these companies can also deliver their telepresence systems to any device, including smartphones, tablets, and laptop and desktop computers.



Jennifer Pottheiser/National Basketball Association/Getty Images

FIGURE 6.11 Telepresence system.

During the pandemic, work, school, and business all transferred to the internet so that they could continue functioning. This posed problems for many people, but the vision-impaired community was one group that was particularly affected by digitalization. How can a blind person use a computer efficiently if they need to wait for a narrator function to read everything on the page? How can a blind person click on the right spot if they do not know where the mouse cursor is? The Canadian National Institution for the Blind (CNIB; www.cnib.ca) faced these and many more problems while trying to provide critical aid to the community and overcame them brilliantly using Zoom.

Created in 1918 to help soldiers blinded during the First World War, the CNIB has served the blind community in Canada for well over 100 years by providing programs that support participants in all areas of life. But, during COVID-19, it faced a serious problem: How could it continue its support for the blind during a global pandemic? Zoom gave the CNIB a much-needed form of communication. Members were able to participate in programs, get live feedback, share their screens, and receive guidance from CNIB workers. Zoom provided a simple, easy-to-use platform that really helped save many blind people from complete social isolation. Another way Zoom helped out was in the guide dog program. Guide dog trainers received personalized instructions over Zoom. The trainer would observe the dog's behaviour and other specialists would provide solutions to any problems. Zoom also aided the CNIB by giving it a platform on which to broadcast important events and webinars. Frank Lombardo, the Vice President of Property & Technology at the CNIB, talked about this point: "People with sight loss often have difficulty travelling, and with Zoom, they are no longer limited by geography; they can attend our events no matter where they are. We can gather and see so many people in one virtual space, and that really gives attendees that feeling of being part of something bigger."

Although the use of Zoom has not solved all its problems, it played a key role in helping the CNIB to follow through with its mission, to care for and help the blind community in Canada. Without digital technology, the CNIB—and the whole world—would have suffered even more during the pandemic than they actually did.

Telecommuting

telecommuting A work arrangement whereby employees work at home, at a customer's premises, in special workplaces, or while travelling, usually using a computer linked to their place of employment.

Knowledge workers are often called the distributed workforce, or “digital nomads.” This group of highly prized workers is now able to work anywhere and anytime, a process called **telecommuting**. Distributed workers are those who have no permanent office at their companies, preferring to work in home offices, airport lounges, client conference rooms, or even on a high school stadium bleacher. The growth of the distributed workforce is driven by globalization, extremely long commutes to work, ubiquitous broadband communications links (wireline and wireless), and powerful computing devices.

HRM Telecommuting offers a number of potential advantages for employees, employers, and society. For employees, the benefits include reduced stress and improved family life. Telecommuting also offers employment opportunities for housebound people such as single parents and persons with disabilities. Benefits for employers include increased productivity, the ability to retain skilled employees, and the potential to attract employees who do not live within commuting distance.

HRM However, telecommuting also has some potential disadvantages. For employees, the major disadvantages are increased feelings of isolation, possible loss of fringe benefits, lower pay (in some cases), no workplace visibility, lack of socialization, and the potential for slower promotions. Researchers at Stanford University found that telecommuting employees are 50 percent less likely to be promoted than onsite workers. The researchers concluded that a lack of “face time” with bosses caused careers to stall.

Another problem is that telecommuting employees also often have difficulties “training” their families to understand that they are at work even though they are physically at home. Families have to understand that they should not disturb the telecommuter for anything that they would not disturb them about in a “real” office. The major disadvantages for employers are difficulties supervising work and potential data security problems.

Before you go on . . .

1. Describe the advantages and disadvantages of email.
2. Why are companies bringing their call centres back to their countries of origin?
3. Describe Voice-over-Internet Protocol.
4. What are the advantages and disadvantages of telecommuting to you as an individual?

6.6

Network Applications: Collaboration

LEARNING OBJECTIVE

Explain the impact that collaboration network applications have had on business and everyday life.

collaboration Mutual efforts by two or more individuals who perform activities to accomplish certain tasks.

The third major category of network applications is collaboration. **Collaboration** refers to efforts by two or more entities—that is, individuals, teams, groups, or organizations—who work together to accomplish certain tasks. The term *workgroup* refers specifically to two or more individuals who act together to perform a task.

Workflow is the movement of information as it progresses through the sequence of steps that make up an organization's work procedures. Workflow management makes it possible to pass documents, information, and tasks from one participant to another in a way that is governed by the organization's rules or procedures. Workflow systems are tools for automating business processes.

If group members are working in different locations, they constitute a **virtual group (team)**. Virtual groups conduct *virtual meetings*—that is, they “meet” electronically. **Virtual collaboration** (or *e-collaboration*) refers to the use of digital technologies that enable organizations or individuals who are geographically dispersed to collaboratively plan, design, develop, manage, and research products, services, and innovative applications. Organizational employees frequently collaborate virtually with one another. Some organizations collaborate virtually with customers, suppliers, and other business partners to become more productive and competitive.

Collaboration can be *synchronous*, meaning that all team members meet at the same time. Teams may also collaborate *asynchronously* when team members cannot meet at the same time. Virtual teams, whose members are located throughout the world, typically must collaborate asynchronously.

Although a variety of software products are available to support all types of collaboration, many organizations feel that too many different software tools are being used in collaborative efforts. These firms want a single tool to let them know what was shared, who shared it with whom, and when. Firms also want smarter collaboration tools that are capable of anticipating workers' needs.

Collaborative software products include Microsoft Teams (<https://www.microsoft.com/en-us/microsoft-teams/log-in>), Jive (www.jivesoftware.com), RingCentral (www.ringcentral.com), Slack (www.slack.com), Atlassian (www.atlassian.com), and Facebook's Workplace (www.workplace.com), as well as many others. In general, these products provide online collaboration capabilities, workgroup email, distributed databases, electronic text editing, document management, workflow capabilities, instant virtual meetings, application sharing, instant messaging, consensus building, voting, ranking, and various application-development tools.

IT's About Business 6.3 provides an example of how collaboration network applications are helping one Canadian First Nation to onboard new interns at one of their main offices.

workflow The movement of information as it flows through the sequence of steps that make up an organization's work procedures.

virtual group (team) A workgroup whose members are in different locations and meet electronically.

virtual collaboration The use of digital technologies that enable organizations or individuals to collaboratively plan, design, develop, manage, and research products, services, and innovative information systems and electronic commerce applications.

IT's About Business 6.3

The Takla Lake Nation Partners with Technology to Onboard New Talent

The Takla Lake Nation is a Canadian First Nation located 320 kilometres north of Prince George, British Columbia. The traditional territory of the Takla Lake First Nation is home to 18 reserves and is bordered on the west by the Skeena Mountains and on the east by the Rocky Mountains. It is a land of approximately 27,250 square kilometres surrounded by an abundance of nature.

About six years ago, the Takla Nation's Chief and Council devised an ambitious plan to build capacity, create economic wealth, and help develop a self-sustaining environment for the Nation. Despite their efforts, challenges required the community leaders to think about different ways to bring economic development to the main community. As a result, a partnership between the Takla Nation and the Sasuchan Development Corporation (SDC) was formed to start, own, and operate businesses in forestry, environmental sustainability, and housing development, among others. Today, SDC is the economic arm of the Takla community, with annual revenue in the vicinity of \$20 million.

SDC's tremendous growth was accompanied by an office expansion and the hiring of new staff. Although there has been no lack of good talent, the onboarding of new employees has not been

an easy task for Brooklyn Wilson, SDC's HR generalist. As former director of finance Nick Fuchs said, “we're always looking to bring new people into the organization, especially young superstars from the community, and we have a strong internship program.” However, new employees have varying degrees of experience with technology and, according to Wilson, “it used to take us a week to get someone updated and onboarded with their teams and projects.”

To help with this challenge, SDC adopted Microsoft Viva Connections, an employee technology platform that integrates with MS Teams. The program helped SDC connect interns, employees, people, projects, and individuals involved with the community. Microsoft Viva is easily customizable and extensible, and accessible from anywhere with an internet connection. It provides a one-stop shop for employees to discover, learn, and collaborate, facilitating the onboarding of new employees and reducing the time it takes to bring them up to speed.

SDC is also using SharePoint to provide secure communications and file sharing capabilities among employees and with external vendors. Now it is able to share purchase requisitions and purchase orders with vendors without the need to physically send a paper copy.

For the future, SDC proposes to add MS Viva Learning to its centralized employee hub. Viva Learning will give employees micro-learning opportunities and consolidated access to learning

platforms. This application will make it easy to personalize learning for employees by recommending training modules based on their interests and allowing them to search content from SDC and from external partners such as LinkedIn Learning.

These and other technology-driven initiatives are a good reflection of how technology can help First Nations communities achieve their goal of self-government and self-reliance. As Fuchs put it, “It’s pretty amazing to see how much the Nation has achieved through the partnership with the help of this technology.”

Questions

1. What are some examples of other network technologies that the Takla Lake Nation could benefit from? Provide an example that illustrates their use.

2. Describe three challenges of deploying network technologies in First Nations communities and, for each challenge, identify ways that it could be overcome.

Sources: Microsoft Viva Connections, www.microsoft.com/en-us/microsoft-viva/connections#Demo, accessed April 20, 2023; Microsoft Customer Stories, “Indigenous Organization Builds Wealth and Community with Technology,” customers.microsoft.com, October 11, 2022; Takla Nation, www.taklafn.ca, accessed April 20, 2023; Sasuchan Development Corporation, www.sasuchan.ca, accessed April 20, 2023; Microsoft Viva overview, www.learn.microsoft.com, accessed March 4, 2023.

Crowdsourcing

crowdsourcing A process in which an organization outsources a task to an undefined, generally large, group of people in the form of an open call.

One type of collaboration is **crowdsourcing**, in which an organization outsources a task to an undefined, generally large, group of people in the form of an open call. Crowdsourcing creates many potential benefits for organizations. First, crowds can explore problems—and often resolve them—at a relatively low cost, and often very quickly. Second, the organization can tap a wider range of talent than might be present among its employees. Third, by listening to the crowd, organizations gain first-hand insight into their customers’ desires. Finally, crowdsourcing taps into the global world of ideas, helping companies work through a rapid design process. Let’s look at some examples of crowdsourcing.

- **MIS** Crowdsourcing help desks: IT help desks are a necessary service on college campuses because students depend on their computers and internet access to complete their schoolwork and attend class online. At Indiana University at Bloomington, IT help desks use crowdsourcing to alleviate the cost and pressure of having to answer so many calls. Students and professors post their IT problems on an online forum, where other students and amateur IT experts answer them.
- **MKT** AccessNow (www.accessnow.com) is a Canadian website and mobile app that intends to make the world a bit more accessible to people with disabilities. AccessNow shares crowdsourced accessibility information from around the world that has been collected by volunteer contributors using a mobile app. For example, you can type the name of a store or restaurant that you want to visit and see whether it is accessible for wheelchairs. Anyone interested in contributing, can download the AccessNow App and begin reviewing places based on their accessibility features.
- **MKT** Scitable (www.nature.com/scitable) combines social networking and academic collaboration. Through crowdsourcing, students, professors, and scientists discuss problems, find solutions, and swap resources and journals. Scitable is a free site that lets each individual user turn to crowdsourcing for answers even while helping others.
- Violence broke out after the 2007 Kenyan elections. Within days, developers built a platform, Ushahidi (www.ushahidi.com), which means “testimony” or “witness” in Swahili. The platform crowdsourced 40,000 verified, first-hand reports of the violence via short-message service (SMS) and then sent alerts back to locals and to viewers around the world. By 2022, Ushahidi had evolved into an open-source, crisis-mapping platform accessible to anyone. To follow crises, Ushahidi analyzes millions of Tweets, hundreds of thousands of news articles, and geotagged, timestamped data from a vast number of sources. Ushahidi has been used over 150,000 times in 160 countries, crowdsourcing more than 150 million reports.

Although crowdsourcing has numerous success stories, there are many questions and concerns about this approach, including the following:

- Should the crowd be limited to experts? If so, then how would a company go about implementing this policy?
- How accurate is the content created by the non-experts in the crowd? How is accuracy maintained?

- How is crowd-created content updated? How can companies be certain the content is relevant?
- The crowd may submit too many ideas, and most of them will be worthless. In this scenario, evaluating all of these ideas can be prohibitively expensive.
- Content contributors may violate copyright, either intentionally or unintentionally.
- The quality of content (and therefore subsequent decisions) depends on the composition of the crowd. The best decisions may come if the crowd is made up of people with diverse opinions and ideas. In many cases, however, companies do not know the makeup of the crowd in advance.

Before you go on . . .

1. Describe virtual collaboration and why it is important to you.
2. Define crowdsourcing, and provide two examples of crowdsourcing not mentioned in this section.
3. Identify the business conditions that have made videoconferencing more important.

6.7 Network Applications: Educational

LEARNING OBJECTIVE

Explain the impact that educational network applications have had on business and everyday life.

The fourth major category of network applications consists of education applications. In this section, we discuss e-learning, distance learning, and virtual universities.

E-Learning and Distance Learning

E-learning and **distance learning** are not the same thing, but they do overlap. E-learning refers to learning supported by the Web. It can take place inside classrooms as a support to conventional teaching, such as when students work on the Web during class. It also can take place in virtual classrooms, in which all coursework is completed online and classes do not meet face to face. In these cases, e-learning is a part of distance learning. Distance learning (DL) refers to any learning situation in which teachers and students do not meet face to face.

As a result of the COVID-19 pandemic, distance education became a critical necessity in March 2020. DL increased dramatically in both K–12 and university classes in a matter of weeks, sometimes even days.

By April 2020, almost all K–12 schools in Canada had moved online and were employing some form of online or distance education. Similarly, by April 2020, most community colleges and universities in Canada had also deployed distance education initiatives, moving the majority of their classes online.

Today, the Web provides a multimedia interactive environment for self-study. Web-enabled systems make knowledge accessible to those who need it, when they need it, anytime, anywhere. For this reason, e-learning and DL can be useful for both formal education and corporate training.

E-learning has many benefits. For example, online materials can deliver very current content that is of high quality (created by content experts) and consistent (presented the same way every time). It also gives students the flexibility to learn in any place, at any time, and at their own pace. In corporate training centres that use e-learning, learning time is generally shorter, which means that more people can be trained within a given time frame. This system reduces training costs and eliminates the expense of renting facility space.

e-learning Learning supported by the Web; can take place inside traditional classrooms or in virtual classrooms.

distance learning (DL) Learning situations in which teachers and students do not meet face to face.

Despite these benefits, e-learning has some drawbacks. For one, students must be computer literate. They may also miss the face-to-face interaction with instructors and fellow students. In addition, accurately assessing students' work can also be problematic because instructors really do not know who completed the assignments.

E-learning does not usually replace the classroom setting. Rather, it enhances it by taking advantage of new content and delivery technologies. Advanced e-learning support environments, such as Docebo (www.docebo.com), D2L Brightspace (www.d2l.com) Blackboard (www.blackboard.com), Moodle (www.moodle.com), and Canvas (www.instructure.com), add value to traditional learning in higher education.

A new form of distance learning appeared in 2008, called *massive open online courses* or *MOOCs*. MOOCs are a tool for democratizing higher education. Several factors have contributed to their growth, including improved technology and the rapidly increasing costs of traditional universities. MOOCs are highly automated, complete with computer-graded assignments and exams.

Many universities are now offering MOOCs. For example, the University of Manitoba (<http://umanitoba.ca>) was a MOOC pioneer back in 2008, when it offered a free online course on learning theory to some 2,300 students around the world. The University of Toronto (www.utoronto.ca) offers over 60 different MOOCs, ranging from introduction to psychology to programming fundamentals, and Laval University offers MOOCs in French. One of the most popular MOOCs in Canada is called Indigenous Canada, offered by the Faculty of Native Studies at the University of Alberta, which enrolls over 200,000 students in one semester. The course involves 12 lessons that explore Indigenous histories and contemporary issues in Canada.

MOOCs have not yet proved that they can effectively teach the thousands of students who enroll in them. They also do not generate revenues for universities. Furthermore, MOOCs may include a mixture of, for example, high school students, retirees, faculty, enrolled students, and working professionals. Designing a course that adequately meets the needs of such a diverse student population is quite challenging. Finally, although initial registrations for a MOOC might exceed 100,000 students, completion rates in any given MOOC tend to be less than 10 percent of registrants. Nevertheless, despite these issues, hundreds of thousands of students around the world who lack access to universities are using MOOCs to acquire sophisticated skills and high-paying jobs without having to pay tuition or obtain a college degree.

In 2023, these organizations were the world's top providers of MOOCs:

- Coursera is the largest MOOC platform in the world, with 97 million students and 8,250 courses.
- edX is the second largest MOOC in the world, with 42 million students and 3,550 courses.
- XuetangX (China) is China's first and largest MOOC platform, with over 80 million users and approximately 400 courses.
- FutureLearn (UK), now jointly owned by the Open University and the Australia-based SEEK Group, has 17 million students and 485 courses.

virtual universities Online universities in which students take classes on the internet at home or at an offsite location.

Virtual Universities **Virtual universities** are online universities in which students take classes on the internet, either at home or in an offsite location. Two examples of virtual universities in Canada are Athabasca University (www.athabascau.ca) and TÉLUQ (www.telug.ca). Both offer hundreds of courses and dozens of degrees to students, all online. Other Canadian universities also offer selected courses and degrees online, although most of their courses include some form of traditional classroom elements such as in-person lectures and examinations.

Before you go on . . .

1. Describe the differences between e-learning and distance learning.
2. What are virtual universities? Would you be willing to attend a virtual university? Why or why not?

What's in IT for me?

ACCT For the Accounting Major

Accounting personnel use corporate intranets and portals to consolidate transaction data from legacy systems to provide an overall view of internal projects. This view contains the current costs charged to each project, the number of hours spent on each project by individual employees, and an analysis of how actual costs compare with projected costs. Finally, accounting personnel use internet access to government and professional websites to stay informed on legal and other changes affecting their profession.

FIN For the Finance Major

Corporate intranets and portals can provide a model to evaluate the risks of a project or an investment. Financial analysts use two types of data in the model: historical transaction data from corporate databases through the intranet and industry data obtained through the internet. Financial services firms can also use the Web for marketing and to provide services.

MKT For the Marketing Major

Marketing managers use corporate intranets and portals to coordinate the activities of the sales force. Sales personnel access corporate portals through the intranet to discover updates on pricing, promotion, rebates, customer information, and information about competitors. Sales staff can also download and customize presentations for their customers. The internet, particularly the Web, opens up a completely new marketing channel for many industries. Just how advertising, purchasing, and information should be provided appears to vary from industry to industry, product to product, and service to service.

POM For the Production/Operations Management Major

Companies are using intranets and portals to speed product development by providing the development team with three-dimensional

models and animation. All team members can access the models for to explore ideas more quickly and to enhance feedback. Corporate portals, accessed through intranets, enable managers to carefully supervise their inventories, as well as real-time production on assembly lines. Extranets are also proving valuable as communication formats for joint research and design efforts among companies. The internet is also a great source of cutting-edge information for POM managers.

HRM For the Human Resources Management Major

Human resources personnel use portals and intranets to publish corporate policy manuals, job postings, company telephone directories, and training classes. Many companies deliver online training obtained from the internet to employees through their intranets. Human resources departments use intranets to offer employees health care, savings, and benefit plans, as well as the opportunity to take competency tests online. The internet supports worldwide recruiting efforts; it can also be the communications platform for supporting geographically dispersed work teams.

MIS For the MIS Major

As important as the networking technology infrastructure is, it is invisible to users (unless something goes wrong). The MIS function is responsible for keeping all organizational networks up and running all the time. MIS personnel, therefore, provide all users with an "eye on the world" and the ability to compute, communicate, and collaborate any time, anywhere. For example, organizations have access to experts at remote locations without having to duplicate that expertise in multiple areas of the firm. Virtual teaming allows experts physically located in different cities to collaborate on projects as though they were in the same office.

Summary

6.1 Compare and contrast the major types of networks.

The two major types of networks are local area networks (LANs) and wide area networks (WANs). LANs encompass a limited geographical area and are usually composed of one communications medium. In contrast, WANs encompass a broad geographical area and are usually composed of multiple communications media.

6.2 Describe wireline communications media and transmission technologies.

Twisted-pair wire, the most prevalent form of communications wiring, consists of strands of copper wire twisted in pairs. It is relatively inexpensive to purchase, widely available, and easy to work with.

However, it is relatively slow for transmitting data, subject to interference from other electrical sources, and can be easily tapped by unintended recipients.

Coaxial cable consists of insulated copper wire. It is much less susceptible to electrical interference than is twisted-pair wire and it can carry much more data. However, coaxial cable is more expensive and more difficult to work with than twisted-pair wire. It is also somewhat inflexible.

Fibre-optic cables consist of thousands of very thin filaments of glass fibres that transmit information by way of pulses of light generated by lasers. Fibre-optic cables are significantly smaller and lighter than traditional cable media. They can also transmit far more data, and they provide greater security from interference and tapping. Fibre-optic cable is often used as the backbone for a network, whereas

twisted-pair wire and coaxial cable connect the backbone to individual devices on the network.

6.3 Describe the most common methods for accessing the internet.

Common methods for connecting to the internet include dial-up, DSL, cable modem, satellite, wireless, and fibre-to-the-home.

6.4 Explain the impact that discovery network applications have had on business and everyday life.

Discovery involves browsing and information retrieval and gives users the ability to view information in databases, download it, and process it. Discovery tools include search engines, directories, and portals. Discovery tools enable business users to efficiently find needed information.

6.5 Explain the impact that communication network applications have had on business and everyday life.

Networks provide fast, inexpensive *communications*, through email, call centres, chat rooms, voice communications, and blogs. Communications tools provide business users with a seamless interface among team members, colleagues, business partners, and customers.

Telecommuting is the process whereby knowledge workers are able to work anywhere and any time. Telecommuting gives employees more flexibility, with many benefits and some drawbacks.

6.6 Explain the impact that collaboration network applications have had on business and everyday life.

Collaboration refers to mutual efforts by two or more entities (individuals, groups, or companies) that work together to accomplish tasks. Collaboration is enabled by workflow systems. Collaboration tools enable business users to collaborate with colleagues, business partners, and customers.

6.7 Explain the impact that educational network applications have had on business and everyday life.

E-learning refers to learning supported by the Web. Distance learning refers to any learning situation in which teachers and students do not meet face to face. E-learning provides tools for business users to facilitate their lifelong learning aspirations.

Virtual universities are online universities in which students take classes on the internet at home or at an offsite location. Virtual universities make it possible for students to obtain degrees while working full-time, thus increasing their value to their firms.

Key Terms

affinity portal 184	extranet 174	search engine 182
backbone networks 166	fibre-optic cable 168	servers 171
bandwidth 164	file server 165	telecommuting 188
broadband 164	hyperlink 180	teleconferencing 186
broadcast media 167	hypertext Transfer Protocol (HTTP) 169	transmission Control Protocol/Internet Protocol (TCP/IP) 169
browsers 180	hypertext 180	twisted-pair wire 167
cable media 167	industrywide portal 184	unified communications (UC) 186
client/server computing 171	internet ("the Net") 172	uniform resource locator (URL) 180
clients 171	internet backbone 172	videoconference 186
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collaboration 188	internet Protocol (IP) 169	virtual group (team) 189
commercial (public) portal 184	internet telephony 186	virtual universities 192
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computer network 164	local area network (LAN) 165	voIP 186
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domain name system (DNS) 176	packet switching 169	workflow 189
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enterprise network 165	protocol 169	
ethernet 169	routers 165	

Discussion Questions

1. What are the implications of bringing fibre-optic cable to everyone's home?
2. What are the implications of BitTorrent for the music industry? For the motion picture industry?
3. Discuss the pros and cons of P2P networks.
4. Should the internet be regulated? If so, by whom?
5. Discuss the pros and cons of delivering this book over the internet.
6. Explain how the internet works. Assume you are talking with someone who has no knowledge of information technology (in other words, keep it very simple).
7. How are the network applications of communication and collaboration related? Do communication tools also support collaboration? Give examples.
8. Search online for this article: N. Carr, "Is Google Making Us Stupid?", *The Atlantic*, July/August 2008. Support your answer.
9. Should businesses monitor network usage? Do you see a problem with employees using company-purchased bandwidth for personal use? Please explain your answer.

Problem-Solving Activities

1. Calculate how much bandwidth you consume when using the internet every day. How many emails do you send daily and what is the size of each? (Your email program may have email file size information.) How many music and video clips do you download (or upload) daily and what is the size of each? If you view YouTube often, surf the Web to find out the size of a typical YouTube file. Add up the number of email, audio, and video files you transmit or receive on a typical day. When you have calculated your daily internet usage, determine if you are a "normal" internet user or a "power" internet user.

2. Access several P2P applications, such as SETI@home. Describe the purpose of each application and indicate which ones you would like to join.

3. Access www.ipv6.com and learn more about the advantages of IPv6.

4. Access www.icann.org and learn more about this important organization.

5. Set up your own website using your name for the domain name (e.g., KellyRainer).

- a. Explain the process for registering a domain.
- b. Which top-level domain will you use and why?

6. Access www.icann.org and obtain the name of an agency or company that can register a domain for the TLD that you selected. What is the name of that agency or company?

7. Access the website for the agency or company identified in question 6 to learn the process that you must use. How much will it initially cost to register your domain name? How much will it cost to maintain that name in the future?

8. **Network neutrality** is an operating model under which internet service providers (ISPs) must allow customers equal access to content and applications, regardless of the source or nature of the content. That is, internet backbone carriers must treat all Web traffic equally rather than charge different rates based on the user, content, site, platform, or application.

In early June 2022, a Canadian Federal Court judge granted major Canadian ISPs Rogers, Bell, and Groupe TVA the ability to block websites with pirated NHL real-time video streaming. Some people applauded the measure as a fight against copyright infringement; others saw it as an attack on network neutrality.

Visit the Canadian Radio-television and Telecommunications Commission to learn about net neutrality in Canada. Also read the "Report of the Standing Committee on Access to Information, Privacy and Ethics" from the House of Commons and answer the following questions:

- Why are telecommunications and cable companies (ISPs) against network neutrality?
- Why are technology companies in favour of keeping network neutrality?
- What are fast lanes and slow lanes? What impacts could fast and slow lanes have on businesses and consumers?
- How could the end of network neutrality impact consumers?
- What is the practice of zero-rating?
- What is the relationship between the end of network neutrality and potential censorship?
- What is the relationship between network neutrality and innovation?
- Would entrepreneurs be in favour of, or opposed to, network neutrality?

9. From your own experience or from the vendor's information, list the major capabilities of Gmail. Do the same for Microsoft Outlook. Compare and contrast the products. Explain how the products can be used to support knowledge workers and managers.

10. Visit the websites of two companies that manufacture telepresence products for the internet. Prepare a report. Differentiate between telepresence products and videoconferencing products.

11. Access your university's website. Does it provide high-quality information (the right amount, clear, accurate, etc.)? Do you think a high school student who is thinking of attending your university would feel the same way as you?

12. Access the website of Music Canada (www.musiccanada.com). Discuss what you find there regarding digital rights and copyright infringement (i.e., downloading music files through P2P networks, for example). What are Music Canada's efforts to stop music downloads? What are some of the recent changes to music digital rights? Debate this issue from your point of view and from Music Canada's point of view.

13. Research the companies involved in internet telephony (Voice-over-IP). Compare their offerings as to price, necessary technologies,

ease of installation, and so on. Which company is the most attractive to you? Which company might be the most attractive to a large company?

14. Access various search engines other than Google. Search for the same terms on several of the alternative search engines and on Google. Compare the results for their breadth (number of results found) and precision (results are what you were looking for).

15. Access Microsoft's Bing translator (www.bing.com/translator) or Google Translate (<http://google.translate.com>) translation pages. Type in a paragraph in English and select, for example, English-to-French. When you see the translated paragraph in French, copy it into the text box, and select French-to-English. Is the paragraph that you first entered the same as the one you are looking at now? Why or why not? Support your answer.

Closing Case

MIS Internet Shutdowns

Internet shutdowns really began in December 2010 with the start of the Arab Spring. As people across North Africa and the Middle East protested against authoritarian rulers, the internet became a force for political mobilization. Protest movements gained traction in Facebook groups and on Twitter and YouTube. In response to one protest, in January 2011 Egypt's president Hosni Mubarak shut down the internet for five days.

According to AccessNow (www.accessnow.org), a digital rights advocacy group, in 2022 governments and other actors in 35 countries shut down internet access 187 times. Significantly, most governments do not acknowledge that a shutdown is under way. Rather, they attribute the disruption to technical problems or foreign cyberattacks, or simply deny that the government itself closed internet access.

In most cases, governments want to control the internet in order to control the political narrative. They view the internet as a threat because it weakens their control of the information that is available to their citizens. They believe that social media, for instance, enable individuals and groups to produce and circulate alternative political narratives. Significantly, the United Nations has explicitly defined government-led internet shutdowns and censorship as human rights violations. These shutdowns were imposed to prevent citizens from freely participating in protests, elections, and demonstrations, with the ultimate goal of controlling citizens and silencing dissenting opinions against the ruling government or authorities.

Governments adopt four general approaches to controlling citizens' access to the internet. First, and most serious, is to completely block access to the internet on all platforms. This approach incurs significant social, economic, and political costs. Specifically, the financial costs can run into millions of dollars for each day that the internet is blocked.

The second method is to block specific content, typically by restricting access to particular websites or applications. This strategy is the most common, and it usually targets social media platforms. Governments generally adopt this strategy because these sites have become platforms for various forms of political expression that they consider subversive.

The third strategy, usually carried out in secret, is *bandwidth throttling*. In this method, the government forces telecommunications operators or ISPs to lower the quality of their cell signals or internet speed. This process makes the internet and phones too slow to use. Throttling can also target certain online destinations such as social media sites.

Governments employ these strategies inside their own countries. A fourth, more recent strategy is for a foreign government to

cause internet shutdowns in another country, while also employing the first three strategies in its own country. Russia is utilizing this strategy in its invasion of Ukraine (discussed below).

The strategies that governments adopt frequently depend on how much control they exercise over the telecommunications infrastructure in their country. The amount of control varies by country and over time. Unfortunately, some governments are considering laws that would increase that control.

There are numerous examples of governments employing these methods to control internet access. We consider several instances here.

Russia

Russia's strategy is to shut down internal websites that are presenting information opposing the government's invasion of Ukraine while blocking Ukrainian government websites as well. For example, Russia's state communications and media monitor, Roskomnadzor, blocked several Russian and Ukrainian media outlet websites over their coverage of the invasion. As another example, the Kremlin blocked the Russian magazine *The New Times*, which has been openly critical of the invasion, for reporting details about Russian military casualties, which the Russian Defence Ministry had not disclosed.

In addition, alleged Russian hackers brought down dozens of Ukrainian government websites immediately prior to the invasion. The attack crippled much of the government's public-facing infrastructure, including Diia, the most widely used site for managing government services online. The attack compromised the sites of the Cabinet of Ministers as well as the Ministries of Energy, Sports, Agriculture, Veterans' Affairs, and Ecology. Fortunately for Ukraine, the websites of the president and the Defence Ministry remained online.

India

India accounted for 85 percent of the world's internet shutdowns in the first six months of 2022, according to internet watchdog NetBlocks (<https://netblocks.org>). In just one example, police in the Indian state of Rajasthan, fearing outbreaks of religious violence, banned public gatherings and suspended internet services a day after two Muslims posted a video claiming responsibility for killing a Hindu tailor in the city of Udaipur. Brandishing a meat cleaver, two bearded men announced in the video that they were avenging an insult to the prophet Mohammed attributed to the victim.

According to reports, the two suspects confronted the tailor over a social media post in support of the Bharatiya Janata Party (BJP) that they traced to his cellphone. The BJP is known for its pro-Hindu policies. After being released, the tailor had told police that he was being threatened by some group.

Authorities claimed they had suspended internet services in several parts of Rajasthan to prevent the video from being circulated. The federal government asked social media platforms to immediately remove content that encouraged, glorified, or justified the killing. The Ministry of Electronics and Information Technology announced that the removal was necessary “to prevent any incitement and disruption of public order and to restore public peace and harmony.”

Iran

On September 16, 2022, the Iranian Guidance Patrol, the religious morality police of Iran’s government, arrested a 22-year-old Iranian woman named Mahsa Amini for not wearing her hijab in accordance with government standards. They accused her of wearing the hijab too loosely, showing some hair. Shortly after her arrest, she died in a Tehran hospital, under suspicious circumstances.

After transferring her to a hospital, police said that she had a heart attack while in police custody. Eyewitnesses, including women detained with Amini, said police beat her severely and she died because of their brutality. These assertions, in addition to leaked medical scans, led independent observers to believe that Amini had had a cerebral hemorrhage.

Amini’s death triggered numerous protests, which spread even farther than the protests that had broken out in 2009, 2017, and 2019. By October 2022, Iran Human Rights, an international non-profit human rights organization with members inside and outside Iran, reported that security forces had killed at least 185 protesters.

In late September, Iranian authorities cut off internet access in the country, stating that they will not restore access until calm is restored. The authorities hope that by restricting the internet they can control the protests. First, the government blocked Instagram, then WhatsApp. Several hours later, the local internet, known as National Internet, replaced the global internet, meaning that Iranians could only access local servers. These actions disrupt the process of sending videos, photos, and news from Iran to the world.

Results

Even though internet shutdowns continue, there is little evidence that they actually work. Let’s consider three reasons why they are not effective.

- Shutdowns frequently encourage dissent. They can create camaraderie among citizens that can inspire an even more powerful protest movement. In fact, observers have noted that internet blackouts just drive people into the streets.
- Governments damage their economies when they shut down internet applications and services. In just the first half of 2022, government-led internet shutdowns cost the global economy \$10 billion and had technological and economic impacts on nearly 2 billion people.
- Consider the COVID-19 pandemic. During any pandemic, internet blackouts seriously obstruct citizens’ ability to access

the most reliable data on infection counts, social distancing measures imposed in their area, current medical information, and corrections to circulating misinformation. Blackouts also hinder the public’s ability to communicate with others and to call wirelessly for medical assistance. The bottom line is that internet shutdowns cause tangible, physical harm.

Questions

1. Of the four strategies that governments are using to control internet access, which is the most effective?
2. Of the four methods that governments are using to control internet access, which is the least effective?
3. In your opinion, is internet access a fundamental human right? Why or why not? Support your answer. Be sure to include in your answer what your day would look like without internet access of any kind.

Sources: Compiled from A. Kohli, “Here’s What Has Happened in Iran since the Death of Mahsa Amini,” *Yahoo! News*, October 8, 2022; A. Moshtaghian, et al., “Young Iranians Are Rising up against Decades of Repression – Arguably Bolder than Even,” *CNN*, September 25, 2022; A. MacDonald, “Mahsa Amini: Iran Shuts Down Internet as Death Toll from ‘Bad Hijab’ Protests Rises,” *Middle East Eye*, September 22, 2022; V. Aggarwal, “Government-Imposed Internet Shutdowns Impacted 1.9 Billion People in First Half of 2022,” *Network World*, August 4, 2022; A. Belanger, “Internet Shutdowns Cost Global Economy \$10B so far in 2022,” *Ars Technica*, July 6, 2022; B. Kaur, “Protests Erupt Across the U.S. amid Internet Shutdown in India and Manhunt for Activist,” *NBCNews*, March 23, 2023; G. York, “Despite Peace Deal, Tigray Still cut off from World as Internet Shutdown Persists,” *The Globe and Mail*, December 5, 2022; “Killing of Indian Tailor Prompts Internet Shutdown over Unrest Fears,” *Reuters*, June 30, 2022; “Internet Shutdowns: UN Report Details ‘Dramatic’ Impact on People’s Lives and Human Rights,” *United Nations Press Report*, June 23, 2022; K. Paul, “Russian Disinformation Surged on Social Media after Invasion of Ukraine, Meta Reports,” *The Guardian*, April 7, 2022; “Russia Blocks Media Outlets, Others Hacked over Ukraine War,” *Associated Press*, February 28, 2022; “Ukraine Struggles with Internet Blackout after Russian Invasion,” *Business Standard*, February 25, 2022; T. Ryan-Moseley, “Why You Should Be More Concerned about Internet Shutdowns,” *MIT Technology Review*, September 9, 2021; G. Volpicelli, “The Draconian Rise of Internet Shutdowns,” *Wired*, September 2, 2021; S. Faleiro, “How India Became the World’s Leader in Internet Shutdowns,” *MIT Technology Review*, August 19, 2020; “End Internet Shutdowns to Manage COVID-19,” *Human Rights Watch*, March 31, 2020; J. Sherman, “Democracies Can Become Digital Dictators,” *Wired*, January 5, 2020; A. Ghoshal, “Indian Government Orders Mobile Internet to Be Suspended in the Capital, Says Airtel,” *TheNextWeb*, December 19, 2019; D. Flamini, “The Scary Trend of Internet Shutdowns,” *Poynter.org*, August 1, 2019; “Shutting Down the Internet Doesn’t Work—But Governments Keep Doing It,” *The Conversation*, February 19, 2019; “Weapons of Control, Shields of Impunity: Internet Shutdowns in 2022,” accessnow.org, March 22, 2023.

E-Business and E-Commerce

CHAPTER OUTLINE

LEARNING OBJECTIVES

7.1 Overview of E-Business and E-Commerce

7.1 Describe the eight common types of electronic commerce.

7.2 Business-to-Consumer (B2C) Electronic Commerce

7.2 Describe the various online services of business-to-consumer (B2C) commerce, along with specific examples of each.

7.3 Business-to-Business (B2B) Electronic Commerce

7.3 Describe the three business models for business-to-business (B2B) electronic commerce.

7.4 Ethical and Legal Issues in E-Business

7.4 Discuss the ethical and legal issues related to electronic commerce along with examples.

Opening Case

TEMU Arrives in Canada

TEMU is a rising Chinese e-commerce giant. Owned by PDD Holdings, another Chinese e-commerce giant, TEMU offers extremely competitive prices, an accessible online platform, and free shipping. Accessible through its domain www.temu.com, TEMU first entered Canada in the fall of 2022. It offers a variety of products in over 30 major categories and over 250 subcategories from fashion, beauty, and electronics, to musical instruments, all available at the lowest price possible. It may sound like just another Amazon competitor; however, in just over a year, the TEMU app has become the Number 1 app for both Google Play and App Store according to usage, new users, and engagement. But what are the reasons behind such stellar growth?

TEMU's growth stems from a single reason: price. The site offers many of the products that we would find on Amazon but for half of the cost. Looking for yoga pants? Looking for a garment steamer? You'll find them both for just over \$15. Shoppers' reviews claim that the quality is virtually the same as anything you would buy from Amazon, but at half or a third of the price, and with free delivery. Does all this seem too good to be true? These prices are possible because products are shipped directly from factories in China, unlike Amazon, which has to get the products from China to its fulfillment centres and then ship to the consumer. TEMU cuts out the middleman, achieving significant savings. In addition, parcel delivery services have improved significantly during the pandemic, and the average

TEMU package takes somewhere between one and two weeks to arrive at its Canadian destination, which is pretty fast considering the distance between the two countries. Many see TEMU's success as the consumer response to the current inflationary environment where prices in Canada have been increasing at an annual rate of almost 7 percent in 2022, and an estimated 3 percent in 2023.

Although TEMU and other similar sites such as Shein.com have their benefits for consumers and the economy, not everyone is satisfied. In the past, TEMU has used questionable tactics to win over consumers. For example, first-time visitors had no other way to enter the website but to spin a wheel that offered them \$20, \$50, and \$100 coupons; then a countdown timer would start, giving the customer one hour to claim the coupon by scanning a QR code and downloading the TEMU app.

It has also been argued that TEMU poses a serious threat to small businesses, because small family-owned businesses don't have the size and money to compete with an e-commerce giant like TEMU.

Another serious concern about TEMU is the collection of information by the Chinese government. Given that it's a Chinese company, many people question its collection and protection of customer information and its future uses of that information. The Pinduoduo app, TEMU's sister app in China, was found to have malware that could bypass security permissions, view information from other apps, and even change the settings of mobile phones to make Pinduoduo difficult to uninstall.

Perhaps the most serious problem relates to concerns about labour rights in China. When a person sees a smartphone priced at \$60, they must surely begin to question how ethically sourced the labour and materials could be. With a minimum wage of around \$400 a month in China, it would be no surprise to learn that employees in these factories are paid too little to live on.

Despite these concerns, TEMU keeps expanding, having recently set up shop in Europe including France, Germany, Italy, the Netherlands, Spain, and the United Kingdom.

Questions

1. Can TEMU's success be sustainable over the long run? Why or why not? Can you think of other industries where the same e-commerce business model could be applied? Provide an example. Consider the discussion in Chapter 2 about business pressures. Identify and explain three business pressures that have an impact on TEMU.

2. Could TEMU replace Amazon.ca as the top e-commerce website in Canada? Why or why not? What are the different ways in which online retailers can respond to the threat posed by TEMU?

Sources: Compiled from: B. Bundale, "Low-Cost TEMU Goes Head-to-Head with Amazon after Advertising Blitz," *The Canadian Press*, April 7, 2023; D. Xiong, "Chinese E-Commerce Giant Makes Successful Entry into Canadian Market," *Business Intelligence for BC*, April 18, 2023; J. Ding, "This App Promises You Can 'Shop Like a Billionaire.' But Is There a Catch?," *Los Angeles Times*, May 2, 2023; J. Herrman, "Is TEMU the Future of Buying Things? Imagine If Amazon and TikTok Had a Baby," *Intelligencer*, May 4, 2023; J. Wynne Lockhart, "Live Shopping: How to Launch a Live Event That Drives Engagement and Conversions," *Shopify.com*, January 18, 2022; M. Toh, "Online Superstore TEMU Expands to Europe after Conquering America," *CNN Business*, April 25, 2023. R. Liao, "TEMU Accelerates Global Expansion with Parent's New Dublin Office," *TechCrunch*, May 4, 2023; S. Ahmad, "Pinduoduo's Sister Company TEMU Expands to Canada," *Techinasia.com*, February 15, 2023.

Introduction

electronic commerce (EC or e-commerce) The process of buying, selling, transferring, or exchanging products, services, or information through computer networks, including the internet.

Electronic commerce (EC or e-commerce) is the process of buying, selling, transferring, or exchanging products, services, or information through computer networks, including the internet. E-commerce is transforming all the business functional areas as well as their fundamental tasks, from advertising to paying bills. Its impact is so pervasive that it is affecting every modern organization. Regardless of where you land a job, your organization will be engaging in electronic commerce.

Electronic commerce influences organizations in many significant ways. First, it increases an organization's *reach*: the number of potential customers to whom it can market its products. In fact, e-commerce provides unparalleled opportunities for companies to expand worldwide at a small cost, increase market share, and reduce costs. By utilizing electronic commerce, many small businesses can now operate and compete in market spaces that were formerly dominated by larger companies.

Another major impact of electronic commerce has been to remove many of the barriers that previously obstructed entrepreneurs seeking to start their own businesses. E-commerce offers amazing opportunities for you to open your own business.

As illustrated in the opening case, electronic commerce is also fundamentally transforming the nature of competition through the development of new online companies, new business models, and the diversity of EC-related products and services. Recall our discussion of competitive strategies in Chapter 2, particularly the impact of the internet on Porter's five forces. You learned that the internet can both endanger and enhance a company's position within a given industry.

It is important for you to have a working knowledge of electronic commerce because your organization will almost certainly be employing e-commerce applications that will affect its strategy and business model. This knowledge will make you more valuable to your organization and will enable you to quickly contribute to the e-commerce applications employed in your functional area. As you read "What's in IT for me?" at the end of the chapter, envision yourself performing the activities discussed in your functional area.

Going further, you may decide to become an entrepreneur and start your own business. In this case, it is even more essential for you to understand electronic commerce, because e-commerce, with its broad reach, will more than likely be critical for your business to survive and thrive.

In this chapter, you will discover the major applications of e-business, and you will be able to identify the services necessary for its support. You will then study the major types of electronic commerce: business-to-consumer (B2C), business-to-business (B2B),

consumer-to-consumer (C2C), business-to-employee (B2E), and government-to-citizen (G2C). You will conclude by examining several legal and ethical issues that impact e-commerce.

As you read this chapter, note that e-commerce can be wireless, and can include texting and messaging, as you will see in our discussion of mobile commerce in Chapter 8. E-commerce also has many social aspects, as you will see in our discussion of social commerce in Chapter 9.

7.1

Overview of E-Business and E-Commerce

LEARNING OBJECTIVE

Describe the eight common types of electronic commerce.

Just how important is electronic commerce? Consider these statistics. Industry analysts estimated that Canadian retail sales in 2022 totalled approximately \$800 billion. Electronic commerce accounted for close to 15 percent of these sales, for a total of \$109 billion. Significantly, in 2022, e-commerce increased by 13.6 percent over 2021 and 41 percent over 2020.

This section examines the basics of e-business and e-commerce. First, we define these two concepts. You will then become familiar with pure and partial electronic commerce and examine the various types of e-commerce. Next, you will focus on e-commerce mechanisms, which are the ways that businesses and people buy and sell over the internet. You will conclude this section by considering the benefits and limitations of e-commerce.

Definitions and Concepts

Recall that electronic commerce describes the process of buying, selling, transferring, or exchanging products, services, or information through computer networks, including the internet. **Electronic business (e-business)** is a somewhat broader concept. In addition to the buying and selling of goods and services, e-business refers to servicing customers, collaborating with business partners, and performing electronic transactions within an organization.

Electronic commerce can take several forms, depending on the degree of digitization involved. The *degree of digitization* is the extent to which the commerce has been transformed from physical to digital. This concept can relate to both the product or service being sold and the delivery agent or intermediary. In other words, the product can be either physical or digital, and the delivery agent can also be either physical or digital.

In traditional commerce, both dimensions are physical. Purely physical organizations are referred to as **brick-and-mortar organizations**. (You may also see the term *bricks-and-mortar*.) In contrast, in *pure EC* all dimensions are digital. Companies engaged only in EC are considered **virtual** (or **pure-play**) **organizations**. All other combinations that include a mix of digital and physical dimensions are considered *partial EC* (but not pure EC). **Clicks-and-mortar organizations** conduct some e-commerce activities, but their primary business is carried out in the physical world. A common alternative to the term *clicks-and-mortar* is *clicks-and-bricks*. You will encounter both terms. Clicks-and-mortar organizations are examples of partial EC. E-commerce is now so well established that people generally expect companies to offer this service in some form.

Purchasing a shirt at Walmart Online or a book from Amazon.ca is an example of partial EC because the merchandise, although bought and paid for digitally, is physically delivered by, for example, UPS or Canada Post. In contrast, buying an e-book from [Amazon.ca](https://www.amazon.ca) or a software product from [GetApp.ca](https://www.getapp.ca) constitutes pure EC because the product itself and its delivery, payment, and transfer are entirely digital. We use the term *electronic commerce* to denote both pure and partial EC.

electronic business

(e-business) A broader concept than electronic commerce, including buying and selling of goods and services, servicing customers, collaborating with business partners, conducting e-learning, and conducting electronic transactions within an organization.

brick-and-mortar

organizations Organizations in which the product, the process, and the delivery agent are all physical.

virtual (or pure play)

organizations Organizations in which the product, the process, and the delivery agent are all digital.

clicks-and-mortar

organizations Organizations that do business in both the physical and digital dimensions.

There are many e-commerce business models. **Table 7.1** describes several of these models. IT's About Business 7.1 presents an omnichannel strategy that seamlessly blends traditional brick-and-mortar stores into modern e-commerce.

TABLE 7.1 E-Commerce Business Models

Online direct marketing	Manufacturers or retailers sell directly to customers. Very efficient for digital products and services. Can allow for product or service customization (www.amazon.ca).
Electronic tendering system	Businesses request quotes from suppliers. Uses B2B with a reverse auction mechanism.
Name-your-own-price	Customers decide how much they are willing to pay. An intermediary tries to match each customer with a provider (www.priceline.com).
Find-the-best-price	Customers specify a need; an intermediary compares providers and shows the lowest price. Customers must accept the offer in a short time, or they may lose the deal (www.hotwire.com).
Affiliate marketing	Vendors ask partners to place logos (or banners) on partner's site. If customers click on a logo, go to a vendor's site, and make a purchase, then the vendor pays commissions to the partners.
Viral marketing	Recipients of your marketing notices send information about your product to their friends.
Group purchasing (e-coops)	Small buyers aggregate demand to create a large volume; the group then conducts tendering or negotiates a low price.
Online auctions	Companies run auctions of various types on the internet. Very popular in C2C, but gaining ground in other types of EC as well (www.ebay.com).
Product customization	Customers use the internet to self-configure products or services. Sellers then price them and fulfill them quickly (<i>build-to-order</i>) (www.dell.com).
Electronic marketplaces and exchanges	Transactions are conducted efficiently (more information to buyers and sellers; lower transaction costs) in electronic marketplaces (private or public).
Bartering online	Intermediary administers online exchange of surplus products or company receives "points" for its contribution, which it can use to purchase other needed items (www.barterpay.ca).
Deep discounters	Company offers deep price discounts. Appeals to customers who consider only price in their purchasing decisions (www.discounterspoolandspa.com).
Membership	Only members can use the services provided. (www.disney-plus.com).

IT's About Business 7.1

Omnichannel Target(ing)

The Business Problem

Target (www.target.com) is a general merchandise retailer that opened in 1962. In 1979, it surpassed US \$1 billion in annual sales. By 2018, the company had a store in every U.S. state, and an

astounding 75 percent of the U.S. population now lives within 10 minutes of a Target store. The retailer's tagline is "Expect More. Pay Less." This tagline reflects the company's positioning as a discount retailer that sells trendy essential items in areas such as homeware, toys, electronics, and sporting goods.

Since Target opened its first store, business models have changed dramatically. Perhaps most significantly, the internet has added a new channel to reach customers. Suddenly, Target found itself competing against Amazon—a store with no physical locations for customers to visit. Target responded by creating a website, Target.direct, in 2000, which became Target.com in 2004. It seemed, however, as though there were two versions of Target—one physical, and one virtual. Customers couldn't always get the same products across these channels, and they couldn't return an online purchase to a physical store. Fast-forward to 2009, when Target introduced its mobile app, adding a third dimension to its channel mix. Again, however, the mobile app served one purpose, the website another, and the physical store a third. The question remained: Are you one customer of Target as a whole? Or, are you three distinct customers, depending on which medium you use to interact with the store?

Today, Target's customer interaction is far greater than in-store, online, or mobile. The company offers multiple platforms to interact with customers including social media platforms, virtual assistants, the Web, and even the old-fashioned physical store aisle. Today's customers want businesses to be wherever they are. Problems don't always occur neatly within regular call centre hours, nor do they happen only within a single channel. When customers need answers, they want those answers immediately. Research reveals that 40 percent of customers will give companies only one day to resolve their issues before they move to another channel or, worse, to a competitor. Even more daunting, 20 percent will give companies only a few minutes.

In addition to these changes, the COVID-19 pandemic that started in 2020 has redefined the way millions of customers shop. Target has adjusted effectively to meet customers where they want to shop—whether online, in person, or both. However, its transformation wasn't a response to the pandemic. The company had begun preparations for a multi-platform strategy as early as 2016. The pandemic made customers more willing to appreciate the consistent nature of the experience regardless of their ability—or willingness—to visit a physical store.

Nowadays, whether they are shopping via a mobile app, a website, social media, or in person, consumers expect a seamless and consistent experience when they interact with a brand. Today's empowered shoppers expect to be catered to, they expect convenience, and they expect to be able to shop whenever and however they want.

The IT Solution

Target's actions, streamlining the customer experience across all platforms, represent what is referred to as an *omnichannel customer experience strategy*. According to market experts, total sales from this type of strategy comprise approximately 46 percent of all e-commerce sales. The omnichannel experience involves marketing to, selling to, and serving customers on all channels to create an integrated, cohesive customer experience. This experience should be the same for customers regardless of which platform or method they choose.

As mentioned earlier, Target started down this strategic path in 2016. While many other retailers were trying to catch up with Amazon by shipping directly to a customer's home, Target chose a different path. The company built a fulfillment model using its existing store infrastructure to provide same-day service through in-store pickup or drive-up services. Furthermore, promising that orders would be ready in less than two hours with no minimum order was a game changer. In this way, Target differentiated itself

from Amazon—which still struggles with same-day delivery—and Walmart—which requires a minimum order for drive-up service.

Today, customers can shop via the Target app and check inventory for an item in local stores. They can even learn which aisle the item is located in. They can also select in-store pickup, so the item is ready when they enter the store, or choose the drive-up to have someone bring it to their car. And, if they remember something else they need on their way to the store, they can seamlessly change the drive-up to a pickup in real time. Alternatively, they can choose to have the item shipped to their home. Finally, customers can mix buying online and in-store and enjoy the same flexibility with returns.

Achieving the proper omnichannel mix between online and off-line was a challenge. Since 2019, Target has invested US \$7 billion to build an integrated IT system that can provide real-time inventory, order updates across channels, and create picking logic (a guide for employees who are "picking" items from the shelf for same-day orders). The company has also overhauled its supply chain to reinvent and align the in-store, online, and mobile experience.

The Results

The key to Target's omnichannel strategy was to redefine the role of its store network. Using stores rather than warehouses and a host of delivery options to drive the same-day solution has made all the difference.

Unlike other retailers who had built giant warehouses and a separate supply chain for their online stores, Target's model focused on its local stores. In fact, in 2020, the company's local stores fulfilled 95 percent of its total sales. Shipping from stores engages associates, and makes inventory visible to both store associates and customers.

The strategic omnichannel innovations proved to be a winning combination. For 2021, Target's digital sales were up 31 percent, with omnichannel selling playing a significant role. More than ever, consumers are demanding options for obtaining their online orders. For many customers, waiting two or more days for an online order to be delivered is no longer an option.

Times have changed. Many of us walk around with phones in our pockets or purses that contain more than 100,000 times the processing power that took astronauts to the Moon. Customers with more information require a different approach. For now, the omnichannel strategy is working well for Target.

Questions

1. Is e-commerce a part of Target's brick-and-mortar strategy? Or, are its brick-and-mortar stores part of its e-commerce strategy?
2. Have you experienced Target's pickup or drive-up service? If so, then what was it like for you?
3. How has Target differentiated itself with its omnichannel strategy?

Sources: Compiled from A. Zaheer, "How to Develop a Seamless CS for the Omnichannel Shopper," *Total Retail*, August 31, 2022; B. Freedman, "The Retail Shift from Store to Home: Omnichannel Strategies That Are Here to Stay Post-Lockdown," *Forbes*, August 10, 2022; P. Tatevosian, "Can Target's Omnichannel Advantage Extend Record Profitability in 2022?," *The Motley Fool*, May 11, 2022; M. Becker, "5 Successful Omnichannel Retailing Examples," *emarsys.com*, June 25, 2022; T. Harnett, "Why Omnichannel CX Succeeds When Channels Work Together," *cmswire.com*, March 17, 2022;

C. Fontanella, “What Is OmniChannel? 20 Top OmniChannel Experience Examples,” *HubSpot*, February 1, 2022; Zacks Equity Research, “Target’s (TGT) Omnichannel, Digitization Efforts Propel Sales,” *yahoo.com*, January 24, 2022; D. Kline, “Target’s Secret: Sharp Focus on Changing How People Shop,” *TheStreet*, December 6, 2021; D. Ratliff, “Target Enhances Omnichannel Pickup and Payment Offerings for the Holidays,” *Retail Touch Points*, October 27, 2021; R. Watson, “Building Out Omnichannel? Target Is the One to Watch,” *parcelindustry.com*, September 27, 2021; S. Lauchlan,

“How Target’s Omni-Channel Leap of Faith 5 Years Ago Set It Up for Retail’s COVID Crisis and Beyond,” *diginomica.com*, March 3, 2021; F. Ali, “Omnichannel Fuels Target’s 145% Growth in Ecommerce,” *digitalcommerce360.com*, March 2, 2021; N. Botting, “Target: A Shining Example of Omnichannel Retail Success,” *blog.lengow.com*, September 6, 2020; R. Redman, “Target Accelerates Omnichannel Game Plan,” *Supermarket News*, March 3, 2020; Target, “Founding of Target,” <https://corporate.target.com/about/purpose-history/History-Timeline?era=2>, accessed September 28, 2022.

Types of E-Commerce

E-commerce can be conducted among various parties. In this section, you will identify seven common types of e-commerce, and you will learn about three of them—C2C, B2E, and e-government—in detail. We discuss B2C and B2B in separate sections because they are very complex. We discuss mobile commerce in Chapter 8 and social commerce in Chapter 9.

- *Business-to-consumer electronic commerce (B2C)*: In B2C, the sellers are organizations, and the buyers are individuals. You will learn about B2C electronic commerce in Section 7.2.
- *Business-to-business electronic commerce (B2B)*: In B2B transactions, both the sellers and the buyers are business organizations. B2B comprises the vast majority of EC volume. You will learn more about B2B electronic commerce in Section 7.3. Look back to **Figure 1.5** for an illustration of B2B electronic commerce.
- *Consumer-to-consumer electronic commerce (C2C)*: In C2C (also called customer-to-customer), an individual sells products or services to other individuals. The major strategies for conducting C2C on the internet are auctions and classified ads. Most auctions are conducted by C2C intermediaries such as eBay (www.ebay.com). For another example, let’s take a look at Movate (www.movate.com).

MKT Many companies use Movate OnDemand to facilitate the resolution of customer questions and complaints by knowledgeable customers themselves. Movate’s clients first enroll a group of knowledgeable customers, called “answerers.” Some client companies test their customers’ writing skills and product knowledge before asking them to participate and become answerers. Movate’s technology platform has an artificial intelligence component that matches answerers with questions that it thinks they will be able to answer well, sending customer queries to them via the Movate app.

HRM Movate answerers have *gig jobs*, similar to Amazon’s Mechanical Turk and Uber. A gig job is one in which an organization contracts with independent workers for short-term engagements where the worker is paid for each engagement. Movate pays answerers 70 percent of the fee for each customer query they resolve. Answerers have reputation scores; those with higher scores receive more questions and may be asked to contribute to collections of stock answers to common questions (known as frequently asked questions or FAQs).

Reputation scores, the flexibility of the work, and Movate’s artificial intelligence component give the start-up a competitive advantage over rivals such as InSided (www.insided.com) and IAdvize (www.iadvize.com) in the US \$4.3-billion customer self-service software market. An average Movate representative makes about US \$200 per week and the top 5 percent earn more than US \$2,000 per week. Movate has experienced very rapid growth. Now let’s look at how game maker Kixeye uses Movate.

MKT Kixeye (www.kixeye.com) receives approximately 40,000 customer support requests per month. About 40 percent of them go to Kixeye answerers via Movate OnDemand. Kixeye says that, while Movate’s costs are comparable to those of overseas contractors, the start-up delivers better results. Since it replaced an Indian outsourcing firm with Kixeye answerers and Movate, the average response time for players’ questions has decreased from 12 hours to 10 minutes, and customer satisfaction has risen by 50 percent.

Similarly, online classified ads websites are also examples of C2C e-commerce. Portals such as Kijiji (www.kijiji.ca) and Craigslist (www.craigslist.org) are among the most popular online classified ad providers.

- *Business-to-employee (B2E)*: In B2E, an organization uses EC internally to provide information and services to its employees. For example, companies allow employees to manage their benefits and to take training classes electronically. Employees can also buy discounted insurance, travel packages, and tickets to events on the corporate intranet. They can also order supplies and materials electronically. Finally, many companies have electronic corporate stores that sell their products to their employees, usually at a discount.
- *E-government*: E-government is the use of internet technology in general and e-commerce in particular to deliver information and public services to citizens (called *government-to-citizen*, or *G2C EC*) and to business partners and suppliers (called *government-to-business*, or *G2B EC*). G2B EC is much like B2B EC, usually with an overlay of government procurement regulations. That is, G2B EC and B2B EC are conceptually similar. However, the functions of G2C EC are different from anything that exists in the private sector (e.g., B2C EC).

E-government is also an efficient way of conducting business transactions with citizens and businesses and within governments themselves. E-government makes government more efficient and effective, especially in the delivery of public services. An example of G2C electronic commerce is requesting a birth certificate online, or registering online for sports activities run by your municipality.

- *Mobile commerce (m-commerce)*: The term *m-commerce* refers to e-commerce that is conducted entirely in a wireless environment. An example is using cellphones to shop over the internet (see Chapter 8).
- *Social commerce*: Social commerce refers to the delivery of electronic commerce activities and transactions through social computing (see Chapter 9).
- *Conversational commerce*: Conversational commerce is a type of electronic commerce that uses natural language processing (see Chapter 14) to engage in various means of conversation, such as online chat with messaging apps, chatbots on messaging apps or websites, and voice assistants.

Messaging apps include Facebook Messenger (www.messenger.com), WhatsApp (www.whatsapp.com), Kik (www.kik.com), and WeChat (www.wechat.com). Customers can chat with company representatives, access customer support, ask questions, receive personalized recommendations, and click to purchase, all from within messaging apps. They have the options of interacting with a human representative, a chatbot, or a combination of the two. Facebook Messenger and WeChat are among the largest messaging apps in the world.

Some 1.3 billion individuals use Facebook Messenger. Facebook's objective is to drive Messenger users to the more than 40 million businesses with an official brand Facebook page. For example, to shop for a T-shirt on Facebook Messenger, users can send a text to Messenger to start a chat with the mobile shopping app Spring. The app will request information concerning the buyer's budget and will then display several possible T-shirts. If the customer does not like any of these choices, Spring will present more options.

Messenger also has a chatbot-building capability. In mid-2023, there were over 300,000 active messenger bots on the app. These bots can process purchases without directing shoppers to a third party. To process transactions in Messenger, Facebook is collaborating with leading companies in the payments industry, including electronic payment leaders Stripe and PayPal, as well as credit card giants Visa, Mastercard, and American Express.

Some 1.24 billion people use WeChat, China's massive social media site. They can utilize bots on the app to chat with friends about an upcoming concert, purchase tickets to the event, book a restaurant, split the check, and call a taxi. In addition to the individual WeChat users, 10 million Chinese businesses have an account. In fact, for some firms, the WeChat bot completely replaces an internet site.

Each type of EC is executed in one or more business models. A **business model** is the method by which a company generates revenue to sustain itself. Table 7.1 summarizes the major EC business models.

business model The method by which a company generates revenue to sustain itself.

Major E-Commerce Mechanisms

MKT Businesses and customers can buy and sell on the internet through a number of mechanisms, including electronic catalogues and electronic auctions. Businesses and customers use electronic payment mechanisms to digitally pay for goods and services.

Catalogues have been printed on paper for generations. Today, they are also available over the internet. *Electronic catalogues* consist of a product database, a directory and search capabilities, and a presentation function. They are the backbone of most e-commerce sites.

auction A competitive process in which either a seller solicits consecutive bids from buyers or a buyer solicits bids from sellers, and prices are determined dynamically by competitive bidding.

forward auctions Auctions that sellers use as a selling channel to many potential buyers; the highest bidder wins the items.

reverse auctions Auctions in which one buyer, usually an organization, seeks to buy a product or a service, and suppliers submit bids; the lowest bidder wins.

An **auction** is a competitive buying and selling process in which prices are determined dynamically by competitive bidding. Electronic auctions (e-auctions) generally increase revenues for sellers by broadening the customer base and shortening the cycle time of the auction. Buyers generally benefit from e-auctions because they can bargain for lower prices. They also do not have to travel to an auction at a physical location.

The internet provides an efficient infrastructure for conducting auctions at lower administrative costs and with a larger number of involved sellers and buyers. Both individual consumers and corporations can participate in auctions.

There are two major types of auctions: forward and reverse. In **forward auctions**, sellers solicit bids from many potential buyers. Usually, sellers place items for auction on websites, and buyers bid continuously for them. The highest bidder wins the items. Both sellers and buyers can be either individuals or businesses. The popular auction site eBay is a forward auction site.

In **reverse auctions**, one buyer, usually an organization, wants to purchase a product or a service. The buyer posts a request for a quotation (RFQ) on its website or on a third-party site. The RFQ provides detailed information on the desired purchase. Interested suppliers study the RFQ and then submit bids electronically. Everything else being equal, the lowest-price bidder wins the auction. The reverse auction is the most common auction model for large purchases (in regard to either quantities or price). Governments and large corporations frequently use this approach, which may provide considerable savings for the buyer.

Auctions can be conducted from the seller's site, the buyer's site, or a third party's site. For example, eBay, the best-known third-party site, offers hundreds of thousands of different items in several types of auctions.

An *electronic storefront* is a website that represents a single store. An *electronic mall*, also known as a *cybermall* or an *e-mall*, is a collection of individual shops consolidated under one internet address. Electronic storefronts and electronic malls are closely associated with B2C electronic commerce. You will study each one in more detail in Section 7.2.

An **electronic marketplace** (*e-marketplace*) is a central, virtual market space on the Web where many buyers and many sellers can conduct e-commerce and e-business activities. Electronic marketplaces are associated with B2B electronic commerce. You will learn about electronic marketplaces in Section 7.3.

electronic marketplace

A virtual market space on the Web where many buyers and many sellers conduct electronic business activities.

electronic payment mechanisms Computer-based systems that allow customers to pay for goods and services electronically, rather than writing a cheque or using cash.

Electronic Payment Mechanisms

MIS ACCT Implementing EC typically requires electronic payments. **Electronic payment mechanisms** enable buyers to pay for goods and services electronically, rather than writing a cheque or using cash. Payments are an integral part of doing business, whether in the traditional manner or online. Traditional payment systems have typically involved cash or cheques.

In most cases, traditional payment systems are not effective for EC, especially for B2B. Cash cannot be used because there is no face-to-face contact between buyer and seller. Not everyone accepts credit cards or cheques, and some buyers do not have credit cards or chequing accounts. Finally, contrary to what many people believe, it may be *less* secure for the buyer to use the telephone or mail to arrange or send payments, especially from another country, than to complete a secured transaction on a computer. For all of these reasons, a better method is needed to pay for goods and services in cyberspace. This method is electronic payment systems. Let's take a closer look at electronic cheques, electronic cards, and digital, online payments. We discuss the blockchain and various cryptocurrencies such as Bitcoin later in this chapter, and then discuss digital wallets in Chapter 8.

ACCT Electronic Cheques *Electronic cheques (e-cheques)*, which are used primarily in B2B, are similar to regular paper cheques. A customer who wishes to use e-cheques must first establish a chequing account with a bank. Then, when the customer buys a product or a service, they email an encrypted electronic cheque to the seller. The seller deposits the cheque in a bank account, and the funds are transferred from the buyer's account into the seller's account.

Like regular cheques, e-cheques carry a signature (in digital form) that can be verified (see www.authorize.net). Properly signed and endorsed e-cheques are exchanged between financial institutions through electronic clearinghouses.

FIN ACCT Electronic Cards There are a variety of electronic cards, and they are used for different purposes. The most common types are electronic credit cards, purchasing cards, stored-value money cards, and smart cards.

Electronic credit (or debit) cards allow customers to charge online payments to their credit (or debit) card account. These cards are used primarily in B2C and in shopping by small and medium-sized enterprises (SMEs). Here is how e-credit cards work (see [Figure 7.1](#)).

1. When you purchase a book from Amazon, for example, your credit card information and purchase amount are encrypted in your browser. This procedure ensures the information is safe while it is “travelling” on the internet to Amazon.
2. When your information arrives at Amazon, it is not opened. Rather, it is transferred automatically (in encrypted form) to a *clearinghouse*, where it is decrypted for verification and authorization.
3. The clearinghouse asks the bank that issued you your credit card (the card issuer bank) to verify your credit card information.
4. Your card issuer bank verifies your credit card information and reports this to the clearinghouse.
5. The clearinghouse reports the result of the verification of your credit card to Amazon.
6. Amazon reports a successful purchase and amount to you.
7. Your card issuer bank sends funds in the amount of the purchase to Amazon's bank.
8. Your card issuer bank notifies you (either electronically or in your monthly statement) of the debit on your credit card.
9. Amazon's bank notifies Amazon of the funds credited to its account.

Purchasing cards are the B2B equivalent of electronic credit cards (see [Figure 7.2](#)). In some countries, purchasing cards are the primary form of payment between companies. Unlike credit cards, where credit is provided for 30 days (for free) before payment is made to the merchant, payments made with purchasing cards are settled within a week.

Stored-value money cards allow you to store a fixed amount of prepaid money and then spend it as necessary. Each time you use the card, the amount is reduced by the amount you spent. [Figure 7.3](#) illustrates a Presto card, which allows users to take the bus and train in several Ontario cities, including Toronto, Hamilton, and Ottawa.

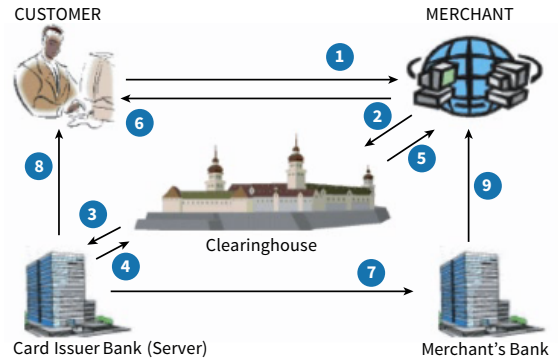


FIGURE 7.1 How e-credit cards work. (The numbers 1–9 indicate the sequence of activities.)



MIKE CLARKE/AFP/Getty Images

FIGURE 7.2 Example of a purchasing card.



HKPhotography Toronto/Shutterstock

FIGURE 7.3 The Presto card is an example of a stored-value money card.



FIGURE 7.4 Smart cards are frequently multipurpose.

Finally, *EMV smart cards* contain a chip that can store a large amount of information as well as a magnetic stripe for backward compatibility (see [Figure 7.4](#)). EMV stands for Europay, Mastercard, and Visa, the three companies that originally created the standard. EMV is a technical standard for smart payment cards. EMV cards can be physically swiped through a reader, inserted into a reader, or read over a short distance using near-field communications. EMV cards are also called “chip and PIN” or “chip and signature” depending on the authentication methods employed by the card issuer.

ACCT MIS Digital, Online Payments The rapid growth of electronic commerce necessitated a fast, secure method for customers to pay online using their credit cards. Traditionally, to process online credit card payments, merchants set up internet merchant accounts and payment gateway accounts. The merchants obtained their merchant accounts through a bank.

A payment gateway is an application that authorizes payments for e-businesses, online retailers, bricks-and-clicks businesses, or traditional brick-and-mortar businesses. It is the virtual equivalent of a physical point-of-sale terminal located in a retail outlet.

Payment gateways link, on one hand, to credit card accounts belonging to online customers and, on the other, to internet merchant accounts. Payment gateways interact with the card issuer’s bank to authorize the credit card in real time when a purchase is made. The funds received flow into the merchant’s account.

The leading providers of payment gateway accounts in Canada are PayPal (www.paypal.com), Moneris (www.moneris.com), Ingenico (www.ingenico.com), Adyen (www.adyen.com), and Stripe (www.stripe.com), among others. These providers help merchants set up merchant accounts and payment gateways in one convenient package. Let’s take a closer look at how electronic payment gateways work using the example of Stripe.

FIN MIS Founded in 2011, Stripe (www.stripe.com) is an electronic payment software solution in the financial technology (fintech) industry whose goal is to transform e-payment systems. Stripe allows individuals and businesses to accept payments over the internet. Stripe focuses on providing the technical, fraud prevention, and banking infrastructure required to operate online payment systems.

Using Stripe, merchants can integrate payment processing into their websites without having to register and maintain a merchant account. For online credit card transactions, merchants create a Stripe account and insert a few lines of JavaScript into their website’s source code. When shoppers provide their credit card information, it is collected directly by Stripe’s servers, so merchants do not need to handle sensitive data. Stripe processes the transaction, scans for signs of fraud, and charges a fee of 2.9 percent plus 30 cents per transaction. Stripe deposits the funds from the sale into the vendor’s bank account a week later.

In the fall of 2018, Stripe moved into brick-and-mortar retail when the firm deployed a new product called Stripe Terminal. Terminal is Stripe’s payments solution for fast-growing internet businesses that sell products and services in person as well as online. For example, food delivery business SkipTheDishes (www.skipthedishes.com) and beauty products provider Glossier (www.glossier.com) use Terminal for in-person payments.

Benefits and Limitations of E-Commerce

Few innovations in human history have provided as many benefits to organizations, individuals, and society as e-commerce has. E-commerce benefits organizations by making national and international markets more accessible and by lowering the costs of processing, distributing, and retrieving information. Customers benefit by being able to access a vast number of products and services around the clock. The major benefit to society is the ability to easily and conveniently deliver information, services, and products to people in cities, rural areas, and developing countries.

Despite all these benefits, EC has some limitations, both technological and nontechnological, that have restricted its growth and acceptance. One major technological limitation is the lack of universally accepted security standards. Also, in less-developed countries, telecommunications bandwidth is often insufficient, and accessing the Web is expensive. The remaining nontechnological limitation is the perception that EC is not secure.

Before you go on...

1. Define e-commerce and distinguish it from e-business.
2. Differentiate among B2C, B2B, C2C, and B2E electronic commerce.
3. Define e-government.
4. Discuss forward and reverse auctions.
5. Discuss the various online payment mechanisms.
6. Identify some benefits and limitations of e-commerce.

7.2 Business-to-Consumer (B2C) Electronic Commerce

LEARNING OBJECTIVE

Describe the various online services of business-to-consumer (B2C) commerce, along with specific examples of each.

B2B EC is much larger than B2C EC by volume, but B2C EC is more complex. The reason is that B2C involves a large number of buyers making millions of diverse transactions per day from a relatively small number of sellers. As an illustration, consider Amazon, an online retailer that offers its customers thousands of products. Each customer purchase is relatively small, but Amazon must manage every transaction as if that customer were its most important one. The company needs to process each order quickly and efficiently, and ship the products to the customer in a timely manner. It also has to manage returns. Multiply this simple example by millions, and you get an idea of how complex B2C EC can be.

Overall, B2B complexities tend to be more business-related, whereas B2C complexities tend to be more technical and volume-related. As you saw in the previous section of this chapter, one of the complexities of B2C involves digital, online payments.

This section addresses the primary issues in B2C EC. We begin by studying the two basic mechanisms that customers utilize to access companies on the Web: electronic storefronts and electronic malls. In addition to purchasing products over the Web, customers access online services, such as banking, securities trading, job searching, and travel. Companies engaged in B2C EC must “get the word out” to prospective customers, so we turn our attention to online advertising. Finally, the complexity of B2C EC creates two major challenges for sellers: channel conflict and order fulfillment, which we examine in detail.

Electronic Storefronts and Malls

For several generations, home shopping from catalogues, and later from television shopping channels, has attracted millions of customers. **Electronic retailing (e-tailing)** is the direct sale of products and services through electronic storefronts or electronic malls, usually designed around an electronic catalogue format and auctions.

E-commerce enables you to buy from anywhere, at any time. EC offers a wide variety of products and services, including unique items, often at lower prices. The name given to selling unique items is “the long tail.” The *long tail* describes the retailing strategy of selling a large number of unique items in small quantities.

Shoppers can gain access to very detailed supplementary product information. They can also easily locate and compare competitors’ products and prices. Finally, buyers can find hundreds of thousands of sellers. Two popular online shopping mechanisms are electronic storefronts and electronic malls.

electronic retailing

(e-tailing) The direct sale of products and services through storefronts or electronic malls, usually designed around an electronic catalogue format and auctions.

electronic storefront The website of a single company, with its own internet address, at which orders can be placed.

electronic mall A collection of individual shops under one internet address; also known as a cybermall or an e-mall.

disintermediation Elimination of intermediaries in electronic commerce.

fintech An industry composed of companies that use technology to compete in the marketplace with traditional financial institutions and intermediaries in the delivery of financial services, which include banking, insurance, real estate, and investing.

As we saw earlier in the chapter, an **electronic storefront** is a website that represents a single store. Each storefront has a unique uniform resource locator (URL), or internet address, at which buyers can place orders. Large businesses have dedicated teams of professionals in charge of building and maintaining their electronic storefronts. However, this would be very expensive for small businesses that are turning to the use of e-commerce software platforms to enable their online storefronts. Small and medium businesses turn to e-commerce platforms such as Shopify to set up and manage their own electronic storefronts.

An **electronic mall**, also known as a *cybermall*, or an *e-mall*, is a collection of individual shops grouped under a single internet address. Electronic malls may include thousands of vendors. For example, Microsoft Bing shopping (www.bing.com/shop) includes tens of thousands of products from thousands of vendors, as does Amazon (www.amazon.ca).

Online Service Industries

In addition to purchasing products, customers access needed services on the Web. Selling books, toys, computers, and most other products on the internet can reduce vendors' selling costs by 20 to 40 percent. Further reduction is difficult to achieve because the products must be delivered physically. Only a few products, such as software and music, can be digitized and then delivered online for additional savings. In contrast, services such as buying an airline ticket or purchasing shares or insurance can be delivered entirely through e-commerce, often with considerable cost reduction.

One of the most pressing EC issues relating to online services (as well as in marketing tangible products) is **disintermediation**. Intermediaries, also known as *middlemen*, have two functions: (1) they provide information, and (2) they perform value-added services such as consulting. The first function can be fully automated and most likely will be assumed by e-marketplaces and portals that provide information for free. When this development occurs, the intermediaries who perform only (or primarily) this function are likely to be eliminated. The process whereby intermediaries are eliminated is called *disintermediation*.

In contrast to simply providing information, performing value-added services requires expertise. Unlike the information function, then, this function can be only partially automated. Intermediaries who provide value-added services are thriving. The Web helps these employees in two situations: (1) when the number of participants is enormous, as with job searches; and (2) when the information that must be exchanged is complex.

In this section, you will examine some leading online service industries: banking, trading of securities (shares, bonds), job matching, travel services, and advertising.

FIN MIS Financial Technology (Fintech) Traditional banks have massive, entrenched, and inefficient legacy infrastructures: brick-and-mortar buildings and information technology infrastructures. These legacy infrastructures make it difficult for traditional banks to upgrade their systems or to be agile and flexible. Furthermore, their infrastructures are making banks' customer experience outdated. Customers now expect their financial experiences to be mobile, personalized, customizable, and accessible.

Responding to customer expectations, **fintech** is an industry composed of companies that use technology to compete in the marketplace with traditional financial institutions and intermediaries in the delivery of financial services, which include banking, insurance, real estate, and investing. (Fintech is also a blanket term for disruptive technologies that are affecting the financial services industry.) Let's take a closer look at the many services that fintech companies are offering.

FIN Lending An alternative source of financing, person-to-person (P2P) lending platforms use machine learning technologies and algorithms to save individuals and businesses time and money and help them access a line of credit. P2P lending platforms provide borrowers with an easy, fast, and lower-cost service that most traditional banks cannot match. Canadian companies in this area include Spring Financial (www.springfinancial.ca), MOGO (www.mogo.ca), Lend Direct (www.lenddirect.ca), and LoanAway (www.loanaway.com). Other lending websites include Lending Tree (www.lendingtree.com), Lending Club (www.lendingclub.com), Prosper (www.prosper.com), and Zopa (www.zopa.com).

FIN Trading and Investing New automated financial advisers and wealth management services are making an impact on the industry. *Robo-advisers* create relatively straightforward asset allocation portfolios based on customers' ages and risk tolerance. Basically, they tell clients what percentage of equities, bonds, and cash they should have. They then monitor the portfolio and reallocate funds as needed. *Robo-analysts* use sophisticated algorithms to make trading and investing a more automated online experience. Often in conjunction with human advisers, these platforms allow users to save money and offer financial research and planning services that are normally reserved for wealthy investors. They also enable users with small amounts of capital to begin investing. The leading companies in Canada in this area are Questrade (www.questrade.com) and Wealthsimple Trade (www.wealthsimple.com); in the United States, online wealth managers include Wealthfront (www.wealthfront.com), Betterment (www.betterment.com), etoro (www.etoro.com), and Robinhood (www.robinhood.com).

FIN ACCT Personal Finance Fintech companies are trying to make personal finance more transparent and more affordable. Mobile apps and online platforms are now helping individuals and businesses develop a budget, find a loan, file their taxes, and invest. These platforms also use technology to track daily expenditures and help users analyze their financial status in real time. Some examples of companies in this area are Acorns (www.acorns.com), LearnVest (www.learnvest.com), Mint (www.mint.intuit.com), NerdWallet (www.nerdwallet.com), and KOHO (www.koho.ca).

FIN Funding Equity and crowdfunding platforms provide alternative sources of investment for individuals who want to start a business. Online crowdfunding platforms raise money from a large number of individuals who collectively fund projects that typically would not attract funding from traditional banks and venture capital firms. The leading companies in this area are Kickstarter (www.kickstarter.com), Indiegogo (www.indiegogo.com), and GoFundMe (www.gofundme.com).

FIN Currency Exchange and Remittances Transferring and exchanging money internationally can be a time-consuming and expensive process. Fintech companies are developing innovative platforms that make this process simpler, faster, and less expensive. These companies range from P2P currency exchanges that reduce the costs of exchanging currencies to mobile phone-based money transfers and remittance platforms that provide a cost-effective method for people to transfer small amounts of money overseas. The leading companies in this area are RemitBee (www.remitbee.com), Wise (www.wise.com), Xoom (www.xoom.com), WeSwap (www.weswap.com), and WorldRemit (www.worldremit.com).

FIN Mobile Banking Mobile banking refers to the service that banks and other financial institutions provide to their customers that enables them to conduct a range of transactions by using an app on their mobile devices. The apps allow customers to remotely access and transact with their accounts. In Canada, approximately 65 percent of consumers used mobile app-based banking in 2022.

FIN Internet Banking Internet banking (also called e-banking or online banking) is closely related to mobile banking. However, instead of using an app, customers use the internet. All of the transactions are conducted through the financial institution's website. Several internet-only banks exist in Canada, including Tangerine (www.tangerine.ca), EQ Bank (www.eqbank.ca), and Simplii Financial (www.simplii.com). In the United States, some examples are Ally (www.ally.com), TIAA Bank (www.tiaabank.com), and Axos (www.axosbank.com).

FIN ACCT Payments Casual payments that people make every day, such as \$75 for domestic help or \$40 to split a lunch check with friends, have long been a problem for the banking system. Today, new payment technologies are changing the ways that consumers bank, transfer money, and pay for goods and services.

With P2P services, consumers link a bank account, credit card, or debit card to a smartphone app and can then send money to anyone else with only the recipient's email address or phone number. For example, in Canada one can use Interac e-transfer to send and receive money by simply using an email address. Many consumers do not carry a physical wallet filled with cash and credit cards, but use only a smartphone. The leading companies in this area are Venmo (<http://venmo.com>; a subsidiary of PayPal), PayPal (www.paypal.com), Square (<https://squareup.com>), Apple Pay (www.apple.com/apple-pay), Google Pay (<https://payments.google.com>), and Facebook Messenger (www.messenger.com).

In Canada, all major banks, including TD Canada Trust, CIBC, BMO (Bank of Montreal), and ScotiaBank use Interac (www.interac.ca), a digital payments network that allows consumers to send money instantly through participating banks' mobile apps. Consumers who utilize this network do not have to download a separate app. A similar service is offered in the United States by Zelle (www.zellepay.com).

ACCT **MIS** **Blockchain** A *ledger* records a business's summarized financial information as debits and credits and displays their current balances. A blockchain is a decentralized, distributed, encrypted, secure, anonymous, tamper-proof, unchangeable, and often public digital ledger (a database, if you will) consisting of transactions bundled into *blocks*. Blocks contain details such as transaction timestamps and a link to the previous block. These links form the blockchain.

The blockchain records transactions across many computers so that blocks cannot be altered retroactively without all subsequent blocks being altered as well. This process allows all participants to independently verify and audit transactions. We now take a closer look at how blockchains function.

Nodes are the computers that support a blockchain network and keep it operating smoothly. Nodes are operated by individuals or groups of people who contribute money toward buying powerful computer systems. There are two types of nodes: full nodes and lightweight nodes. *Full nodes* keep a complete copy of the blockchain ledger, which is a record of every single transaction that has ever occurred. *Lightweight nodes* download only a fraction of the blockchain. Lightweight nodes are used by most people as a Bitcoin wallet for Bitcoin transactions.

A *miner* is a type of node that creates blocks in the blockchain. Miners bundle pending transactions into a block, verify that block, and add it to the blockchain.

To be able to add a block to the blockchain, a miner must compete to be the first to complete the Proof-of-Work (PoW) mining algorithm. Miners append a nonce, which is a random whole number, to the hashed contents of the block. (Note: The contents of the block are hashed when they are encrypted by a mathematical formula.) With the nonce appended to the block, miners rehash the contents to try to produce a hash value lower than or equal to the value set by the network. A *hash value* is a series of numbers and letters that is generated by the hash function. Miners keep trying different nonces until they obtain the correct hash value.

The miner who finds the correct hash value broadcasts the correct solution to the network. Receiving nodes validate the transactions in the block and accept it only if all are valid. Once a majority of nodes agree that all transactions in the recent past are unique (i.e., not double spent), the transactions in the block are cryptographically sealed into it. Each new block is linked to previously sealed blocks to create a chain of accepted history, thereby preserving a verified record of every transaction.

The new block is then added to the blockchain and the winning miner is given 12.5 Bitcoins by the blockchain as payment for its success. The winning miner also receives all of the fees from Bitcoin transactions that were included in that block.

The central problem in electronic cash is called *double spend*. Because electronic money consists of data, nothing stops a currency holder from trying to spend it twice.

Blockchain technology allows for the tracking of digital assets so that they can be verified as authentic and cannot be copied without permission. This capability makes blockchain ideal for financial transactions but also for other kinds of digital content such as contracts, and verified assets such as property deeds and election votes.

Blockchain technology does present problems, the most significant of which is hacking. For instance, in 2019, an attacker gained control of more than half of Ethereum Classic (a cryptocurrency exchange) and started rewriting its transaction history. This kind of attack

is called a 51-percent attack. Between 2017 and 2019, industry analysts note that hackers stole nearly US \$2 billion in cryptocurrency, mostly from exchanges, and that includes only what was publicly revealed.

Another problem is that some blockchains allow for anonymity. As a result, cybercriminals use these blockchains for illegal purposes. Recall the problem of ransomware (see Chapter 4): attackers typically require ransoms to be paid in cryptocurrency.

Blockchain technology has a variety of uses. The best-known is cryptocurrency. We will look at Bitcoin next and then examine other applications.

MIS Bitcoin Blockchain is not Bitcoin itself but the technology underlying Bitcoin. A Bitcoin is the digital token and blockchain is the ledger to keep track of who owns the digital tokens. *Bitcoin* is a decentralized cryptocurrency, which is a digital form of currency that uses blockchain and cryptography for validation. The blockchain records every Bitcoin and every transaction related to it.

The Bitcoin network is a peer-to-peer payment network that operates with encryption. Users send and receive Bitcoins, units of digital currency, by sending digitally signed messages to the network using Bitcoin cryptocurrency wallet software.

Let's look at an example of a simple Bitcoin transaction. Jim wants to send one Bitcoin to Sally.

Jim and Sally both have Bitcoin wallets. Each wallet contains two pieces of information. One is the public key, which is that person's Bitcoin address. The other is the private key, which is that person's Bitcoin password.

If someone loses their private key, they lose access to their Bitcoin wallet and their Bitcoins. No centralized entity exists that can recover private keys. In fact, if someone else has your private key, they can take your Bitcoins.

Sally sends Jim her public key. Jim opens his Bitcoin wallet, enters the instruction to send one Bitcoin to Sally's public address, and enters his private key to authorize the transaction. The Bitcoin network examines the proposed transaction. It checks to see that Jim has enough Bitcoins in his account and whether the address Sally provided is valid.

After Jim and Sally's transaction passes these two tests, miners bundle it with other pending transactions into a block. The winning miner verifies the block and, after consensus is reached, adds it to the blockchain. The blockchain processes the transaction and updates the database. Jim's balance is decreased by one Bitcoin and Sally's is credited by one Bitcoin.

POM Energy Grid Power companies manage and control modern electrical grids. The power companies, as trusted intermediaries between producers and consumers, buy and sell power at the prices they set because they control the infrastructure.

However, rapid improvements in renewable energy sources and batteries are leading to innovations like microgrids in communities. A *microgrid* is a self-sufficient energy system that serves a discrete area, such as a college campus or a neighbourhood. For instance, if homeowners generate more power than they need, they can sell the excess power to neighbours or local businesses at market value. The peer-to-peer process of selling and buying energy can operate with blockchain technology, saving money because there is no intermediary in each transaction. The process also saves energy by keeping it local, because the farther that energy travels, the more is wasted.

MKT POM Digital Content Creators A major problem in the digital content space today is the lack of transparency regarding royalty payments and rights management. For the creators of digital content and virtual property, blockchain means enforceable copyrights, transparency around royalty payments, and payments made securely without an intermediary. Blockchain technology can provide evidence of ownership of content in both digital media and music. Furthermore, with smart contracts on the blockchain, copyright becomes more enforceable. A *smart contract* is a self-executing contract with the terms of agreement between buyer and seller directly written into the software. The software and the agreements in the contract exist on a blockchain network.

Blockchains could eliminate the middlemen and enable musicians and other digital content creators to get paid directly by their audiences. As the market shifts to blockchain over time, consumers could see lower prices for content, while content creators could see increased returns.

ACCT The Music Industry The digitization of the music industry and the rise of streaming services such as iTunes, Spotify, and Pandora have transformed the way people buy and listen to music. As the industry has transitioned into a streaming model, issues with rights management, copyright enforcement, and royalty payments have led to new challenges that will force the music industry to rethink how payments are made to artists and creators.

For example, royalty payments are often difficult to calculate when there are multiple collaborators on a single track. Record companies, publishers, and streaming service providers also operate with siloed databases, making it difficult to keep track of music rights and who is owed how much money.

With blockchain, each song file can have its royalty and licensing rights contained in the file. Each download can automatically trigger micropayments to the artist, who can get paid first instead of last.

Artist Imogen Heap was among the first musicians to start experimenting with blockchain. In 2015, she used the Ethereum blockchain-based Ujo platform to launch the song “Tiny Human” for \$0.60 per download. Heap has also founded her own blockchain-based offering, Mycelia, that aims to give artists more control over how their music is sold and circulated.

ACCT Journalism Similar to the music industry, blockchain-verified micropayments could change the revenue system for journalism. Stories could have their rights embedded in each file and readers could be charged a small amount of Bitcoin for each piece of content that they actually consume. Specifically, accessing an article would automatically send a micropayment to a smart contract that has been originally coded to transparently pay all of the parties involved in the creation and publication of that article with the appropriate payment percentages. The result could be that readers really think about which material is worth consuming, leading to the best journalism being funded.

POM Supply Chains Blockchain technology could help track and monitor raw materials as they pass through supply chains, adding transparency and the ability to trace materials to their source. In logistics, blockchain could help keep track of each stage of a transport container’s journey from point to point, creating a clear record of who authorized its movement, who moved it, and when.

- Diamond conglomerate De Beers has deployed its blockchain-backed platform, Tracr, to track diamonds throughout their journey from mines to stores. With Tracr, a diamond is given a Global Diamond ID that records its carat weight, colour, clarity, and other attributes. The ID number is used to track the diamond through the supply chain.

A company called Everledger (www.everledger.io) combines blockchain technology with machine learning, the Internet of Things, and nanotechnology to create a digital twin of each diamond. This process ensures that each diamond is traceable in a secure, unchangeable, and private platform. The unique identity of each diamond enables stakeholders to buy and sell with confidence and establishes trust all along the supply chain, from mine to customer.

- According to the World Health Organization, 400,000 people die each year from contaminated food. IBM noted that many of the critical issues affecting food safety, such as cross-contamination, the spread of food-borne illness, unnecessary waste, and the cost of recalls, are magnified by a lack of transparency and traceability along the supply chain, encompassing growers, suppliers, processors, distributors, retailers, regulators, and consumers. As a result, it can take weeks to identify the precise point of contamination, causing further illness, lost revenue, and wasted product.

Walmart, Wegmans, Nestlé, and four other major food providers joined with IBM to create the IBM Food Trust Network. Before this network was created, it would take Walmart at least seven days to catch an *E. coli* outbreak. With blockchain and the IBM network, it now takes Walmart 2.2 seconds to trace any of its food products back to the exact farm of origin. In another example, one major fast food retailer uses blockchain to track the temperature of meat in near real time as it moves along the supply chain from farm to restaurant.

FIN Online Securities Trading Millions of do-it-yourself investors use computers to trade shares, bonds, and other financial instruments. In fact, several well-known securities companies, including Questrade, TD Direct Investing, and Scotia iTRADE in Canada, and E*Trade, Ameritrade, and Charles Schwab in the United States, offer only online trading because it is cheaper than a full-service or discount broker. On the Web, investors can find a considerable amount of information regarding specific companies or mutual funds in which to invest (e.g., on www.cnn.com/business and www.bloomberg.com).

HRM The Online Job Market Job seekers use online job market sites such as www.indeed.ca, www.careerbuilder.ca, www.monster.ca, and www.linkedin.com to help them find available positions. In many countries, governments must advertise job openings on the internet. (See our discussion on LinkedIn and “how to find a job” in Chapter 9.)

MKT Travel Services The internet is an ideal place to plan, explore, and arrange almost any trip economically. Online travel services allow you to purchase airline tickets, reserve hotel rooms, and rent cars. Most sites also offer a fare-tracker feature that sends email messages about low-cost flights. Examples of comprehensive online travel services are www.expedia.ca, www.travelocity.ca, and www.orbitz.com. Online services are also provided by all major airline vacation services, large conventional travel agencies, car rental agencies, hotels (e.g., www.hotels.com), and tour companies. In a variation of this process, www.priceline.com allows you to set a price you are willing to pay for an airline ticket or hotel accommodations. It then attempts to find a vendor that will match your price.

One costly problem that e-commerce can cause is “mistake fares” in the airline industry. For example, in January 2019, Cathay Pacific (www.cathaypacific.com) offered business class flights from Vietnam to several U.S. cities for US \$675. This price was incorrect; the actual price would have been about US \$4,000. In most countries, including Canada, airlines are not required to honour mistake fares, but Cathay did honour the tickets purchased before it fixed the erroneous price.

MKT Online Advertising *Advertising* is the practice of disseminating information to attempt to influence a buyer–seller transaction. Traditional advertising on TV or in newspapers involves impersonal, one-way mass communication. In contrast, direct response marketing, or telemarketing, contacts individuals by direct mail or telephone and requires them to respond in order to make a purchase. The direct response approach personalizes advertising and marketing. At the same time, however, it can be expensive, slow, and ineffective. It can also be extremely annoying to consumers.

Online advertising has redefined the advertising process, making it media-rich, dynamic, and interactive. It improves on traditional forms of advertising in several ways. First, online ads can be updated at any time at minimal cost and therefore can be kept current. These ads can also reach very large numbers of potential buyers all over the world. Furthermore, they are generally cheaper than radio, television, and print ads. Finally, online ads can be interactive and targeted to specific interest groups or individuals.

Online advertising is responsible in large part for the profit margins of content creators, and it plays a critical role in keeping online content free. In 2021, online advertising spending worldwide totaled US \$522.5 billion and it is expected to surpass the US \$800-billion mark by 2026. Also in 2021, online advertising spending in Canada (\$11 billion) exceeded spending on traditional advertising (\$5.74 billion).

The predominant business model for content creators, as well as platforms such as Google and Facebook, has always involved the income from online advertising. Advertising is sold based on *impressions*, or the number of times that people view an ad. Consequently, content creators are placing more—and more intrusive—ads on each Web page, thus irritating users even more. Such ads include banners, pop-up ads, pop-under ads, and email. Although cost-effective, email advertising is often misused, causing consumers to receive a flood of unsolicited email, or *spam*. **Spamming** is the indiscriminate distribution of electronic ads without the permission of the recipient. Unfortunately, spamming has become worse over time.

Today, online advertising is facing a crisis because content creators have been placing more and more intrusive ads. As a result, users have become irritated with videos that automatically

spamming Indiscriminate distribution of email without the recipient’s permission.

start playing when they load a Web page and full-screen takeovers that force them to find and then click on a tiny “x” before they can read the content that they wanted in the first place. They are also concerned about cookies that track every Web page they visit and every click they make, thus enabling advertisers to target them with increasing frequency and precision.

MIS MKT As a result of these problems with online advertising, many Web users are employing ad-blocking software—called *ad blockers*—to prevent online advertising. According to the Global Ad-Blocking Behavior Report by GlobalWebindex (www.gwi.com), approximately 47 percent of users worldwide used an ad blocker in 2020. Industry analysts estimate that the global revenue loss to content creators in 2020 ranged from US \$16 billion to US \$78 billion, depending on how actively the content creators adopted ad-blocking countermeasures. There are several types of ad blockers:

- Ad blockers that will stop almost every ad and tracker; for example, Privacy Badger (www.privacybadger.org), which is operated by the nonprofit Electronic Frontier Foundation.
- Ad blockers that are for-profit businesses. The most popular ad blocker is Adblock Plus (<https://adblockplus.org>), which has more than 100 million users worldwide. The tool blocks ads, banners, pop-ups, and video ads, and stops tracking services.
- Ad blockers that collect data. Ghostery (www.ghostery.com) monitors Web servers that are being accessed from a particular Web page and matches them with its library of known trackers. Ghostery then shows that tracker to users.
- Ad blockers that use the freemium model. Blockers such as Disconnect (<https://disconnect.me>) and 1Blocker (<https://1blocker.com>) are free apps for mobile users, who then have to pay if they want to use features such as being able to simultaneously block more than one ad or tracker.
- Ad blockers that are a function of operating systems. For example, Google Chrome will block ads from sites that engage in particularly annoying behaviour. Apple’s latest operating systems enable owners of Apple devices to download Web browser extensions that block ads. Brave (<https://brave.com>) is a free, open-source Web browser that blocks ads and website trackers.

Not surprisingly, content creators are fighting back against ad-blocking software. For example, about 30 percent of the internet’s top 10,000 websites use software designed to subvert browser-level ad blocking. In addition, they have begun using ad block detectors. This type of software tool looks for ad blockers and then asks the user to disable them. It might even deny access to content until they do.

It is very important to realize that all of the “free” content on the Web must be paid for somehow. If online ads are no longer viable, then content on the Web will be displayed only behind paywalls. That is, users will have to pay (e.g., subscriptions) to view content. And the results? The battles between content creators and ad blockers continue.

Issues in E-Tailing

Despite e-tailing’s increasing popularity, many e-tailers continue to face serious issues that can restrict their growth. Three significant issues are channel conflict, order fulfillment, and personalized pricing.

MKT POM Channel Conflict Clicks-and-mortar companies may face a conflict with their regular distributors when they sell directly to customers online. This situation, known as **channel conflict**, can alienate distributors. Channel conflict has forced some companies to avoid direct online sales. For example, Walmart, Lowe’s, and Home Depot would rather have customers come to their stores. Therefore, although all three companies maintain e-commerce websites, their sites place more emphasis on providing information—products, prices, specials, and store locations—than on online sales.

Channel conflict can arise in areas such as pricing and resource allocation—for example, how much money to spend on advertising. Another potential source of conflict involves the logistics services provided by the off-line activities to the online activities. For example, how should a company handle returns of items purchased online? Some companies have

channel conflict The alienation of existing distributors when a company decides to sell to customers directly online.

completely separated the “clicks” (the online portion of the organization) from the “mortar” or “bricks” (the traditional bricks-and-mortar part of the organization). However, this approach can increase expenses, reduce the synergy between the two organizational channels, and alienate customers. As a result, many companies are integrating their online and off-line channels, a process known as **multichannelling**.

Multichannelling has created the opportunity for showrooming. *Showrooming* occurs when shoppers visit a brick-and-mortar store to examine a product in person. They then conduct research about the product on their smartphones. Often, they then purchase the product from the website of a competitor of the store they are visiting. Showrooming is causing problems for brick-and-mortar retailers, such as Target, Best Buy, and others. At the same time, it benefits Amazon, eBay, and other online retailers.

multichannelling A process in which a company integrates its online and off-line channels.

POM Order Fulfillment The second major issue confronting e-commerce is *order fulfillment*, which can create problems for e-tailers. Anytime a company sells directly to customers, it is involved in various order-fulfillment activities. It must perform the following activities: quickly find the products to be shipped; pack them; arrange for the packages to be delivered speedily to the customer’s door; collect the money from every customer, either in advance, on delivery, or by individual billing; and handle the return of unwanted or defective products.

It is very difficult to accomplish these activities both effectively and efficiently in B2C, because a company has to ship small packages to many customers and do it quickly. For this reason, companies involved in B2C activities can experience difficulties in their supply chains.

In addition to providing customers with the products they ordered and doing it on time, order fulfillment provides all related customer services. For example, the customer must receive assembly and operation instructions for a new appliance. If the customer is unhappy with a product, the company must also arrange for an exchange or a return.

MKT Personalized Pricing The third major issue in e-commerce is personalized pricing. In the relationship between buyers and sellers, price has traditionally been a meeting point. The practice of setting a fixed price for a good or service, which appeared in the 1860s, eliminated haggling. Each party surrendered something in this relationship. Buyers were forced to accept, or not accept, the fixed price on the price tag. In return, retailers gave up the ability to exploit customers’ varying willingness to pay more for a particular good or service. That is, retailers surrendered the ability to make more profit.

Today, consumers are accustomed to *standardized pricing*, which means that, when a product is sold through multiple channels, the cost should not vary by more than the difference in shipping, taxation, and distribution costs. If the price is higher for a product at a certain retailer, then customers can easily use the internet to compare prices and features among a huge number of retailers and purchase that product from another retailer, in other words, showrooming. There is even a website, www.camelcamelcamel.com, that tracks Amazon prices for specific products and alerts consumers when a price drops below a pre-set threshold.

In theory, charging all consumers the same price is ineffective for merchants, because some customers would have been willing to pay more, and others who opted not to buy would have bought at a lower price. Economic theory states that personalized pricing can save companies this lost revenue.

Personalized pricing is the practice of pricing items at a point determined by a particular customer’s perceived ability to pay. The optimal outcome of personalized pricing *for the merchant* is maximizing the price that each customer will pay. Merchants are now able to approximate the maximum price that each customer will pay. How do they do this?

They analyze the data that consumers generate when they place items in shopping carts; swipe their rewards cards at store registers; “like” something on Facebook; provide ratings, reviews, and recommendations; and perform many other actions. They also virtually assess each customer who visits their website. Specifically, when a customer accesses a retailer’s site, the merchant may know where the customer is located based on their Internet Protocol address. Merchants may also know the customer’s postal code. In that case, they can determine the customer’s socioeconomic status based on data from the most recent federal census.

As a result of analyzing this Big Data, retailers are developing increasingly sophisticated personalized pricing algorithms. That is, they can find the optimal, profit-maximizing price of

a good or a service for a particular customer. As a result, prices can fluctuate hour to hour and even minute to minute. For example, the price of a can of pop in a vending machine can now vary with the outside air temperature!

When merchants combine these data with cookies (see Chapter 4), they can learn a significant amount about individual customers. Based on these data, merchants can predict which products a customer is interested in purchasing, when they are likely to purchase them, and, critically, the price they would be willing to pay. That is, a merchant can estimate a customer's *reservation price*—the maximum amount they would be willing to pay for a specific product, before they had “reservations” about buying it—and then charge them that amount.

Furthermore, with e-commerce, merchants can easily adjust prices for different customers simply by changing them in the system in real time. They therefore avoid the expense of physically changing the prices on thousands of products.

For example, Delta Airlines (www.delta.com) uses personalized pricing to raise ticket prices for frequent flyers. The rationale is that these customers probably have to travel frequently, usually for business. They are therefore willing (however unenthusiastically) to pay more than infrequent travellers.

Companies such as Wiser (www.wiser.com) and Dunnhumby (www.dunnhumby.com) offer personalized pricing solutions to retailers. Blue Yonder (<https://blueyonder.com>) claims it can optimize prices not only according to the region but also according to the channel in which the customer is interacting with the retailer.

Most companies hesitate to utilize personalized pricing because it remains to be seen whether consumers will accept the practice. Typically, when consumers hear about the practice, they react negatively, and companies employing it experience customer dissatisfaction.

A valuable source of data for companies in personalizing prices is what competitors are charging. Brick-and-mortar retailers can send mystery shoppers to their competitors' stores to note prices, but online merchants use software to scan rival websites and collect data, a process called *scraping* that is carried out by software called *scraping bots*.

Large companies have internal teams dedicated to scraping, whereas smaller companies use retail price optimization firms such as Competera (www.competera.net) and Price2Spy (www.price2spy.com). These firms scrape pricing data from websites and use machine-learning algorithms to help their customers decide how much to charge for different products.

Retailers want to see rivals' prices but they also want to prevent their rivals from spying on them. In addition, they seek to protect intellectual property like product photos and descriptions, which can be scraped and reused by competitors. So, many retailers show different prices to people than to scraping bots. The question is: How do retailers detect bots?

If a website visitor makes hundreds of requests per minute, it is probably a bot. Another method is to look for human behaviour. Specifically, when humans tap a button on their phones, they move the phone very slightly. This movement can be detected by the phone's accelerometer and gyroscope. These movements predict that the site visitor is a human and the absence of such movements predicts that the user is probably a bot.

Keep in mind that retailers need to allow some, but not all, bots to scrape a website. If websites blocked bots entirely, they would not show up on search results. Furthermore, retailers generally want their pricing and items to appear on shopping comparison websites such as Google Shopping (<https://shopping.google.ca/>) and Price Grabber (www.pricegrabber.com). IT's About Business 7.2 presents a recent story where variable (dynamic) pricing created a problem for Bruce Springsteen.

MKT IT's About Business 7.2

MKT Dynamic Pricing and The Boss

Background

In the age before digital tickets, it was common to go to a ticketed event and see someone selling tickets on the street corner. People would purchase tickets on their way into the event, often negotiating the price on the spot. This practice, known as *scalping*, was common for sporting events, concerts, and any

other events where the demand for tickets is far greater than the supply.

Bruce Springsteen, who is known for standing up for working-class people, has always been viewed as offering an excellent deal. His concerts were priced fairly, and his performances were outstanding, often lasting longer than three hours. As with other popular events, however, tickets were sometimes scalped for a premium price, far above their face value. This activity is generally

criticized as unfair, unethical, and potentially fraudulent (by scalping fake tickets). In some cases, it is illegal.

StubHub.com (www.stubhub.com) has built an entire business allowing individuals to resell tickets, often at a higher price. In some cases, a customer purchases tickets and then cannot attend the event. In such cases, it makes sense to resell the tickets. In other cases, however, a person purchases the best seats for an event with the expressed intent of reselling them for a large premium. In these cases, the scalpers pocket the price increase (minus the StubHub fees), and none of the extra revenue goes to the artist or the venue.

There are other issues with StubHub as well. When events are cancelled and people request a refund, they will likely receive the face value from the venue and not the amount they paid through StubHub.

Clearly, then, the practice of buying tickets through a reselling portal like StubHub poses a risk for consumers. In addition, performers stand to lose money. Artists and teams receive a portion of the revenue from each ticket sale. However, if a \$100 ticket sells on StubHub for \$1,000, the artist does not receive the extra royalty. In general, when tickets are priced below what customers are willing to pay, scalpers stand to make more money from ticket sales than the performers do.

The IT Solution

What is an appropriate solution? For customers, a better process, where the person who purchases the tickets is the person who will attend the concert, would lower their risk. For the venue and the artist, a pricing strategy could price tickets according to what customers are willing to pay. Such a strategy could help the artists and venues—rather than the scalpers—to receive most of the profits.

As early as 2011, Ticketmaster (www.ticketmaster.com) began to employ a strategy called *dynamic pricing*. The company uses data analytics to adjust the price of a percentage of tickets according to demand. In theory, this strategy would allow promoters to sell the most sought-after tickets at a higher price, while filling up the least desirable seats by charging less. To succeed, the algorithm needs to take many factors into account, such as time since tickets went on sale, time until the event, seat location, remaining seats in that location, total number of seats remaining, and number of times a person has visited the site.

Ticketmaster utilizes these factors to respond to real-time supply and demand, sometimes in a matter of minutes. Significantly, companies in other areas also employ dynamic pricing. For example, Amazon updates its prices every 10 minutes. If you want to see this system at work, simply place an item in your cart. Then, check back every day or so. You might see a note informing you that the price for that item has changed. Similarly, airlines continually adjust pricing for their seats; hotels adjust pricing based on demand, supply, and availability; ride-sharing platforms charge more for peak times; and so on. A 2018 report from Deloitte (www2.deloitte.com) and Salesforce (www.salesforce.com/) found that 40 percent of brands that utilize artificial intelligence to personalize the customer experience also employ dynamic pricing. And the proportion of businesses that employ this strategy will continue to increase.

At face value, dynamic pricing appears to be logical and ethical. Data help to set the price where it needs to be to sell the most tickets at the highest prices. However, dynamic pricing should be employed carefully so as not to offend loyal customers who are accustomed to certain ticket prices.

For years, devoted fans would camp out for days to be in line to get the best seats. These customers would sacrifice their time and convenience, but not their money. Once ticket sales went online,

however, it was all about who could refresh their page and get the tickets in their cart first. Now that dynamic pricing is in play, it isn't always about the race to be first for the best seats. Instead, the question is, are you willing to pay a far higher price for them?

Some people feel that now the artists are scalping their own tickets. Others, however, feel that fans need to be realistic: Sometimes the best seats really are worth more than other seats. Premium pricing, adjusted dynamically, reflects that belief, and attempts to capture more revenue for the artist and the venue.

The Results

Bruce Springsteen, born in 1949, is likely nearing the end of his career. He vowed never to have a “farewell tour,” so fans assume that each tour could be the last. His next tour, scheduled for 2023, will be his first in seven years. For some fans, the long break between shows and the fact that this could be his final tour make the concert more valuable. Dynamic pricing algorithms tapped into this reality and priced the tickets accordingly.

Springsteen is not alone in using dynamic pricing. Taylor Swift, Drake, Paul McCartney, and Harry Styles have embraced dynamic pricing. Currently, artists such as The Weeknd, Alicia Keys, and Carrie Underwood are also offering their best seats—often dubbed “Platinum Tickets”—through this system. None of these artists, however, has built their careers on working-class values.

Nearly 90 percent of tickets were sold at a face value between US \$59.50 to US \$399, with an average price of US \$202. Only 1.3 percent of tickets across all shows sold for more than US \$1,000. So the number of seats that were “Springsteen scalped” is minimal. Nevertheless, many fans were outraged because Springsteen always touted himself as a working-class hero, yet near the end of his career he shifted from traditional pricing to dynamic pricing—a move that cut many of his working-class fans out of the chance to get good seats.

Questions

1. Who do you feel for the most in this situation: artists who are losing revenue from scalped tickets, or customers who are overpaying for their tickets?
2. What alternatives to dynamic pricing could Bruce Springsteen have employed?
3. Should Springsteen's image as an advocate for working-class people have affected his pricing decision?

Sources: Compiled from S. Bhattacharyya, “Retailers Double Down on Dynamic Pricing to Protect Margins,” *CFO Dive*, September 1, 2022; M. Cava, “Springsteen Tickets for \$4,000? How Dynamic Pricing Works and How You Can Beat the System,” *USA Today*, August 17, 2022; A. Stewart, “Bruce Springsteen Fans Face \$5,000 Tickets—and a ‘Crisis of Faith,’” *Washington Post*, August 3, 2022; J. Sparrow, “Dynamic Ticketing: Springsteen's Manager Defends Pricing,” musically.com, July 29, 2022; W. Gittins, “What Is Dynamic Pricing and Why Are Bruce Springsteen Concert Tickets So Expensive?” as.com, July 28, 2022; A. Mahdawi, “Springsteen Tickets Are Going for a Whopping \$4,000—What Else Are We Paying Dynamic Prices For?” *The Guardian*, July 27, 2022; R. Ho, “Bruce Springsteen Fans Outraged over ‘Dynamic Pricing’ of Concert Tickets with Prices Hitting \$5,000,” *Atlanta Journal Constitution*, July 27, 2022; R. Neubecker, “The Case of the \$5,000 Springsteen Tickets,” *New York Times*, July 26, 2022; M. Spear, “Ticketmaster's ‘Dynamic Ticket Pricing’ Has Bruce Springsteen Tickets Going for \$4,000,” cbsnews.com, July 22, 2022; C. Brooks, “What Is Dynamic Pricing, and How Does It Affect E-Commerce?” business.com, June 29, 2022; B. Sisario, “Ticketmaster Plans to Use a Variable Pricing Policy,” *New York Times*, April 18, 2011; R. Friedman, “StubHub: Adele Fans Won't Get Money Back Until Singer Reschedules Shows, Can't Resell Tickets Now,” showbiz411.com, January 21, 2022.

Before you go on...

1. Describe electronic storefronts and malls.
2. Discuss various types of online services, such as securities trading, job searches, travel services, and so on.
3. Discuss online advertising, its methods, and its benefits.
4. Identify the major issues related to e-tailing.
5. What are spamming and viral marketing?

7.3 Business-to-Business (B2B) Electronic Commerce

LEARNING OBJECTIVE

Describe the three business models for business-to-business (B2B) electronic commerce.

In *business-to-business (B2B)* e-commerce, both buyers and sellers are business organizations. B2B comprises about 85 percent of EC volume. It covers a broad spectrum of applications that enable an enterprise to form electronic relationships with its distributors, resellers, suppliers, customers, and other partners. B2B applications use any of several business models. The major models are sell-side marketplaces, buy-side marketplaces, and electronic exchanges.

Sell-Side Marketplaces

sell-side marketplace B2B model in which organizations sell to other organizations from their own private e-marketplace or from a third-party site.

In the **sell-side marketplace** model, organizations sell their products or services to other organizations electronically from their own private e-marketplace website or from a third-party website. This model is similar to the B2C model in which the buyer is expected to come to the seller's site, view catalogues, and place an order. In the B2B sell-side marketplace, however, the buyer is an organization.

The key mechanisms in the sell-side model are forward auctions and electronic catalogues that can be customized for each large buyer. Sellers such as Dell Computer (www.dellrefurbished.com) use auctions extensively. In addition to conducting auctions from their own websites, organizations can use third-party auction sites like eBay to liquidate items.

The sell-side model is used by hundreds of thousands of companies. The seller can be either a manufacturer (e.g., Dell or IBM), a distributor such as Avnet (www.avnet.com), or a retailer like Grand & Toy (www.grandandtoy.com/). The seller uses EC to increase sales, reduce selling and advertising expenditures, increase delivery speed, and lower administrative costs. The sell-side model is especially suitable to customization. Many companies allow their customers to configure their orders online. For example, at Dell (www.dell.com), you can determine the exact type of computer that you want. You can choose the type of chip, the size of the hard drive, the type of monitor, and so on. Similarly, the Jaguar website (www.jaguar.com) allows you to customize the Jaguar you want. Self-customization greatly reduces any misunderstandings concerning what customers want, and it encourages businesses to fill orders more quickly.

Buy-Side Marketplaces

POM *Procurement* is the overarching function that describes the activities and processes needed to acquire goods and services. Distinct from purchasing, procurement involves the activities necessary to establish requirements, conduct sourcing activities such as market

research and vendor evaluation, and negotiate contracts. *Purchasing* refers to the process of ordering and receiving goods and services. It is a subset of the procurement process.

The **buy-side marketplace** is a model in which organizations attempt to procure needed products or services from other organizations electronically. A major method of procuring goods and services in the buy-side model is the reverse auction.

The buy-side model uses EC technology to streamline the procurement process. The goal is to reduce both the costs of items procured and the administrative expenses involved in procuring them. EC technology can also shorten the procurement cycle time.

Procurement by using electronic support is referred to as **e-procurement**. E-procurement uses reverse auctions, particularly group purchasing. In **group purchasing**, multiple buyers combine their orders so that they constitute a large volume and therefore attract more seller attention. When buyers place their combined orders on a reverse auction, they can also negotiate a volume discount. Typically, the orders of small buyers are aggregated by a third-party vendor. For example, Mohawk Medbuy is a group-purchasing platform for Canadian hospitals (www.mohawkmedbuy.ca/).

buy-side marketplace B2B model in which organizations buy needed products or services from other organizations electronically, often through a reverse auction.

e-procurement Procurement using electronic support.

group purchasing The aggregation of purchasing orders from many buyers so that a volume discount can be obtained.

Electronic Exchanges

Private exchanges have one buyer and many sellers. Electronic marketplaces (e-marketplaces), called **public exchanges** or just **exchanges**, are independently owned by a third party, and they connect many sellers with many buyers. Public exchanges are open to all business organizations. Public exchange managers provide all of the necessary information systems to the participants. Thus, buyers and sellers merely have to “plug in” in order to trade. B2B public exchanges are often the initial point of contact between business partners. Once the partners make contact, they may move to a private exchange or to private trading rooms provided by many public exchanges to conduct their subsequent trading activities.

Electronic exchanges deal in both direct and indirect materials. *Direct materials* are inputs to the manufacturing process, such as safety glass used in automobile windshields and windows. *Indirect materials* are items, such as office supplies, that are needed for maintenance, operations, and repairs (MRO).

There are three basic types of public exchanges: vertical, horizontal, and functional. All three types offer diversified support services, ranging from payments to logistics.

Vertical exchanges connect buyers and sellers in a given industry. Vertical e-marketplaces offer services that are particularly suited to the community they serve. These exchanges are frequently owned and managed by a *consortium*, a term for a group of major players in an industry. For example, Marriott and Hyatt own a procurement consortium for the hotel industry, and Chevron owns an energy e-marketplace.

Horizontal exchanges connect buyers and sellers across many industries. They are used primarily for MRO materials. Examples of horizontal exchanges are Distribution Now (www.dnow.com), Global Sources (www.globalsources.com), and Alibaba (www.alibaba.com).

HRM Finally, in *functional exchanges*, needed services such as temporary help or extra office space are traded on an “as-needed” basis. For example, ZipRecruiter (www.ziprecruiter.com) is an employment electronic exchange for job seekers and employers. At LiquidSpace (www.liquidspace.com), one can find temporary office space by the hour or month or custom offices.

public exchanges (or exchanges) Electronic marketplaces in which there are many sellers and many buyers, and entry is open to all; frequently owned and operated by a third party.

exchanges See **public exchanges**.

Before you go on...

1. Briefly differentiate between the sell-side marketplace and the buy-side marketplace.
2. Briefly differentiate among vertical exchanges, horizontal exchanges, and functional exchanges.

Ethical and Legal Issues in E-Business

LEARNING OBJECTIVE

Discuss the ethical and legal issues related to electronic commerce along with examples.

Technological innovation often forces a society to re-examine and modify its ethical standards. In many cases, the new standards are incorporated into law. In this section, you will learn about two important ethical considerations—privacy and job loss—as well as various legal issues arising from the practice of e-business.

Ethical Issues

By making it easier to store and transfer personal information, e-business presents some threats to privacy. Businesses use encryption to protect buyers' identities.

Another major privacy issue is tracking. For example, individuals' activities on the internet can be tracked by cookies (discussed in Chapter 4). Cookies store your tracking history on your personal computer's hard drive, and anytime you revisit a certain website, the server recognizes the cookie. In response, antivirus software packages routinely search for potentially harmful cookies.

In addition to compromising individual privacy, the use of EC may eliminate the need for some of a company's employees, as well as brokers and agents. The manner in which these unneeded workers, especially employees, are treated can raise ethical issues. How should a company handle layoffs? Should companies be required to retrain employees for new positions? If not, how should a company compensate or otherwise assist its displaced workers? The Closing Case for this chapter presents the opposition to how EC is changing the way we buy cars. One of the arguments against it is the number of auto workers (primarily at local dealerships) who would lose their jobs.

Another interesting ethical/legal question involves national governments. What if a government limited electronic commerce from foreign companies to favour local companies? Should customers have access to the best products or to the companies that will best support their local industry?

Legal Issues Specific to E-Commerce

Many legal issues are related specifically to e-commerce. A business environment in which buyers and sellers do not know one another and cannot even see one another creates opportunities for dishonest people to commit fraud and other crimes. These illegal actions range from creating a virtual bank that disappeared along with the investors' deposits to manipulating share prices on the internet. Unfortunately, fraudulent activities on the internet are increasing.

Fraud on the Internet Internet fraud has grown even faster than internet use itself. In one case, stock promoters falsely spread positive rumours about the prospects of the companies they touted in order to boost the share price. In other cases, the information provided might have been true, but the promoters did not disclose that they were being paid to talk up the companies. Stock promoters specifically target small investors who are lured by the promise of fast profits.

Shares are only one of many areas in which swindlers are active. Auctions are especially conducive to fraud, by both sellers and buyers. Other types of fraud include selling bogus investments, setting up phantom business opportunities, and fraudulent affiliate marketing.

IT's About Business 7.3 provides examples of recent online frauds in Canada and some tips on how to avoid falling for one.

IT's About Business 7.3

Online Fraud in Canada

Recent statistics indicate that an overwhelming majority of Canadians (96 percent) participate in online activities, with a significant portion engaging in online banking (78 percent) and managing their credit cards digitally (72 percent). Moreover, a considerable proportion (29 percent) acknowledge making substantial purchases online, including expensive items like household appliances, vacations, and vehicles. This percentage rises even higher to slightly above one in three (35 percent) among Canadians aged 18 to 34. As the number of Canadians relying on the internet for shopping and banking continues to grow, online fraudsters and criminals are adapting their strategies to exploit this trend.

According to the Canadian Anti-Fraud Centre (CAFC), over 57,000 Canadians were victims of fraud in 2022, resulting in a total loss of \$522 million. Similarly, a recent survey conducted on behalf of the Chartered Professional Accountants of Canada (CPA Canada) found that nearly half (43 percent) of Canadians claim to have been affected by fraud or scams at some point in their life. Surprisingly, the group that is primarily affected is not older Canadians (aged 55 or older), but younger people, aged 18 to 54, who report being scammed more often. According to the same report, two-thirds of Canadians between the ages of 18 and 34 have been victims of fraud at least once in their lifetime. In comparison, only one-third of Canadians aged 55 and over report being victimized by fraud ever. Among the types of fraud, credit card fraud is the most reported (21 percent), followed by debit card fraud (8 percent) and online phishing scams (8 percent).

Common types of online e-commerce frauds include investment fraud such as cryptocurrency investments, online dating scams, the puppy scam, rental scams, and online product scams. In the puppy scam, puppies are advertised for sale online, and when the shopper pays for a puppy and tries to pick it up, they realize that the address is fake. In the online product scam, shoppers buy an item from a website, but when payment is made, the product is never delivered, or if it is, it is something different from what was originally bought. Rental scams involve a property (house, apartment, commercial space) that is listed online as available for rent, but after making the first payment, the renter arrives to find a property that is already occupied by another person or business. These are all common types of online frauds involving e-commerce. Extortion scams are another common kind of online fraud that costs Canadians millions each year. These include the Canadian Revenue Agency (CRA) scam, where the recipient is told that they need to pay the CRA for taxes due; the Canada Border Services Agency (CBSA) email scam, where victims are asked to make a payment to the CBSA in order to remain in Canada; and the grandparent scam, where perpetrators pose as a close family member in an emergency such as a car accident or a medical episode and ask for a payment transfer to be made to them urgently. All these scams involve an intimidating phone call or email claiming that something has gone wrong, and if payment is not made, there will be negative consequence.

In response to the rise of online fraud among financial institutions, the Canadian Bankers Association (CBA), in collaboration

with the Government of Canada, has launched a series of fraud prevention websites to help individuals, small businesses, and older adults protect themselves against common frauds (www.cba.ca/cyber-security-toolkit). The website for individuals includes, among other things, simple guidelines to identify fake websites and deceptive retailer apps when doing online shopping. Small businesses have their own set of resources as well, which include tips for business owners and managers on how to protect their companies from having their business email compromised, avoidance of and response to ransomware attacks, security best practices for employees, and how to safeguard customer information and data. The website for older adults (www.cba.ca/fraud-prevention-toolkit-older-adults) contains tips and resources designed to help seniors protect themselves against financial abuse and scams such as phone fraud, the grandparent scam, and tech support scams. For example, it educates older adults on how to set strong passwords to prevent financial abuse while online.

As e-commerce continues to grow and play a more significant role in our lives, individuals and businesses need to stay vigilant and educate themselves about existing and potential online frauds. Online resources, such as the CBA anti-fraud toolkits, are a great resource to keep current and to protect ourselves from online fraud. Lastly, one final word of advice: if you notice any form of unauthorized activity in your online transactions, you should immediately report it to your financial institution, your local police service, and the Canadian Anti-Fraud Centre.

Questions

1. Compare the CAFC toolkit for small businesses and Shopify's e-commerce fraud prevention tips. Prepare a report describing the differences. Which one is more comprehensive?
2. Review the CAFC toolkit for small businesses and identify three additional ways in which small businesses can protect themselves against e-commerce fraud.
3. What role do information systems controls play in protecting against e-commerce fraud? Provide three examples to support your answer.

Sources: Compiled from L. Y. Guides, "Ecommerce Fraud Prevention Tips Every Merchant Should Know," *Shopify*, shopify.com, June 16, 2022; J. Dondo, "Fraud Losses in Canada Hit New All-Time High," *Wealth Professional*, March 1, 2023; R. DeMontis, "Family Emergency Crisis Latest Internet Scam Targeting Canadians across the Country," *Toronto Sun*, March 23, 2023; M. Labrèche, "Canadian Bankers Association Launches Fraud Prevention Toolkits to Help Canadians Combat Scams," March 9, 2023; M. Lajarte, "4 Top Scams Currently Making the Rounds—and How to Avoid Them," *CPA Canada*, March 9, 2023; D. Charbonneau, "The Top 10 Riskiest Scams for Canadians to Watch Out For," *CTV News Ottawa*, March 6, 2023; "Fraud Is Too Common in Canada: Nearly Half (43%) of Canadians Have Knowingly Been Victimized by Fraud or Scams, in Their Lifetime," *Ipsos*, February 17, 2023; D. Otis, "Canadian Border Agency Issues New Scam Warning," *CTV News*, January 25, 2022.

MIS **MKT** **Fraudulent Affiliate Marketing** *Affiliate marketing* involves a merchant paying a commission to other online entities, known as affiliates, for referring new business to the merchant's website. Affiliates are paid only when their marketing efforts actually result in a transaction, such as a customer registration, a completed lead form, a new free trial user, a new newsletter subscriber, or a product sale.

Affiliates do promote legitimate businesses, such as Amazon and eBay, but they are also behind many of the misleading and fraudulent ads that appear on Facebook, Instagram, Twitter, Google, and the rest of the internet. *Affiliate fraud* refers to false or unscrupulous activity conducted to generate commissions from an affiliate marketing program. Consider the following example.

A manufacturer of a fake nutritional supplement wants to sell it and does not care how the sales actually take place. The vendor approaches an affiliate network and offers to pay a commission per customer sign-up. The network spreads the word to affiliates, who design often misleading ads and pay to place them on various websites in hopes of earning commissions. The affiliates take the risk, paying to run ads without knowing if they will work. However, if even a small percentage of the people who see the ads become buyers, the profits could be substantial.

Affiliates once had to guess what kind of person might fall for their ads, targeting users by age, geography, or interests. Today, Facebook's analytics tools do the targeting for them automatically.

Facebook tracks who clicks on ads as well as who buys particular products, then starts targeting others whom its algorithms predict should be shown the ads because they are likely to buy. Affiliates typically lose money for a few days as Facebook gathers data through trial and error, and then their sales rapidly increase.

A software program called Voluum enables affiliates to track their campaigns and defeat the ad networks' defences. The software can track marketing campaigns across multiple platforms, such as Facebook, Google, X (formerly Twitter), and other websites. Voluum enables affiliates to tailor the content they deliver according to a number of factors, including the location or IP address associated with a user. The feature is useful for ad targeting—for example, showing Spanish speakers a message in their native language.

Facebook must police a US \$40-billion annual ad platform that malicious players are constantly trying to subvert. Its reviewers examine ads that users or Facebook algorithms have flagged as questionable and ban accounts that break the rules. However, Voluum makes it easy for affiliates to identify the addresses of Facebook's ad reviewers and program campaigns to show them, and only them, legitimate content. This process is called *cloaking*. Interestingly, Google has banned Voluum based on cloaking concerns, but Facebook has not.

Affiliates who are caught and banned can easily circumvent this problem. They simply open new Facebook accounts under different names. Some affiliates buy clean profiles from "farmers." Others rent accounts from strangers or make deals with underhanded advertising agencies to find other solutions.

The Canadian Anti-Fraud Centre, which is part of the Government of Canada (www.antifraudcentre-centreantifraude.ca) and the U.S. Federal Trade Commission (FTC; www.ftc.gov) regularly publishes examples of scams that are most likely to be spread by email or to be found on the Web. Let's look at some ways in which consumers and sellers can protect themselves from online fraud.

As online retail sales continue to grow and are projected to reach \$157 billion in Canada by 2026, the risk for potential fraud is also on the rise. According to a recent report, about 80 percent of fraud occurs online, over the phone, or through the mail, although only a fraction of it gets reported to the authorities. In 2022, Canadians were scammed for a reported \$530 million, according to the RCMP.

Among all types of e-commerce fraud, stealing credit card numbers is one of the most common. Cybercriminals often buy stolen North American credit card information online. The criminals then use these credit card numbers to buy expensive items, such as electronics and car parts, online.

Credit card companies have been working hard to catch up with fraudsters and now use different types of technology and data analysis to identify a potential online fraud. For

example, Visa Canada offers fraud prevention services to online retailers that help them identify potentially fraudulent online transactions, such as the following:

- Unusually large-value orders.
- High numbers of the same product.
- Orders for products that are easily convertible to cash (such as big-screen TVs).
- Orders for high-cost items.
- Orders for rush or overnight delivery.
- Multiple shipping addresses attached to one card.
- Shipping address different than billing address.
- One IP address but the customer has different names, addresses, and card numbers.
- Repeat orders from one card within a short time.

Since the cost of online fraud is ultimately paid by the seller, e-commerce retailers should become familiar with the various fraud prevention tools and tactics. Lastly, anyone who thinks they have been contacted by a scammer can report it to the Canadian Anti-Fraud Centre (www.antifraudcentre-centreantifraude.ca) or on the Better Business Bureau's Scam Tracker website (www.bbb.org/scamtracker).

Domain Names Another legal issue is competition over domain names. Domain names are assigned by central non-profit organizations that check for conflicts and possible infringement of trademarks. Obviously, companies that sell goods and services over the internet want customers to be able to find them easily. In general, the closer the domain name is to the company's name, the easier the company is to locate.

A domain name is considered legal when the person or business who owns the name has operated a legitimate business under that name for some time. Companies such as Christian Dior, Nike, Deutsche Bank, and even Microsoft have had to fight or pay to acquire the domain names that correspond to their company names. Consider the case of Delta Air Lines: Delta originally could not obtain the internet domain name delta.com because Delta Faucet had already purchased it. Delta Faucet had been in business under that name since 1954, so it had a legitimate business interest in using that domain name. Delta Air Lines had to settle for delta-airlines.com until it bought the domain name from Delta Faucet. Delta Faucet is now at deltafaucet.com.

Cybersquatting *Cybersquatting* refers to the practice of registering or using domain names for the purpose of profiting from goodwill or a trademark that belongs to someone else. In Canada, a domain name is protected as a trademark and is therefore governed by the Canadian Trademarks Act (1985). In the United States, the Anti-Cybersquatting Consumer Protection Act (1999) permits trademark owners to sue for damages in such cases.

However, some practices that could be considered cybersquatting are not illegal, although they may well be unethical. Perhaps the most common of these practices is "domain tasting." Domain tasting lets registrars profit from the complex money trail of pay-per-click advertising. The practice can be traced back to the policies of the organization responsible for regulating Web names, the Internet Corporation for Assigned Names and Numbers (ICANN) (www.icann.org). In 2000, ICANN established the five-day "Add Grace Period" during which a company or person can claim a domain name and then return it for a full refund of the registry fee. ICANN implemented this policy to allow someone who had mistyped a domain to return it without cost. In some cases, companies engage in cybersquatting by registering domain names that are very similar to their competitors' domain names in order to generate traffic from people who misspell Web addresses.

Domain tasters exploit this policy by claiming internet domains for five days at no cost. These domain names frequently resemble those of prominent companies and organizations. The tasters then jam these domains full of advertisements that come from Yahoo! and Google. Because this process involves zero risk and 100-percent profit margins, domain tasters register millions of domain names every day—some of them over and over again. Experts estimate

that registrants ultimately purchase less than 2 percent of the sites they sample. In the vast majority of cases, they use the domain names for only a few days to generate quick profits.

FIN ACCT Taxes and Other Fees In retail sales in brick-and-mortar stores, Canadian consumers need to pay federal and provincial taxes within their jurisdiction. For online sales, Canadian consumers pay federal tax and provincial tax according to the province where the goods are delivered. As a general rule in Canada, it is the e-commerce retailer's responsibility to collect the federal and provincial taxes that correspond to the buyer's address. For example, when Amazon.ca sells to a customer in Montreal, it is required to collect the federal Goods and Services Tax (GST) and the Quebec Sales Tax (QST). In some provinces, such as Ontario and Nova Scotia, federal and provincial taxes are combined into a single Harmonized Sales Tax (HST).

In addition to the sales tax, there is a question about where—and in some cases, whether—electronic sellers should pay business licence taxes, franchise fees, gross receipts taxes, excise taxes, privilege taxes, and utility taxes. Furthermore, how should tax collection be controlled? Legislative efforts to impose taxes on e-commerce are opposed by an organization named the Internet Freedom Fighters.

Even before electronic commerce over the internet emerged, the basic law in the United States was that, as long as a retailer did not have a physical presence in the state where the consumer was shopping, that retailer did not have to collect sales tax. Shoppers were supposed to track such purchases and then pay the taxes owed in their annual tax filings. Few people, however, did this or were even aware of their obligation. The result was that online retailers were able to undercut the prices of their non-internet competitors (e.g., brick-and-mortar stores) for years.

Copyright Recall from Chapter 4 that intellectual property is protected by copyright laws and cannot be used freely. This point is significant because many people mistakenly believe that once they purchase a piece of software, they have the right to share it with others. In fact, what they have bought is the right to *use* the software, not the right to *distribute* it. That right remains with the copyright holder. Similarly, copying material from websites without permission is a violation of copyright laws. Protecting intellectual property rights in e-commerce is extremely difficult, however, because it involves hundreds of millions of people in 200 countries with differing copyright laws who have access to billions of Web pages.

Before you go on...

1. List and explain some ethical issues in EC.
2. Discuss the major legal issues associated with EC.
3. Describe buyer protection and seller protection in EC.

What's in IT for me?

ACCT For the Accounting Major

Accounting personnel are involved in several EC activities. Designing the ordering system and its relationship with inventory management requires accounting attention. Billing and payments are also accounting activities, as are determining cost and profit allocation.

Replacing paper documents with electronic ones will affect many of the accountant's tasks, especially the auditing of EC activities and systems. Finally, building a cost-benefit and cost-justification system to determine which products and services to take online and creating a chargeback system are critical to the success of EC.

FIN For the Finance Major

The worlds of banking, securities and commodities markets, and other financial services are being reengineered because of EC. Online securities trading and its supporting infrastructure are growing more rapidly than any other EC activity. Many innovations already in place are changing the rules of economic and financial incentives for financial analysts and managers. Online banking, for example, does not recognize national boundaries, and it may create a new framework for financing global trades. Public financial information is now accessible in seconds. These innovations will dramatically transform the manner in which finance personnel operate.

MKT For the Marketing Major

EC has brought about a major revolution in marketing and sales. Perhaps its most obvious feature is the transition from a physical to a virtual marketplace. Equally important, however, is the radical transformation to one-on-one advertising and sales and to customized and interactive marketing. Marketing channels are being combined, eliminated, or recreated. The EC revolution is creating new products and markets while significantly altering existing ones. Digitization of products and services also has implications for marketing and sales. The direct producer-to-consumer channel is expanding rapidly and is fundamentally redefining the nature of customer service. As the battle for customers intensifies, marketing and sales personnel are becoming the most critical success factor in many organizations. Online marketing can be a blessing to one company and a curse to another.

POM For the Production/Operations Management Major

EC is transforming the manufacturing system from product-push mass production to order-pull mass customization. This transformation

requires a robust supply chain, information support, and reengineering of processes that involve suppliers and other business partners. Suppliers can use extranets to monitor and replenish inventories without having to constantly reorder. The internet and intranets also help reduce cycle times. Many production/operations problems that have persisted for years, such as complex scheduling and excess inventories, are being solved rapidly with the use of Web technologies. Companies can now use external and internal networks to find and manage manufacturing operations in other countries much more easily. Also, the Web is reengineering procurement by helping companies conduct electronic bids for parts and subassemblies, thus reducing costs. All in all, the job of the progressive production/operations manager is closely tied in with e-commerce.

HRM For the Human Resource Management Major

HR majors need to understand the new labour markets and the impacts of EC on old labour markets. The HR department can also use EC tools for such functions as procuring office supplies. Moreover, becoming knowledgeable about new government online initiatives and online training is critical. HR personnel must also become familiar with the major legal issues related to EC and employment.

For the MIS Major

The MIS function is responsible for providing the information technology infrastructure necessary for electronic commerce to function. This infrastructure includes the company's networks, intranets, and extranets. The MIS function is also responsible for ensuring that e-commerce transactions are secure.

Summary

7.1 Describe the eight common types of electronic commerce.

In *business-to-consumer (B2C)* electronic commerce, the sellers are organizations and the buyers are individuals.

In *business-to-business (B2B)* electronic commerce, the sellers and the buyers are businesses.

In *consumer-to-consumer (C2C)* electronic commerce, an individual sells products or services to other individuals.

In *business-to-employee (B2E)* electronic commerce, an organization uses EC internally to provide information and services to its employees.

E-government is the use of internet technology in general and e-commerce in particular to deliver information and public services to citizens (called government-to-citizen or G2C EC) and business partners and suppliers (called government-to-business or G2B EC).

Mobile commerce refers to e-commerce that is conducted entirely in a wireless environment.

Social commerce refers to the delivery of electronic commerce activities and transactions through social computing.

Conversational commerce refers to electronic commerce using messaging and chat apps to offer a daily choice, often personalized, of a meal, product, or service.

We leave the examples of each type to you.

7.2 Describe the various online services of business-to-consumer (B2C) commerce, along with specific examples of each.

Fintech is an industry composed of companies that use technology to compete in the marketplace with traditional financial institutions and intermediaries in the delivery of financial services, which include banking, insurance, real estate, and investing.

Online securities trading involves buying and selling securities over the Web.

Online job matching over the Web offers a promising environment for job seekers and for companies searching for hard-to-find employees. Thousands of companies and government agencies

advertise available positions, accept resumés, and take applications on the internet.

Online travel services allow you to purchase airline tickets, reserve hotel rooms, and rent cars. Most sites also offer a fare-tracker feature that sends you email messages about low-cost flights. The internet is an ideal place to economically plan, explore, and arrange almost any trip.

Online advertising over the Web makes the advertising process media-rich, dynamic, and interactive.

We leave the examples to you.

7.3 Describe the three business models for business-to-business (B2B) electronic commerce.

In the *sell-side marketplace* model, organizations attempt to sell their products or services to other organizations electronically from their own private e-marketplace website or from a third-party website. Sellers such as Dell Computer (www.dellrefurbished.com) use sell-side auctions extensively. In addition to auctions from their own websites, organizations can use third-party auction sites, such as eBay, to liquidate items.

The *buy-side marketplace* is a model in which organizations attempt to buy needed products or services from other organizations electronically.

E-marketplaces, in which there are many sellers and many buyers, are called *public exchanges*, or just exchanges. Public exchanges

are open to all business organizations. They are frequently owned and operated by a third party. There are three basic types of public exchanges: vertical, horizontal, and functional. *Vertical exchanges* connect buyers and sellers in a given industry. *Horizontal exchanges* connect buyers and sellers across many industries. In *functional exchanges*, services such as temporary help or extra office space are traded on an as-needed basis.

7.4 Discuss the ethical and legal issues related to electronic commerce along with examples.

E-business presents some threats to privacy. First, most electronic payment systems know who the buyers are. It may be necessary, then, to protect the buyers' identities with encryption. Another major privacy issue is tracking, through which individuals' activities on the internet can be tracked by cookies.

The use of EC may eliminate the need for some of a company's employees, as well as brokers and agents. The manner in which these unneeded workers, especially employees, are treated can raise ethical issues. How should a company handle layoffs? Should companies be required to retrain employees for new positions? If not, how should they compensate or otherwise assist displaced workers?

We leave the examples up to you.

Key Terms

auction 206	electronic commerce (EC or e-commerce) 200	forward auctions 206
brick-and-mortar organizations 201	electronic mall 210	group purchasing 221
business model 205	electronic marketplace 206	multichannelling 217
buy-side marketplace 221	electronic payment mechanisms 206	public exchanges 221
channel conflict 216	electronic retailing (e-tailing) 209	reverse auctions 206
clicks-and-mortar organizations 201	electronic storefront 210	sell-side marketplace 220
disintermediation 210	exchanges 221	spamming 215
e-procurement 221	fintech 210	virtual (or pure play) organizations 201
electronic business (e-business) 201		

Discussion Questions

1. Discuss the major limitations of e-commerce. Which of these limitations are likely to disappear? Why?
2. Discuss the reasons for having multiple EC business models.
3. Distinguish between business-to-business forward auctions and buyers' bids for RFQs.
4. Discuss the benefits to sellers and buyers of a B2B exchange.
5. What are the major benefits of G2C electronic commerce?
6. Discuss the various ways to pay online in B2C. Which method(s) would you prefer and why?
7. Why is order fulfillment in B2C considered difficult?
8. Discuss the reasons for EC failures.
9. Should Canadian company Bombardier Recreational Products (www.brp.com) sell online? Hint: Take a look at the discussion of channel conflict in this chapter.
10. In some cases, individuals engage in cybersquatting so that they can sell the domain names to companies expensively. In other cases, companies engage in cybersquatting by registering domain names that are very similar to their competitors' domain names in order to generate traffic from people who misspell Web addresses. Discuss each practice in regard to its ethical nature and legality. Is there a difference between the two practices? Support your answer.
11. Do you think information technology has made it easier to do business? Or has it only raised the bar on what is required to be able to do business in the twenty-first century? Support your answer with specific examples.
12. With the rise of electronic commerce, what do you think will happen to people without computer skills, internet access, computers, smartphones, and so on? Will they be able to survive and advance by hard work?

Problem-Solving Activities

1. Assume you are interested in buying a car. You can find information about cars at numerous websites. Access five websites for information about new and used cars, financing, and insurance. Decide which car you want to buy. Configure your car by going to the car manufacturer's website. Finally, try to find the car from www.autotrader.ca or www.usedcarscanada.com. What information is most supportive of your decision-making process? Write a report about your experience.
2. Compare the various electronic payment methods. Specifically, collect information from the vendors cited in this chapter and find additional vendors using Google. Pay attention to security level, speed, cost, and convenience.
3. Conduct a study on selling diamonds and gems online. Access such sites as www.bluenile.com, www.jtv.com, www.tiffany.com, and www.jewelryexchange.com.
 - a. What features do these sites use to educate buyers about gemstones?
 - b. How do these sites attract buyers?
 - c. How do these sites increase customers' trust in online purchasing?
 - d. What customer service features do these sites provide?
4. Access www.nacha.org. What is NACHA? What is its role? What is the ACH? Who are the key participants in an ACH e-payment? Describe the "pilot" projects currently under way at ACH.
5. Access www.tsn.com. Identify at least five different ways the site generates revenue.
6. Access www.queendom.com. Examine its offerings and try some of them. What type of electronic commerce is this? How does this website generate revenue?
7. Access www.ediets.com. Prepare a list of all the services the company provides. Identify its revenue model.
8. Access www.theknot.com. Identify the site's revenue sources.
9. Access www.mint.com. Identify the site's revenue model. What are the risks of giving this website your credit and debit card numbers, as well as your bank account number?
10. Enter www.alibaba.com. Identify the site's capabilities. Look at the site's private trading room. Write a report. How can such a site help a person who is making a purchase?
11. Enter www.grubhub.com. Explore the site. Why is it so successful? Could you start a competing site? Why or why not?
12. Enter www.dell.com, go to "Desktops," and configure a system. Register for "My Cart" (no obligation). What calculators are used there? What are the advantages of this process as compared with buying a computer in a physical store? What are the disadvantages?
13. Enter www.chime.com and www.wealthsimple.com to identify their services. Prepare a report.
14. Access various travel sites such as www.travelocity.com, www.orbitz.com, www.expedia.com, and www.kayak.com. Compare these websites for ease of use and usefulness. Note differences among the sites. If you ask each site for an itinerary, which one gives you the best information and the best deals?

Closing Case

Direct Electric Vehicle (EV) Sales via E-Commerce

Amazon taught us that many of the sales channels we were accustomed to were unnecessary. Removing the middleman—that is, the local store—was possible for thousands of products. And customers still made an educated purchase. Online merchants could reach customers far separated from them geographically while lowering costs and increasing profits. It is interesting that a similar development occurred around the turn of the nineteenth century when Sears & Roebuck introduced its mail-order catalogue system. Suddenly, customers had access to thousands of products within a few weeks.

Significantly, the cover of the Fall 1900 Sears & Roebuck catalogue contained the following words: "This book tells just what your storekeeper at home pays for everything he buys and will prevent him from overcharging you on anything you buy from him." Apparently, the company believed it could increase its profits while decreasing costs to the consumer.

A similar scenario is emerging today in the automotive industry. Electric vehicle (EV) manufacturers want to sell directly to consumers to reduce costs, perhaps as much as US \$2,000 per vehicle. Still, several factors are hindering this move to e-commerce for

the entire industry. Perhaps the major factor is opposition from the middlemen—in this case, local dealerships.

It isn't that the auto industry hasn't embraced e-commerce. Customers regularly shop online for new and used vehicles, schedule appointments with sales and service personnel, and order parts. Companies like Carvana and Vroom even allow customers to order used vehicles online and have them shipped directly to their address. However, in the United States auto manufacturers cannot utilize e-commerce to sell directly to consumers. Most state laws require manufacturers to sell to dealerships, which then sell to the customer. However, most EV companies want to fully embrace e-commerce and bypass the dealer to work directly with the customer.

Let's examine this issue from the following perspectives:

1. Understanding the industry's history will provide the context for current laws and regulations that hinder the shift to e-commerce.
2. Examining examples to determine if direct, manufacturer-to-consumer purchases are possible and, if so, are preferred.
3. Finally, presenting some concluding thoughts about the future of e-commerce in the EV industry.

Industry History and Politics

Early in the automotive era, three manufacturers—General Motors, Ford, and Chrysler—were so dominant that their market control allowed them to impose unfair conditions. These companies had allowed independent dealers to carry their vehicles, while they simultaneously developed corporate-owned dealerships, which enabled them to sell directly to customers. A corporate-owned dealership could beat the independent dealers on price because it was a direct sale, effectively making more money for the manufacturer.

In response, car dealerships in the United States urged state lawmakers to pass laws preventing the manufacturers from creating corporate-owned dealership networks that would control the market. And in fact, lawmakers passed laws to protect the dealerships by making direct sales illegal. Although these measures protected the dealerships, they did not serve customers, who would have benefited from the lower prices. Significantly, many of these laws are still in effect. Unlike nearly every other consumer good, you can't visit an auto manufacturer's website, customize a car, and have it delivered. Instead, a dealership is legally required to act as a middleman.

For many years, dealerships were a kind of local monopoly. You went to your one local Ford dealer if you wanted a Ford truck. Dealerships became influential in their communities by sponsoring everything from local baseball teams to fundraisers and, of course, by donating to local and state politicians. Not surprisingly, they utilized this influence to lobby against attempts to change the legal protection they enjoyed. For example, Ford attempted to establish a retail network in the late 1990s but abandoned the effort after running into strong resistance from independent dealerships. Ultimately, the independent dealerships won, and direct, manufacturer-to-consumer auto sales have been illegal for many years in the United States.

Today, start-up vehicle manufacturers—primarily EV manufacturers like Tesla and Rivian—are lobbying states to repeal these laws. For example, consider the case of Georgia, which is home to a \$5-billion Rivian plant. In 2022, a bill to allow EV manufacturers to sell directly to consumers never made it out of committee. Opponents argued that the economic benefits these companies would obtain would not stay in the states that generated the sales, as they do with franchised dealers. The Automobile Dealers Association of Georgia (gada.com) put it this way: "Ultimately, direct sales by manufacturers will mean dealerships closing and a loss of jobs for hard-working Georgians." Advocates for the bill responded that consumer choice and free-market values should take priority over the interests of dealerships and state tax dollars. Despite their efforts, however, Georgia consumers still cannot purchase a Rivian directly.

In a similar scenario, the United Service Workers Union (USWU) and United Auto Workers (UAW), who represent automotive workers, urged state lawmakers in New York to reject a 2022 proposal to allow manufacturers to sell EVs direct-to-consumer. They also cited concerns that this bill would undercut a traditional business model that benefited manufacturers, dealers, and workers.

Selling Directly to the Consumer

Consumers are the ones who lose out when this happens. EV manufacturers do not sell the same volume of vehicles as traditional gas- or diesel-powered vehicle makers. Customers have to drive to pick up their vehicles, or pay shipping from the states that allow the sale (some states allow sales if the manufacturer has a physical presence in the state).

Despite the challenges, Rivian sells most of its vehicles online from five company-owned stores that serve as showrooms and warranty service locations. The company processes its online transactions in Illinois, the site of its first factory, and ships vehicles directly to the buyer.

Tesla sells its EVs directly to consumers through its website or through its network of showrooms. The purchase is still direct with the manufacturer, but the experience can include a local facility.

Despite the history, politics, and changing business models required to make direct EV sales a reality, change is happening. Consumers are voting with their wallets in spite of the additional cost associated with picking up or having their vehicle delivered. In 2020, 80 percent of electric vehicles were sold through direct sales.

As this market continues to advance, more car buyers may feel at ease buying a car they haven't even seen, let alone driven. Still, most buyers will always want to experience a car first-hand and take it on a test run before making such an important purchase.

There are no laws in Canada prohibiting the direct sale of new cars to consumers. However, automakers do not sell new cars directly to consumers, they only sell through dealerships. There are a few Canadian websites selling new cars online. For example, www.clutch.ca and www.cardoor.ca are two Canadian start up companies selling new and used cars online. These companies are independent from car manufacturers, but they partner with specific auto dealerships in order to sell new cars directly to consumers.

The Future

Independent auto dealers have been a fixture of American life since the early twentieth century. They did the complex and expensive work of finding customers, advertising in specific markets, and servicing customers. When you work hard to establish a system, you are wary of introducing fundamental changes to that system.

When your business methods work, even your competitors will copy you. For example, General Motors is expanding in China, following Tesla's playbook. Rather than negotiate with the Chinese government for dealership protection, the company plans to launch a direct sales platform named Durant Guild.

GM plans for Durant Guild to operate just as Tesla does. It will sell directly to buyers but through showroom events. Durant Guild's purpose is not necessarily to sell large volumes of vehicles. Rather, it is intended to generate interest in GM's cars.

What does the future hold for the automotive market? One thing seems inevitable. Whether they are purchased online and received as a delivery, bought partially online and picked up at a dealer, or sold across a state line, it seems that direct sales of EVs represent the future.

Questions

1. Analysts believe that manufacturers selling directly to consumers could lower overall costs by US \$2,000 per vehicle. In your opinion, do these savings justify such a dramatic shift in the industry?
2. List and explain the factors that have protected dealerships for so many years.
3. What reasons do the dealership and unions give for opposing the direct sales of EVs through e-commerce? Are these reasons valid? Support your answer.
4. Can you think of an omnichannel approach to EV sales that would make use of the brick-and-mortar dealerships?

Sources: Compiled from D. Mihalascu, “Three-Quarters of EV Shoppers Prefer to Buy at Dealerships: Survey,” *InsideEVs.com*, September 27, 2022; J. Zurschmeide, “Buying an EV May Be New, but Customers Cling to Tradition,” *The Detroit Bureau*, September 26, 2022; D. Kenny, “Banning of Direct Electric Vehicle Sales Only Helps Car Dealers,” *Real Clear Markets*, September 23, 2022; J. Lancaster, “Ford’s EV Charger Mandate Shows How Broken Dealership Laws Are,” *Reason.com*, September 20, 2022; S. McLain, “The Man from Rivian Who Wants to Change How We Buy Cars,” *The Wall Street Journal*, September 17, 2022; S. Loveday, “GM To Launch Tesla-Style Direct Sales Model in China,” *InsideEVs.com*, September 9, 2022; R. Walker, “GM Copies Tesla; To Set Up Direct-to-Consumer Sales Channel in China,” *Drive Tesla Canada*, September 8, 2022; L. Lowery, “State Support Not Unanimous as EV OEM Sales & Repair Sites Expand,” *Repairer Driven News*, June 22, 2022;

F. Lambert, “Tesla Is Aiming to Improve Service and Make Majority of Appointments Same-Day Repairs,” June 6, 2022; N. Reisman, “UAW Workers: Reject Expansion of Direct Sales for Electric Vehicle Makers,” *Spectrum News 1*, May 11, 2022; T. Spigolon, “Legislation for Direct Sales of EVs Faces Rough Road in General Assembly,” *The Covington News*, March 23, 2022; J. Crider, “Georgia Tells Rivian: You Can’t Sell Electric Trucks Here,” *CleanTechnica.com*, March 21, 2022; P. Stenquist, “Why You Might Buy Your Next Car Online,” *The New York Times*, June 21, 2022; S. Pruitt, “When the Sears Catalog Sold Everything from Houses to Hubcaps,” *History*, <https://www.history.com/news/sears-catalog-houses-hubcaps>, accessed September 29, 2022; Mackinac Center for Public Policy, “Direct Sales of Electric Vehicles,” <https://www.mackinac.org/archives/2021/The%20Case%20for%20Direct%20Sales%20—%20March%202021%20Update.pdf>, accessed September 29, 2022.

Wireless, Mobile Computing, and Mobile Commerce

CHAPTER OUTLINE

LEARNING OBJECTIVES

8.1 Wireless Technologies

8.1 Identify the advantages and disadvantages of wireless devices and each of the three main types of wireless transmission media.

8.2 Wireless Computer Networks and Internet Access

8.2 Explain how businesses can use short-range, medium-range, and long-range wireless networks.

8.3 Mobile Computing and Mobile Commerce

8.3 Provide a specific example of how each of the five major m-commerce applications can benefit a business.

8.4 The Internet of Things

8.4 Describe the Internet of Things, and provide examples of how organizations can use the Internet of Things.

Opening Case

MIS Bridging the Gap: Satellite Technology Provides Broadband Access to First Nations Communities in Canada

High-speed internet access in Indigenous communities in Canada still lags significantly behind the national average. A 2021 report by the Auditor General of Canada revealed that nearly 91 percent of households across Canada had internet access that met the federal government's minimum connection speed targets—50 megabits per second for downloading and 10 megabits per second for uploading (50/10 Mbps). However, this figure dropped to approximately 60 percent for households in rural and remote areas, and a mere 43 percent for households in First Nations communities in Canada.

This discrepancy in connectivity has important implications for First Nations communities, as it hampers their participation in the digital economy and restricts access to crucial services such as remote health care, e-commerce, and education. The disparity in connectivity is particularly pronounced in Manitoba, where a

mere 15 percent of households in First Nations communities have access to the minimum target speeds (50/10 Mbps). This means that approximately five out of every six households in these communities lack high-speed internet.

To address this gap, in 2022 the Government of Canada announced a \$100-million investment over five years to provide internet connectivity using satellite technology. This initiative involves a partnership with Telesat, a Canadian-based company that is developing low-Earth-orbit satellites to expand high-speed internet access in rural and remote regions. Satellite technology is well suited for First Nations communities due to its ease of installation and cost-effectiveness compared to complex fibre-optic infrastructures, which often require extensive cable laying. With satellite technology, remote communities, including those located in valleys, can easily establish reliable internet connections using a satellite dish antenna to connect wirelessly to the satellite network. According to Telesat's website, its state-of-the-art satellite constellation involves low-Earth-orbit satellites—approximately 1,000 km from the planet's surface—to provide high-speed connectivity in rural and remote communities worldwide.

In addition to Telesat, other satellite internet providers are also investing in high-speed internet for First Nations communities. For example, Starlink, a do-it-yourself internet service operated by SpaceX, Elon Musk's spacecraft company, is enabling 127 homes in the Muscowpetung Saulteaux Nation, located 45 km northeast of Regina, Saskatchewan, to access high-speed internet through its satellite internet service. Starlink's network consists of 3,200 low-Earth-orbit satellites. The 127 homes will receive Starlink satellite dishes, enabling them to obtain high-speed, low-latency internet service at prices comparable to existing packages.

Starlink is also providing reliable high-speed internet to residents in Nunavut and the Northwest Territories. Users in these areas can now engage in Zoom and Teams calls, online learning, high-definition streaming on platforms like Netflix, and video games, all at speeds comparable to home cable internet services. According to Starlink's website, it recently expanded its coverage to include far northern communities such as Yellowknife, Rankin Inlet, and Iqaluit, with plans to cover Canada's three territories and Alaska in full in 2023.

In the near future, OneWeb, a UK-based company, will also offer high-speed internet based on a low-Earth-orbit satellite network. However, OneWeb distinguishes itself from Starlink by primarily targeting governments, larger businesses, and resellers, rather than individual consumers or households. In addition, its installation and operation require more technical proficiency. The combined coverage of OneWeb and Starlink will provide remarkably fast and cost-effective internet connectivity to every corner of the Northwest Territories, Nunavut, Yukon, and Alaska.

While high-speed satellite internet presents a promising solution, it faces certain obstacles. Affordability is a notable challenge, as the initial cost of a Starlink satellite dish, priced at \$759, is inaccessible for many people. Moreover, Starlink's monthly charges significantly exceed those of equivalent fibre-optic internet packages available nationwide. For instance, in Inuvik, Starlink offers download speeds ranging from 50 to 200 Mbps, along with unlimited data, but at a cost of \$140 per month. In comparison, TELUS in Vancouver provides the same service for \$95, highlighting the substantial price disparity.

Moreover, satellite technology sometimes encounters reliability issues. In 2022, a Telesat satellite providing phone and internet services to eight Northwest Territories communities unexpectedly ceased operations three years earlier than anticipated. Consequently, the affected communities faced urgent challenges in seeking alternative solutions. Concerns also arise regarding the durability of satellite dishes in the harsh Arctic conditions, where temperatures can plummet to -40°C and fierce winds can reach speeds of 80 km per hour. Additionally, when internet connectivity is disrupted, the lack of local expertise means that specialists must be brought in to address the problem, leading to logistical challenges. Furthermore, contacting and communicating with satellite internet service providers can prove challenging for users. For instance, Starlink's media line is automated, directing callers to send an email for inquiries and support.

Critics attribute the lack of high-speed internet in First Nations communities to the telecommunications industry, particularly large telecom companies that prioritize projects based on perceived profitability. They argue that these companies tend to overlook the needs of First Nations communities in remote rural areas due to the higher costs involved in constructing telecommunication infrastructure in such locations. Consequently, some

communities feel neglected or underserved by the telecom industry's focus on more lucrative ventures.

The implementation of new projects to reduce the high-speed internet gap in First Nations communities often faces lengthy bureaucratic processes and the need to adapt to changing circumstances. Despite the availability of \$2.4 billion in government-led initiatives in 2022, only 40 percent of the funding had been utilized as of January 2023. Delays in expenditure can be attributed to various factors, including administrative procedures, regulatory requirements, and evolving conditions. The Kuhkenah Network, an internet service provider owned and operated by First Nations, serves as a concrete example: it faced a four-year wait from funding approval to the actual establishment of connectivity. During this period, the network incurred higher costs due to inflation, further complicating the situation.

Critics also raise concerns regarding the process of assigning the wireless telecommunications spectrum, which they believe favours large telecom companies over smaller internet service providers (ISPs). In response, some First Nations communities are urging the Government of Canada to adopt a similar approach to the U.S. government in 2020, by calling for the prioritized allocation of unused and unassigned wireless spectrum to Indigenous communities residing in rural areas. Such measures would give smaller ISPs and Indigenous communities enhanced opportunities to deliver reliable wireless high-speed internet services to underserved regions.

Canada remains committed to achieving its objective of ensuring that every household has access to high-speed internet by 2030, recognizing the importance of this connectivity for all citizens. Internet satellite systems are expected to play a crucial role in achieving this goal, particularly in regions where constructing fibre-optic networks is financially impractical. These satellite systems offer a promising solution to provide fast, dependable high-speed internet service to areas that would otherwise face significant challenges in terms of infrastructure development. By leveraging satellite technology, Canada aims to bridge the digital divide and provide equitable access to reliable internet connectivity across the country.

Questions

1. As a small business owner in a First Nations community, how would the absence of reliable high-speed internet service impact your business? Provide a detailed example highlighting the specific implications.
2. What potential advantages would your business gain from the availability of high-speed internet service? Provide a detailed example illustrating the specific opportunities that would arise.
3. Should telecom companies be mandated to provide reliable high-speed internet service in remote areas? Provide a list of reasons with a detailed explanation of each.
4. How could First Nations communities compete with large telecom corporations in the provision of internet service to their communities?

Sources: Compiled from R. Bergen, "Manitoba Plans to Boost Rural, Northern Internet Using Hydro-Built Fibre Optic Network," *CBC News*, May 15, 2020; S. Schwiientek, "First Nations High-Speed Internet Access Lagging behind Canadian Average," *CBC News*, April 19, 2023; E. Grunwald, "Satellite That Provides Phone, Internet

to 8 NWT Communities Is Shutting Down,” *CBC News*, September 1, 2022; A. Blatchford, “Canada to Invest in Satellite Technology to Connect Rural, Remote Areas,” *CBC News*, July 23, 2019; “Feds Announce \$41M in Funding for High-Speed Internet for Manitoba Rural, First Nations Communities,” *CBC News*, August 4, 2021; S. Cohen, “Elon Musk’s Starlink High-Speed Satellite Internet Service Begins Northern Rollout,” *CBC News*, November 4, 2022;

E. J. Arevalo, “SpaceX Will Provide Starlink Internet to 127 Homes in the Muscowpetung Saulteaux First Nation Reserve in Canada,” *Tesmanian*, December 15, 2022; L. BigEagle, “Sask. First Nation to Provide Community Members High-Speed Internet through SpaceX’s Starlink,” *CBC News*, December 21, 2022; J. Hobart and C. Woodhouse, “Assign Unused Wireless Spectrum to Indigenous Communities,” *Policy Options*, April 14, 2022.

Introduction

The traditional working environment that required users to sit at a wired computer is ineffective and inefficient. Today, workers have access to computers that are small enough to carry or wear and that can communicate through wireless networks. That is, your computing device now comes with you. Wireless computing is convenient and enables you to be more productive.

Wireless computing is critical to the success of both individuals and organizations. However, in some parts of the world, broadband wireless connections are intermittent, poor-quality (low bandwidth), and expensive.

The ability to communicate anytime and anywhere gives organizations a strategic advantage by increasing productivity and speed and improving customer service. We use the term **wireless** to describe telecommunications in which electromagnetic waves, rather than some form of wire or cable, carry the signal between communicating devices such as computers, smartphones, and tablets.

Before you continue, it is important to distinguish between the terms *wireless* and *mobile*: they can mean different things. The term *wireless* means exactly what it says: without wires. In contrast, *mobile* refers to something that changes its location over time. Some wireless networks, such as MiFi (discussed later in this chapter), are also mobile. Others, however, are fixed. For example, microwave towers form *fixed wireless* networks.

Wireless technologies enable individuals and organizations to work with mobile computing, mobile commerce, and the Internet of Things. We will define these terms here and then discuss each one in detail later in the chapter.

Mobile computing refers to a real-time, wireless connection between a mobile device and other computing environments, such as the internet or an intranet. *Mobile commerce*—also known as *m-commerce*—refers to e-commerce (EC) transactions (see Chapter 7) conducted with a mobile device. The *Internet of Things* means that virtually every object contains embedded sensors and has processing power with either wireless or wired connections to a global network.

Wireless technologies and mobile commerce are spreading rapidly, replacing or supplementing wired computing. Almost all (if not all) organizations use wireless computing. Therefore, when you begin your career, you will likely be assigned a company smartphone and a wirelessly enabled computer. Clearly, then, it is important for you to learn about wireless computing, not only because you will be using wireless applications but also because wireless computing will be important to your organization. In your job, you will be involved with customers who conduct wireless transactions, with analyzing and developing mobile commerce applications, and with wireless security. And the list goes on.

Simply put, an understanding of wireless technology and mobile commerce applications will make you more valuable to your organization. When you look at “What’s in IT for me?” at the end of the chapter, envision yourself performing the activities discussed in your functional area. If you are interested in becoming an entrepreneur, an understanding of wireless technology can also help you start and grow your own business.

The wireless infrastructure upon which mobile computing is built is reshaping the entire IT field. The technologies, applications, and limitations of mobile computing and mobile commerce are the focus of this chapter. You begin the chapter by learning about wireless devices, wireless transmission media, and wireless security. You will continue by examining wireless computer networks and wireless internet access. You will then look at mobile computing and mobile commerce, which are made possible by wireless technologies. Finally, you will turn your attention to the Internet of Things.

wireless

Telecommunications in which electromagnetic waves carry the signal between communicating devices.

8.1

Wireless Technologies

LEARNING OBJECTIVE

Identify the advantages and disadvantages of wireless devices and each of the three main types of wireless transmission media.

Wireless technologies include both wireless devices, such as smartphones, and wireless transmission media, such as microwave, satellite, and radio. These technologies are fundamentally changing the ways organizations operate.

Individuals find wireless devices convenient and productive to use, for several reasons. First, people can make productive use of time that was formerly wasted—for example, while commuting to work on public transportation. Second, because people can take these devices with them, their work locations are becoming much more flexible. Third, wireless technology enables people to schedule their working time around personal and professional obligations.

Wireless Devices

Wireless devices provide three major advantages to users:

1. They are small enough to easily carry or wear.
2. They have sufficient computing power to perform productive tasks.
3. They can communicate wirelessly with the internet and other devices.

Modern smartphones exhibit a process called *dematerialization*. Essentially, dematerialization occurs when the functions of many physical devices are included in one physical device. Consider that your smartphone includes the functions of digital cameras for images and video, radios, televisions, internet access through Web browsers, recording studios, editing suites, movie theatres, GPS navigators, word processors, spreadsheets, stereos, flashlights, board games, card games, video games, an entire range of medical devices, maps, atlases, encyclopedias, dictionaries, translators, textbooks, watches, alarm clocks, books, calculators, address books, credit card swipers, magnifying glasses, money and credit cards, car keys, hotel keys, cellular telephony, Wi-Fi, email access, text messaging, a full QWERTY keyboard, and many, many other things. **Figure 8.1** illustrates the process of dematerialization with smartphones.

Our smartphones have come a long, long way in a very short time. Compare these smartphone capabilities (as of May 2023):

- Apple's first iPhone (2007) had a 3.5-inch screen, a 2-megapixel camera, and 16 gigabytes of storage; it did not support third-party apps.
- The Apple iPhone 14 Pro (2022) has a 6.1-inch screen, three 48-megapixel cameras (wide angle, ultra-wide angle, and telephoto), one 12-megapixel selfie camera, and up to 512 gigabytes of storage, provides biometrics for security; it supports a vast array of apps.

One downside of smartphones is that people can use them to copy and pass on confidential information. For example, if you were an executive at Intel, would you want workers snapping pictures of their colleagues with your secret new technology in the background? After all, one of the functions of a smartphone is a digital camera that can transmit wirelessly. New jamming devices are being developed to counter the threat. Some companies, such as Samsung (www.samsung.com), have recognized the danger and have banned these devices from their premises altogether.

Another downside of smartphones is scam calls. According to some reports, as many as 6 percent of unwanted calls in Canada in the first quarter of 2023 were considered to be fraud attempts, compared to 14.5 percent in the United States for the same period. Regardless of any disadvantages, however, cellphones, and particularly smartphones, have had a far greater impact on human society than most of us realize.

As a way to fight against scam calls, in July 2019 the U.S. Federal Communications Commission passed a provision that forces network operators to implement SHAKEN/STIR, the new

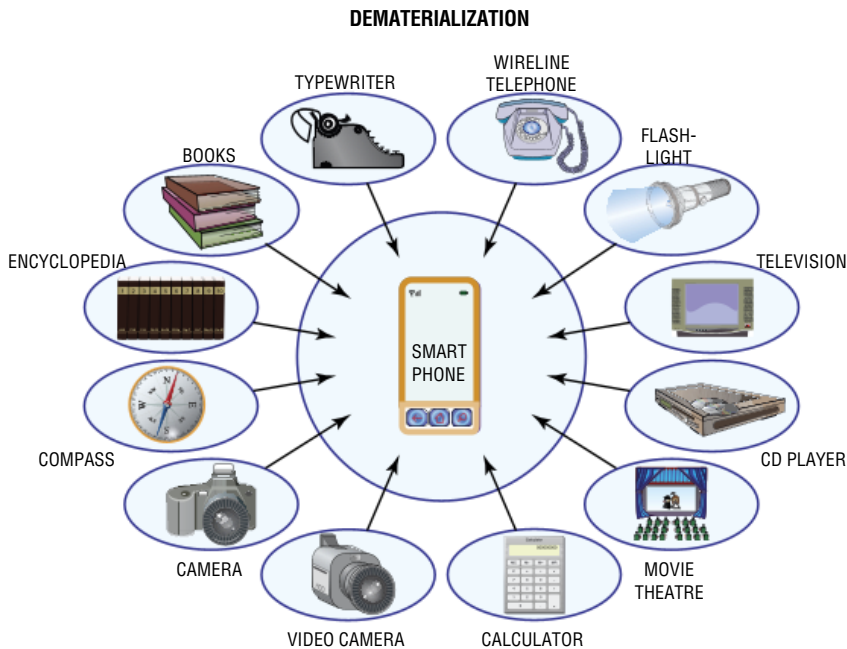


FIGURE 8.1 Dematerialization with smartphones.

industry standard for verifying the source of phone calls. This legislation also affects Canadian telecom carriers. As of May 2023, here is what the major wireless carriers were doing about spam calls.

- Bell Canada (www.bell.ca) offers free tools to its mobile and home customers. For mobile, Bell Anti-SPAM is a free service that screens and automatically blocks incoming spam calls based on risk level and allows customers to report spam.
- Rogers (www.rogers.com) offers Spam Call Detect, which is a feature included in all Rogers Wireless plans with Name Display. Spam Call Detect allows users to see if incoming calls could be fraud or spam and block them.
- TELUS (www.TELUS.com) Call Control is a free service that automatically provides screen alerts for spam calls and blocks them.

Wireless Transmission Media

Wireless media, or broadcast media, transmit signals without wires. The major types of wireless media are microwave, satellite, and radio. [Table 8.1](#) lists the advantages and disadvantages of each type.

TABLE 8.1 Advantages and Disadvantages of Wireless Media

Channel	Advantages	Disadvantages
Microwave	High bandwidth Relatively inexpensive	Must have unobstructed line of sight Susceptible to environmental interference
Satellite	High bandwidth Large coverage area	Expensive Must have unobstructed line of sight Signals experience propagation delay Must use encryption for security
Radio	High bandwidth Signals pass through walls Inexpensive and easy to install	Creates electrical interference problems Susceptible to snooping unless encrypted

microwave transmission A wireless system that uses microwaves for high-volume, long-distance, point-to-point communication.

satellite transmission A wireless transmission system that uses satellites for broadcast communications.

Microwave **Microwave transmission** systems transmit data through electromagnetic waves. These systems are used for high-volume, long-distance, line-of-sight communication. *Line-of-sight* means that the transmitter and receiver are in view of each other. This requirement creates problems because the Earth’s surface is curved. For this reason, microwave towers usually cannot be spaced more than 50 km apart.

Clearly, then, microwave transmissions offer only a limited solution to data communications needs, especially over very long distances. Microwave transmissions are also susceptible to environmental interference during severe weather such as heavy rain and snowstorms. Although long-distance microwave data communications systems are still widely used, they are being replaced by satellite communications systems.

Satellite **Satellite transmission** systems make use of communication satellites. Currently, there are three types of satellites circling Earth: geostationary-Earth-orbit (GEO), medium-Earth-orbit (MEO), and low-Earth-orbit (LEO). Each type has a different orbit, with GEO being farthest from Earth and LEO closest. In this section, you examine the three types of satellites and then discuss three satellite applications: global positioning systems, internet transmission through satellites, and commercial imaging. **Table 8.2** compares and contrasts the three types of satellites.

TABLE 8.2 Three Basic Types of Telecommunications Satellites				
Type	Characteristics	Orbit	Number	Use
GEO	Satellites stationary relative to point on Earth Few satellites needed for global coverage Transmission delay (approximately 0.25 second) Most expensive to build and launch Longest orbital life (many years)	35,900 km	8	TV signal
MEO	Satellites move relative to point on Earth Moderate number needed for global coverage Require medium-powered transmitters Negligible transmission delay Less expensive to build and launch Moderate orbital life (6 to 12 years)	10,350 km	10 to 12	GPS
LEO	Satellites move rapidly relative to point on Earth Large number needed for global coverage Require only low-power transmitters Negligible transmission delay Least expensive to build and launch Shortest orbital life (as low as 5 years)	640 km to 1,100 km	Many	Telephone

As with microwave transmission, satellites must receive and transmit data through line of sight. However, the enormous *footprint*—the area of Earth’s surface reached by a satellite’s transmission—overcomes the limitations of microwave data relay stations. That is, satellites use *broadcast* transmission, which sends signals to many receivers at one time. So, even though satellites are line-of-sight like microwave, they are high enough for broadcast transmission, thus overcoming the limitations of microwave.

The most basic rule governing footprint size is simple: the higher a satellite orbits, the larger its footprint. Thus, medium-Earth-orbit satellites have a smaller footprint than geostationary satellites, and low-Earth-orbit satellites have the smallest footprint of all. **Figure 8.2** compares the footprints of the three types of satellites.

Types of Orbits *Geostationary-Earth-orbit satellites* orbit 35,900 km directly above the Equator. These satellites maintain a fixed position above Earth’s surface because, at this altitude, their orbital period matches Earth’s 24-hour rotational period. For this reason, receivers on Earth do not have to track GEO satellites. These satellites are excellent for sending television programs to cable operators and for broadcasting directly to homes.

propagation delay Any delay in communications from signal transmission time through a physical medium.

One major limitation of GEO satellites is that their transmissions take a quarter of a second to send and return. This brief pause, one kind of **propagation delay**, makes two-way telephone conversations difficult. Also, GEO satellites are large and expensive, and they require substantial amounts of power to launch.

Medium-Earth-orbit satellites are located about 10,350 km above Earth's surface. MEO orbits require more satellites to cover Earth than GEO orbits because MEO footprints are smaller. MEO satellites have two advantages over GEO satellites: they are less expensive and they do not have an appreciable propagation delay. However, because MEO satellites move with respect to a point on Earth's surface, receivers have to track them. (Think of a satellite dish slowly turning to remain oriented to a MEO satellite.)

Low-Earth-orbit satellites are located 640 km to 1,100 km above Earth's surface. Because LEO satellites are much closer to Earth, they have little, if any, propagation delay. Like MEO satellites, however, LEO satellites move with respect to a point on Earth's surface and must therefore be tracked by receivers. Tracking LEO satellites is more difficult than tracking MEO satellites because LEO satellites move much faster relative to a point on Earth.

Unlike GEO and MEO satellites, LEO satellites can pick up signals from weak transmitters. This feature makes it possible for satellite telephones to operate through LEO satellites, because they can operate with less power using smaller batteries. Another advantage of LEO satellites is that they consume less power and cost less to launch.

At the same time, however, LEO satellites' footprints are small, which means that many satellites are needed to cover the planet. For this reason, a single organization often produces multiple LEO satellites, known as *LEO constellations*. Many companies have deployed LEO constellations to provide global voice and data communications. Two of the oldest are Iridium (www.iridium.com) and Globalstar (www.globalstar.com). IT's About Business 8.1 provides several examples of the benefits of satellite technologies.

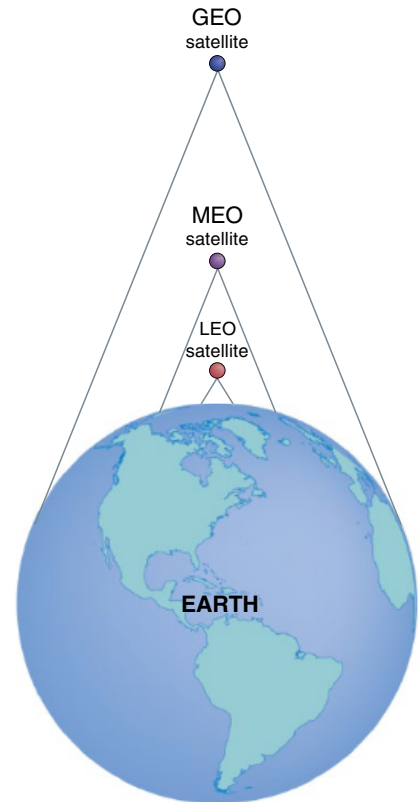


FIGURE 8.2 Comparison of satellite footprints.

IT's About Business 8.1

MIS Putting Satellites to Work

Education in Remote Areas

Sotomo is a small village in remote southern Chile that can be accessed only by boat. Only 20 families live there, and they survive by catching fish and seafood to sell at the nearest market, a five-hour round trip by boat. SpaceX—a company that designs and manufactures spacecraft and rockets—selected Sotomo as one of two locations in Chile where it could conduct a pilot project, giving these communities free internet access for a year. The other location is Caleta Sierra, a small fishing village close to Chile's northern deserts.

Diego is a seven-year-old living in Sotomo, whose father takes him to school by boat. Using tablets provided by the education ministry, the school's seven pupils can now access online learning materials, watch films, make virtual museum visits, and make video calls to children in other schools as a result of the SpaceX project. Their only teacher at John F. Kennedy School in Sotomo uses the internet for ongoing skills development.

The teacher and his students receive signals via a satellite dish installed on the school's roof, which transmits via a Wi-Fi device to most of the school's facilities, including its outdoor patio. Ultimately, the plan is to extend internet access to the rest of the hamlet. Internet access in the village operates only from noon to midnight because Sotomo has only a limited supply of diesel

to run the generator that supplies power to the village. Internet access via SpaceX is a significant advance over the patchy internet signal that residents previously had to lean out of a window or boat out into the bay to receive.

Diego enjoys helping out on his father's fishing boat. His father, however, has more ambitious plans for him and hopes that the new internet connection will broaden his son's horizons.

Early Warning for Natural Disasters

In July 2020, a massive landslide struck Hunan province in southern China. All 33 inhabitants in one village were evacuated in time, thanks to early warnings by advanced positioning technologies that provide more accurate readings than were previously possible. Thus, 12 days before the landslide, the village received an orange alert citing data anomalies that pointed to accelerating surface sliding following days of heavy rain. These positioning technologies are powered by China's BeiDou GPS system and its ground-based stations. The satellites' position sensors can detect subtle changes of a few metres in real time in the soil's surface in landslide-prone regions across the country.

More Accurate Hurricane Predictions

A major challenge in dealing with hurricanes involves predicting the track the storm will take, how intense it will be, and where it will make landfall. Although geostationary satellites have some value,

their effectiveness ends at the cloud tops because the satellites provide only visible and infrared images that cannot pierce cloud cover.

Scientists need to collect data about the interior of a storm: its motion, temperature, and moisture content. To obtain these data, they plan to use the TROPICS system (<https://tropics.ll.mit.edu>), a nanosatellite project that will ultimately consist of seven polar-orbiting satellites that will monitor the Earth's tropical zones, where hurricanes form.

Polar satellites have 800 km high orbits, much lower than geostationary satellites, which orbit at 35,900 km. These lower orbits enable polar satellites to gather data that enable scientists to monitor what is happening within a storm.

The TROPICS satellite constellation will provide a detailed look into a storm every 30 to 40 minutes. The data gathered by these satellites is transmitted to the U.S. National Weather Service and the National Hurricane Center as input into weather-prediction models.

A virtual pretest of the TROPICS system demonstrated that forecasting a hurricane's track improved by 15 percent. The pretest also revealed a consistent improvement in temperature and wind forecasts up to five days before landfall as well as more accurate humidity forecasts up to 36 hours before landfall.

Limiting Deforestation

Proponents of satellite imagery and machine learning want to solve major problems. One of the most important of these problems is deforestation, an activity that impacts the entire Earth.

However, stopping deforestation begins with identifying the problem from space. Although a Brazilian government program helped reduce deforestation by 80 percent from 2004 to 2012, when Jair Bolsonaro was elected president in 2019, he weakened enforcement and encouraged the opening up of the rainforest to industry and cattle ranching. The consequence was that deforestation in the Amazon basin reached its highest levels in over a decade.

Brazil-based nonprofit Imazon (<https://imazon.org.br>) protects the Amazon rainforest using satellite imagery. In the early 2000s, Imazon scientists understood that 90 percent of deforestation occurs within 5 km of newly created roads. Although satellites have long been able to track road expansion, Imazon scientists initially had to label satellite images by hand, creating what eventually became training data. When researchers fed those training data into a machine learning system, it revealed 13 times more roads than previously identified.

Imazon has signed cooperation agreements with public prosecutors who are gathering evidence of environmental crimes in four Brazilian states that border the Amazon rainforest. Their objective is to share information that can help prioritize enforcement resources. Imazon and the prosecutors are aware that, when they prosecute people who have deforested protected lands, it's too late to prevent the damage they have already caused. Therefore, Imazon wants to use machine learning to stop deforestation before it happens, integrating road-detection models with models designed to predict which communities bordering the rainforest are at the highest risk of deforestation within the next year.

Monitoring Illegal Fishing

Spire Global (<https://spire.com>), which operates a low-Earth-orbit constellation of 140 small satellites, specializes in tracking maritime, aviation, and weather patterns. Its satellites pick up the radio signals that boats around the world send out. The primary use of these signals is to prevent vessels from crashing into one another. However, listening for these signals is also a useful strategy to track illegal maritime activity.

Spire notes that the way that boats move when they are fishing is distinctive. The company can predict what kind of fishing equipment boats are using by their speed, direction, and the way they turn. Of the 60,000 vessels that emit such signals, Spire asserts that 5,000 have been found conducting illegal activities, including fishing at restricted times or offloading hauls of protected fish to other vessels to avoid checks at ports.

In 2020, Japanese authorities found that fishing boats kept washing up on their shores with dead North Koreans onboard. They could not explain why so many boats were now appearing.

Using Spire satellites, a nonprofit organization called Global Fishing Watch (<https://globalfishingwatch.org>) discovered that China was fishing illegally in North Korean waters. Competition from larger, more modern Chinese fishing trawlers forced smaller North Korean wooden boats to sail north to fish in Russian waters. The North Korean boats were severely underequipped for the long-distance travel necessary to reach the Russian fishing grounds. As a result, more than 500 of these boats were washed ashore on Japanese coasts. These incidents frequently involved the North Korean fishers on board starving to death. When China was presented with the evidence, it halted its illegal fishing activities.

Monitoring Illegal Logging and Poaching

Rainforest Connection (<https://rfcx.org>), based in Texas, uses Swarm Technologies (www.swarm.space; acquired by SpaceX in August 2021) satellites to track illegal logging and poaching in more than 30 countries. In areas where loggers or poachers might operate, Rainforest Connection places solar-powered acoustic (sound) sensors called Guardians high in treetops. These sensors are designed to blend in with the tree as seen from the ground. The Guardians contain software that can detect the sounds of illegal activities, such as chainsaws and gunshots, up to a mile away. When they detect these activities, they signal a Swarm satellite, which in turn passes the data on to a ground station. Rainforest Connection then alerts law enforcement to the suspected illegal activity.

Before it worked with Swarm, Rainforest Connection relied on cellphones to transmit data. Although this arrangement was quicker, the cellular networks could monitor only regions that were close to populated areas. Swarm has doubled Rainforest Connection's detection capabilities.

Monitoring Russian Destruction of Ukrainian Archaeological Sites

Scientists at University College of London's Institute of Archaeology use imagery from a Planet Labs (www.planet.com) constellation to track Russia's shelling of archaeological sites in Ukraine. Planet Labs' satellites provide images of the entire Earth every day. Using this imagery, the scientists have worked with the Global Heritage Fund, to identify over 165 sites that have suffered damage due to Russian artillery. Scientists catalogue these sites in hopes that some of them can be at least partially restored after the conflict ends.

Questions

1. What are the advantages of employing low-Earth-orbit satellites for so many uses?
2. What are the disadvantages of employing low-Earth-orbit satellites for so many uses?
3. Describe additional uses of low-Earth-orbit satellites for "social good."

Sources: Compiled from J. O’Callaghan, “Swarms of Satellites Are Tracking Illegal Fishing and Logging,” *Wired*, August 30, 2022; “Global Heritage Fund Leveraging Planet SkySat to Protect the Cultural Fabric of Ukraine,” *planet.com*, August 18, 2022; K. Johnson, “Satellites and AI Can Help Solve Big Problems—If Given the Chance,” *Wired*, June 5, 2022; J. Spring, “Brazil’s Amazon Deforestation Sets First-Quarter Record despite March Dip,” *Reuters*, April 8, 2022; N. Patel, “Who Is Starlink Really For?” *MIT Technology Review*, September 6, 2021; J. McDonald, “How Sandwich-Sized Satellites Are Helping Transmit Data from Remote Locations,” *Emerging Technologies Morning Brew*, August 25, 2021; P. Sanhueza,

“Elon Musk’s Satellites Beam Internet into Remote Chilean Fishing Hamlet,” *Reuters*, August 19, 2021; M. Herbst, “Tiny Satellites Could Help Warn of the Next Big Hurricane,” *Wired*, June 25, 2021; L. Xin, “Hyper-Accurate Positioning Is Rolling Out Worldwide,” *MIT Technology Review*, February 24, 2021; J. Park et al., “Illuminating Dark Fishing Fleets in North Korea,” *Science Advances*, July 22, 2020; M. Sandy, “The Amazon Is Completely Lawless: The Rainforest after Bolsonaro’s First Year,” *The New York Times*, December 5, 2019; I. Demir and R. Raskar, “Addressing the Invisible: Street Address Generation for Developing Countries with Deep Learning,” *arxiv.org*, November 10, 2018.

Global Positioning Systems The **global positioning system (GPS)** is a wireless system that uses satellites to enable users to determine their position anywhere on Earth. GPS is supported by MEO satellites that are shared worldwide. As of September 2022, the world had four international GPS systems: the U.S.A.’s GPS, Russia’s *GLONASS*, China’s *BeiDou*, and the European Union’s *Galileo*. In addition, India’s *NavIC* (seven satellites) and Japan’s *QZSS* (four satellites) are regional GPS systems.

All GPS satellites have an extremely accurate clock. The exact position of each satellite is always known because the satellite continuously broadcasts its position along with a time signal. By using the known speed of the signals and the distance from three satellites (for two-dimensional location) or four satellites (for three-dimensional location), it is possible to determine the location of any receiving station or user. GPS software can also convert the user’s latitude and longitude to an electronic map.

Most of you are probably familiar with GPS in automobiles, which “talks” to drivers when giving directions. **Figure 8.3** illustrates a driver obtaining GPS information in a car.

Commercial use of GPS for activities such as navigating, mapping, and surveying has become widespread, particularly in remote areas. Cellphones in many countries now must have a GPS embedded in them so that the location of a person making an emergency call—for example, 911, known as *wireless 911*—can be detected immediately.

It is almost impossible to overstate how much the world’s economy depends on the GPS system. There are some 7 billion GPS receivers in use around the world. In fact, a study by research firm RTI International (www.rti.org) estimated that the loss of GPS service globally would cost private-sector organizations approximately US \$1 billion per day.

The telecommunications industry, banks, airlines, electric utilities, cloud computing businesses, television networks, emergency services, and the military constantly require precise GPS timing.

Before 2020, the GPS II system could provide locations that were accurate to within 5 to 10 metres. The GPS III system, which will become fully operational in 2023, will be three times as accurate. As a result, GPS reception will be accurate to within 1 to 3 metres; it will also become more reliable, even indoors and in dense urban areas. Furthermore, GPS III signals are eight times more resistant to jamming.

NASA is working on developing international compatibility and interoperability for GPS satellites. A United Nations committee is proposing a common set of definitions for GPS signals from the United States, Europe, Russia, China, Japan, and India. When it is finished, GPS receivers will be able to access all GPS satellites, which in turn will lead to positioning within centimeters.

To illustrate how critical GPS has become, Europe’s Galileo satellite navigation system went out of service for one week beginning on July 11, 2019. The incident took down all of the system’s timing and navigation features other than Search and Rescue, which helps people in remote areas. Navigation systems that relied on Galileo could not function. However, these systems were able to seamlessly transition to the United States GPS system rather than taking flawed data and using it to calculate inaccurate positions and routes. The lengthy outage is a serious reminder of the modern world’s reliance on GPS systems.

global positioning system (GPS) A wireless system that uses satellites to enable users to determine their position anywhere on Earth.



FIGURE 8.3 Drivers can obtain GPS information from their automobile.

AP Images/Jeff Chiu

Internet over Satellite In many regions of the world, Internet over Satellite (IoS) is the only option available for internet connections because installing cables is either too expensive or physically impossible. IoS enables users to access the internet from GEO satellites on a dish mounted on the side of their homes. Although IoS makes the internet available to many people who otherwise could not access it, it has its drawbacks. Not only do GEO satellite transmissions involve a propagation delay, but they can also be disrupted by environmental factors such as thunderstorms. Many companies are entering this market.

- OneWeb (<https://oneweb.net/>) has deployed a LEO constellation to bring internet access to all parts of the globe. The firm is targeting rural markets, emerging markets, and in-flight internet services on airlines. As of May 2023, OneWeb was approaching its goal of a 648-satellite LEO constellation.
- SpaceX's (www.spacex.com) LEO constellation, Starlink, provides long-distance internet traffic for people in sparsely populated areas. As of May 2023, SpaceX had put over 3,000 satellites in orbit. The company is planning for 42,000 satellites in total.
- Project Kuiper is Amazon's LEO constellation, which is planned to consist of 3,236 satellites. In 2022, Amazon announced that it had contracted with three launch providers over the next decade. The first launch of a Kuiper satellite is scheduled for the first half of 2024.

Commercial Imaging Another satellite application is commercial images from orbit, using very small satellites called *nanosatellites*. Several companies are involved in launching nanosatellites for scientific and commercial purposes. Let's look at some of them here.

- Planet Labs (www.planet.com) takes pictures of the Earth more frequently than traditional satellites and at a small fraction of the cost. The company's LEO constellation, called Dove, helps entire industries obtain images anywhere on the earth. Planet Labs can also capture video that can be used to develop three-dimensional models of any area that is imaged.

Planet Labs is able to image every location on the entire planet every day. The company has deployed a platform, Queryable Earth, that customers can use to track planes, ships, roads, buildings, and forests worldwide.

A farm software business in the agriculture division of DuPont (www.dupont.com), called Corteva Agriscience (<https://www.corteva.com/>), uses Planet Labs' satellites to access daily images of the Earth, as well as some of the company's archive of images. Corteva analyzes the images to provide information for farmers. For example, farmers use Corteva's analyses to develop crop and field plans, delegate duties to employees, track inventory, and predict yield and revenue.

- **FIN** The World Bank (www.worldbank.org) monitors high-risk urban development by integrating satellite imaging data from NASA's Landsat satellites and the European Space Agency's Sentinel satellites with census data.
- **POM** Spire's (www.spire.com) LEO constellation locates objects. For example, more than 250,000 ships broadcast an automatic identification signal. Spire satellites pick up these signals and provide frequent updates of the ships' positions without the vessels having to use expensive dedicated satellite communications.
- **POM** Ursa Space Systems (www.ursaspace.com) analyzes satellite imaging data to estimate the amount of oil in 10,000 oil storage tanks worldwide by focusing on the heights of the lids to measure fluctuation in the oil levels inside the tanks. The company estimates oil stockpiles and oil demand.
- **POM** Orbital Insight (www.orbitalinsight.com) also has an oil storage tracker and performs daily automobile counts for 80 U.S. retailers. Orbital Insight also partnered with RBC Canada for its use of Orbital's Consumer and Energy Analytics products.
- **POM** EarthCast Technologies (www.earthcastdemo.com) provides inflight forecasts to pilots. Pilots have long had access to basic weather information for their departure from and arrival at airports, but EarthCast gives them the ability to map out conditions along a particular flight path.
- Iceye Oy (www.iceye.com) is planning to launch a constellation of 18 satellites that will allow it to capture images of almost any spot on Earth every three hours.

- **POM** SpaceKnow (www.spaceknow.com) uses image data from about 200 public and private satellites to track everything from planes at airports, to shipping containers in ports, to cars at amusement parks. The company's clients are particularly interested in infrastructure development; for example, whether there are new mines in the cobalt-rich Democratic Republic of Congo, which could impact that mineral's prices.
- Imazon (www.imazon.org.br) uses image data from the European Space Agency's Sentinel satellites to police the deforestation of the Amazon basin in Brazil. The organization focuses on providing data to local governments in the region through its "green municipalities" program, which trains officials to identify deforestation.
- **POM** Indigo Ag Inc. (www.indigoag.com) analyzes image data from NASA and European Space Agency satellites to track global crops, such as wheat, rice, and others.
- Global Fishing Watch (www.globalfishingwatch.org) analyzes satellite ship-tracking image data to help identify where and when vessels are fishing illegally. The organization was jointly founded by three companies: SkyTruth (www.skytruth.org), which uses satellites to monitor natural resource extraction and promote environmental protection; Oceana (www.oceana.org), an international ocean conservation organization; and Google, which provides data analytics.

Radio **Radio transmission** uses radio wave frequencies to send data directly between transmitters and receivers. Radio transmission has several advantages. First, radio waves travel easily through normal office walls. Second, radio devices are fairly inexpensive and easy to install. Third, radio waves can transmit data at high speeds. For these reasons, radio is being used increasingly often to connect computers to both peripheral equipment and local area networks (LANs; discussed in Chapter 6). (Note: Wi-Fi and cellular also use radio frequency waves.)

As with other technologies, however, radio transmission has its drawbacks. First, radio media can create electrical interference problems. In addition, radio transmissions are susceptible to snooping by anyone who has similar equipment that operates on the same frequency.

Another problem with radio transmission is that, when you travel too far away from the source station, the signal breaks up and fades into static. Most radio signals can travel only 50 to 65 km from their source. However, **satellite radio** overcomes this problem. Satellite radio, or *digital radio*, offers uninterrupted, near CD-quality transmission that is beamed to your radio, either at home or in your car, from space. In addition, satellite radio offers a broad spectrum of stations, including many types of music, news, and talk. Sirius XM (www.siriusxm.com) is a leading satellite radio company whose listeners subscribe to its service for a monthly fee.

radio transmission Uses radio-wave frequencies to send data directly between transmitters and receivers.

satellite radio (or digital radio) A wireless system that offers uninterrupted, near CD-quality sound that is beamed to your radio from satellites.

Internet Blimps Altaeros (www.altaos.com) makes the SuperTower, which is a tethered blimp that floats at about 240 m altitude. Each blimp acts like a regular cell tower but with a footprint of up to 10,000 square kilometres. Altaeros claims that one SuperTower will replace 15 land-based cell towers and cut the cost of delivering wireless service by 60 percent. There are many types of use cases for Altaeros SuperTowers.

- Customers can expand their 4G footprint with wide-area coverage from an aerial cell tower and easily upgrade to 5G by swapping out their payload equipment from the platform on the ground.
- Broadband speeds can be delivered to remote and widely dispersed communities and organizations.
- A remote worksite can benefit from uninterrupted coverage both on the job site and outside it.

Wireless Security

Clearly, wireless networks provide numerous benefits for businesses. However, they also present a huge challenge to management—namely, their inherent lack of security. Wireless is a broadcast medium, and transmissions can be intercepted by anyone who is close enough and has access to the appropriate equipment. There are four major threats to wireless networks: rogue access points, war driving, eavesdropping, and radio frequency jamming.

A *rogue access point* is an unauthorized access point into a wireless network. The rogue could be someone in your organization who sets up an access point meaning no harm but fails to inform the IT department. In more serious cases, the rogue is an “evil twin”—someone who wishes to access a wireless network for malicious purposes.

In an *evil twin attack*, the attacker is in the vicinity with a Wi-Fi-enabled computer and a separate connection to the internet. Using a *hotspotter*—a device that detects wireless networks and provides information on them—the attacker simulates a wireless access point with the same wireless network name, or service set identifier (SSID), as the one that authorized users expect. If the signal is strong enough, then users will connect to the attacker’s system instead of the real access point. The attacker can then serve them a Web page asking for them to provide confidential information such as usernames, passwords, and account numbers. In other cases, the attacker simply captures wireless transmissions. These attacks are more effective with public hotspots (e.g., McDonald’s and Starbucks) than with corporate networks.

War driving is the act of locating wireless local area networks (WLANs) while driving (or walking) around a city or elsewhere. To war drive or walk, you simply need a Wi-Fi detector and a wirelessly enabled computer. If a WLAN has a range that extends beyond the building in which it is located, then an unauthorized user might be able to intrude into the network. The intruder can then obtain a free internet connection and possibly gain access to important data and other resources.

Eavesdropping refers to efforts by unauthorized users to access data that are travelling over wireless networks. Finally, in *radio frequency (RF) jamming*, a person or a device intentionally or unintentionally interferes with your wireless network transmissions.

To protect wireless networks, we encrypt our transmissions. Developed by the Wi-Fi Alliance, WPA2 is a type of encryption used to secure the vast majority of Wi-Fi networks. A WPA2 network provides unique encryption keys for each wireless client that connects to it. WPA3 is the latest implementation of WPA2.

Before you go on...

1. Describe the most common types of wireless devices.
2. Describe the various types of transmission media.
3. Describe four threats to the security of wireless transmissions.

8.2 Wireless Computer Networks and Internet Access

LEARNING OBJECTIVE

Explain how businesses can use short-range, medium-range, and long-range wireless networks.

You have learned about various wireless devices and how they transmit wireless signals. These devices typically form wireless computer networks and provide wireless internet access. In this section, you will study wireless networks, which we organize by their effective distance: short range, medium range, and wide area.

Short-Range Wireless Networks

Short-range wireless networks simplify the task of connecting one device to another. They also eliminate wires and enable users to move around while they use their devices. In general, short-range wireless networks have a range of 30 m or less. In this section, you will consider

three basic short-range networks: Bluetooth, ultra-wideband (UWB), and near-field communications (NFC).

Bluetooth **Bluetooth** (www.bluetooth.com) is an industry specification used to create small personal area networks. A **personal area network** is a computer network used for communication among computer devices (e.g., telephones, personal digital assistants, smart-phones) located close to one person. Bluetooth is a very successful wireless technology, with more than 40 billion device shipments.

Bluetooth uses low-power, radio-based communication. Bluetooth 5.2 can transmit up to approximately 50 megabits per second (Mbps) up to 400 m. These characteristics mean that Bluetooth 5 will be important for Internet of Things applications (discussed in Section 8.4). Advantages of Bluetooth include low power consumption and the fact that it uses radio waves that are emitted in all directions from a transmitter. For this reason, you do not have to point one Bluetooth device at another to create a connection.

Bluetooth low energy, marketed as *Bluetooth Smart*, enables applications in the health care, fitness, security, and home entertainment industries. Compared to “classic” Bluetooth, Bluetooth Smart is less expensive and consumes less power, although it has a similar communication range. Bluetooth Smart is fuelling the development and adoption of “wearables” (wearable computers).

Bluetooth is widely used to address the increasing demand for high-speed, highly accurate indoor location services, which enable people and objects to be tracked within a set space. These services allow organizations to understand people’s movements and reduce the loss of revenue from lost or stolen assets.

Bluetooth continues to be extremely useful in the case of COVID-19. Health monitoring applications on wearables (e.g., Fitbit and Apple iWatch) track temperature, heart rate, respiratory rate, and other biometric measurements in real time to aid in the prevention and control of COVID-19.

Other applications of Bluetooth include:

- Mobile payments for easy checkout at stores
- Smart Tags to track travellers’ luggage and belongings
- Remote monitoring of patients with various diseases
- Real-time connectivity for manufacturing and industrial uses: assistance in improving quality and predicting maintenance
- Intelligent vehicles with such technology as remote keyless entry systems, smart steering wheels, proximity reporting, and entertainment systems
- Home automation systems with sensors for tracking water leaks, fires, and motion in case of unauthorized entry
- Real-time player-tracking systems used by European professional hockey leagues so that coaches can analyze the athletes’ play

Ultra-Wideband **Ultra-wideband (UWB)** is a high-bandwidth wireless technology with transmission speeds in excess of 100 Mbps. Let’s take a closer look at Humatics (www.humatics.com), a leading company in UWB technologies. The firm offers several microlocation systems that use UWB technology, including the Humatics Rail Navigation System and the Milo Microlocation System.

Humatics’ Milo Microlocation System uses sensors embedded within products, equipment, or robots to provide real-time, reliable, ultra-precise (less than one millimetre) location data so that organizations know exactly where objects and equipment are and where they are going. For example, companies are using the Milo system to precisely control the movements of not only industrial robot arms but also cobots.

Other interesting UWB applications include:

- Mobile robotics: Enable robots to navigate autonomously indoors and in other GPS-denied environments and to guide drones as they fly
- **POM** Heavy equipment industries such as manufacturing and mining: Precisely position the arm of a crane and track forklifts moving indoors and outdoors

Bluetooth Chip technology that enables short-range connection (data and voice) between wireless devices.

personal area network A computer network used for communication among computer devices close to one person.

ultra-wideband (UWB) A high-bandwidth wireless technology with transmission speeds in excess of 100 Mbps that can be used for applications such as streaming multimedia from, say, a personal computer to a television.

- Defence and security: Low false alarm rate, wireless perimeter fences, and indoor mapping and through-wall surveillance

A laptop equipped with UWB can recognize that its owner is sitting in front of it by listening to the signal from their smartphone or smartwatch. The laptop could then automatically log in to any service that person is authorized to use, in another step toward the elimination of usernames and passwords (see Chapter 4).

near-field communication (NFC) The short-range wireless network with the smallest range; it is designed to be embedded in mobile devices like cellphones and credit cards.

Near-Field Communication **Near-field communication (NFC)** has the smallest range of any short-range wireless network. It is designed to be embedded in mobile devices such as cellphones and credit cards. For example, using NFC, you can wave your device or card within a few centimetres of POS terminals to pay for items. NFC can also be used with mobile wallets (discussed in Section 8.3).

wireless local area network (WLAN) A computer network in a limited geographical area that uses wireless transmission for communication.

Medium-Range Wireless Networks

Medium-range wireless networks are the familiar **wireless local area networks (WLANs)**. The most common type of medium-range wireless network is **Wireless Fidelity**, or Wi-Fi. WLANs are useful in a variety of settings, some of which may be challenging.

Wireless Fidelity is a medium-range WLAN, which is a wired LAN but without the cables. In a typical configuration, a transmitter with an antenna, called a **wireless access point** (see Figure 8.4), connects to a wired LAN or to satellite dishes that provide an internet connection. A wireless access point provides service to a number of users within a small geographical perimeter (up to approximately 100 m), known as a **hotspot**. Multiple wireless access points are needed to support a larger number of users across a larger geographical area. To communicate wirelessly, mobile devices, such as laptop PCs, typically have a built-in wireless network interface capability.

Wi-Fi provides fast and easy internet or intranet broadband access from public hotspots located at airports, hotels, internet cafés, universities, conference centres, offices, and homes. Users can access the internet while walking across a campus, to their office, or through their homes. Most PC and laptop manufacturers incorporate these wireless network cards into their products to access Wi-Fi networks.

The Institute of Electrical and Electronics Engineers (IEEE) has established a set of standards for wireless computer networks. The IEEE standard for Wi-Fi is the 802.11 family. Fortunately, the Wi-Fi Alliance (www.wi-fi.org) decided to rename Wi-Fi generations with simple version numbers. Therefore, Wi-Fi 802.11ac, deployed in 2013, was renamed Wi-Fi 5, and Wi-Fi 802.11ax, deployed in 2019, is Wi-Fi 6.

Wi-Fi 6 advantages include faster speeds (eventually up to 10 Gbps), lower latency (transmission delay), much better battery life, improved security, and support for multi-user environments. As a result of these improvements, Wi-Fi 6 will be beneficial for Internet of Things applications.

The major benefits of Wi-Fi are its low cost and its ability to provide simple internet access. It is the greatest facilitator of wireless internet—that is, the ability to connect to the internet wirelessly.

Corporations are integrating Wi-Fi into their strategies. For example, Starbucks, McDonald's, Panera, and Barnes & Noble offer customers Wi-Fi in many of their stores, primarily for internet access. To illustrate the value of Wi-Fi, consider Meter's (www.meter.com) business model.

Installing an office network is more difficult than it might appear. The process has traditionally required a company to buy its own complicated equipment, then manage that equipment along with a relationship with one or more internet service providers.

Meter charges customers a monthly fee of 15 cents per square foot of office space to completely set up a wireless network and connect it to the internet. A customer sends Meter a floor plan and Meter determines the equipment the customer's office will need. Meter contends that it is uniquely equipped to do this because it makes all its own hardware and software, as well as setting up the connections through its relationships with internet providers.



Roman Samokhin/Shutterstock

FIGURE 8.4 Wireless access point.

Wireless Fidelity (Wi-Fi) A set of standards for wireless local area networks based on the IEEE 802.11 standard.

wireless access point An antenna connecting a mobile device to a wired local area network.

hotspot A small geographical perimeter within which a wireless access point provides service to a number of users.

Because companies generally manage their own office networking, handing control over to a start-up has sometimes been a tough sell. However, companies are realizing that giving the office networking job to Meter is cheaper and less time-consuming than doing it themselves. For example, real estate companies such as Tishman Speyer have begun partnering with Meter so tenants who move into a new office can simply say that they would like internet service as part of their contract and have it turned on right away.

Wi-Fi Direct Until late 2010, Wi-Fi could operate only if the hotspot contained a wireless antenna. Because of this limitation, organizations have typically used Wi-Fi for communications at a range of up to about 250 m. For shorter, peer-to-peer connections, they have used Bluetooth.

This situation changed following the introduction of a new iteration of Wi-Fi known as Wi-Fi Direct. *Wi-Fi Direct* enables peer-to-peer communications so devices can connect directly. It enables users to transfer content among devices without having to rely on a wireless antenna. Devices with Wi-Fi Direct can broadcast their availability to other devices just as Bluetooth devices can. Finally, Wi-Fi Direct is compatible with the more than 1 billion Wi-Fi devices currently in use.

Wi-Fi Direct will probably challenge the dominance of Bluetooth in the area of device-to-device networking. It offers a similar type of connectivity but with greater range and much faster data transfer.

MiFi *MiFi* is a small, portable wireless device that provides users with a permanent Wi-Fi hotspot wherever they go. Thus, users are always connected to the internet. The range of the MiFi device is about 10 m. Developed by Novatel, the MiFi device is also called an *intelligent mobile hotspot*. Accessing Wi-Fi through the MiFi device allows up to five persons to be connected at the same time, sharing the same connection. MiFi also allows users to use Voice-over-Internet-Protocol technology (discussed in Chapter 6) to make free (or inexpensive) calls, both locally and internationally.

MiFi provides broadband internet connectivity at any location that offers 3G cellular network coverage. One drawback is that it is expensive both to acquire and to use.

Li-Fi *Light Fidelity* (Li-Fi) is a technology for wireless communication among devices using light to transmit data and position. Li-Fi is a visible communications system that can transmit data at high speeds over the visible light spectrum, ultraviolet, and infrared radiation.

In terms of users, Li-Fi is similar to Wi-Fi. The key difference is that Wi-Fi uses electromagnetic waves at radio frequencies to transmit data. Using light to transmit data allows Li-Fi to offer several advantages over Wi-Fi:

- Li-Fi provides far greater bandwidth capacity.
- Li-Fi provides very high peak data transmission rates (theoretically up to 200 Gbps).
- Li-Fi enables communications among 100 times more devices on the Internet of Things.
- Li-Fi provides enhanced security for wireless communications due to reduced interception of signals.
- Li-Fi is more effective in areas susceptible to electromagnetic interference, such as aircraft cabins and hospitals.

Wide-Area Wireless Networks

Wide-area wireless networks connect users to the internet over a geographically dispersed territory. These networks typically operate over the licensed spectrum—that is, they use portions of the wireless spectrum that are regulated by the government. In contrast, Bluetooth, Wi-Fi, and Super Wi-Fi operate over the unlicensed spectrum and are therefore more prone to interference and security problems. In general, wide-area wireless network technologies fall into two categories: cellular radio and wireless broadband.

cellular telephones (cell-phones) Phones that provide two-way radio communications over a cellular network of base stations with seamless hand-offs.

Cellular Radio Cellular telephones (cellphones) provide two-way radio communications over a cellular network of base stations with seamless hand-offs. Cellular telephones differ from cordless telephones, which offer telephone service only within a limited range through a single base station attached to a fixed landline—for example, within a home or an office.

The cellphone communicates with radio antennas, or towers, placed within adjacent geographic areas called *cells* (see Figure 8.5). A telephone message is transmitted to the local cell—that is, the antenna—by the cellphone and is then passed from cell to cell until it reaches the cell of its destination. At this final cell, the message is either transmitted to the receiving cellphone or transferred to the public switched telephone system to be transmitted to a wireline telephone. This is why you can use a cellphone to call other cellphones as well as standard wireline phones.

Cellular technology is quickly evolving, moving toward higher transmission speeds, richer features, and lower latencies (delays). This rapid evolution is necessary because more people are using mobile phones and tablets and data traffic is exploding. Cellular technology has progressed through a number of stages:

- **First generation (1G)** cellular networks, introduced in 1982, used analogue signals and had low bandwidth (capacity).
- **Second generation (2G)** networks, introduced in 1992, used digital signals primarily for voice communication and provided data communication up to 10 kilobits per second (Kbps).
- **2.5G** used digital signals and provided voice and data communication up to 144 Kbps.
- **Third generation (3G)** networks, introduced in 2001, used digital signals and could transmit voice and data up to 384 Kbps when the device was moving at a walking pace, 128 Kbps when it was moving in a car, and up to 2 Mbps when it was in a fixed location. 3G supported video, Web browsing, and instant messaging.

- **Fourth generation (4G)** networks, introduced in 2012, do not constitute one defined technology or standard. The International Telecommunications Union (ITU) has specified speed requirements for 4G: 100 Mbps (million bits per second) for high-mobility communications such as cars and trains and 1 Gbps (billion bits per second) for low-mobility communications such as pedestrians. 4G systems provide a secure mobile broadband system to all types of mobile devices. See IT's Personal for more information.

Long-term evolution (LTE) is a wireless broadband technology designed to support roaming internet access through smartphones and hand-held devices. LTE is approximately 10 times faster than 3G networks.

XLTE (advanced LTE) is designed to handle network congestion when too many people in one area try to access an LTE network. XLTE is designed to provide access for all users with no decrease in bandwidth.

- **Fifth generation (5G)** is the latest cellular standard. After an early experiment at the 2018 Winter Olympics, 5G was more widely deployed in 2019. We discuss 5G in detail in the next section.

Fifth-Generation (5G) Cellular Networks

By September 2022, some 70 countries had 5G networks, reaching 1 billion users. There are three types of 5G technology: low-band, middle-band, and high-band.

Low-band 5G, the baseline level, is best for nationwide coverage but has the most limited performance compared to the other two types of 5G. Low-band 5G's signal can penetrate obstacles and travel long distances. A single low-band 5G tower, transmitting on the frequency that used to be used for TV broadcasts, can serve people in a range of hundreds of square

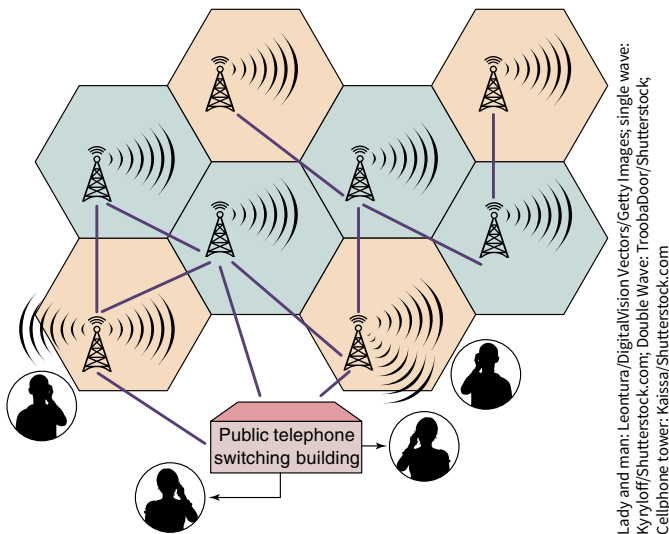


FIGURE 8.5 A cellular network and the public switched telephone system.

Sources: Image Source; © Engine Images-Fotolia.com; © AP/Wide World Photos

kilometres, including in rural locations. This baseline tier is already approximately 20 percent faster than 4G LTE networks.

Mid-band 5G is about six times faster than 4G LTE. It was first launched by Rogers in 2022 in Nanaimo, British Columbia, and will follow in Canada's major cities. Mid-band 5G offers service within smaller areas than low-band 5G. For everyday users, mid-band 5G may prove to be the ideal tier in terms of performance and proximity to a tower.

High-band 5G, also called millimetre wave 5G, is characterized by extremely low latency and is approximately 10 times faster than 4G LTE networks. High-band 5G enables messages to be transmitted almost immediately, but it requires close proximity to a tower. High-band 5G enables higher capacity for transferring data, quicker downloads, better communications, and improved access to information, making businesses more efficient and powering applications across vehicle technologies, smart cities, education, and more. High-band 5G is generally limited to line-of-sight transmission and is vulnerable to interference by weather and other factors.

To recap the characteristics of 5G spectrum bands, think of each band and its capabilities as beams of light. Low-band is similar to a floodlight. It casts an illuminating beam across a wide area but may not be the most concentrated, high-performing light. Mid-band closely resembles the beam of a flashlight; it is more precise but has a smaller cast radius. Finally, high-band can be compared to a laser pointer: it has ultimate precision but illuminates only a very small area.

All three 5G bands are alike in that they all serve enhanced mobile broadband and Internet of Things (IoT) capabilities. However, the three types of 5G also have exclusive use cases adapted to their unique spectrum bands.

Low-band 5G has numerous applications, including public transportation and first responder connectivity, fleet tracking, IoT monitoring, and kiosks. Improvements in low-band 5G transmission speeds will broaden fixed wireless use cases and increase the performance and reliability of applications like pop-up stores and mobile command centres.

Mid-band 5G will continue to enhance applications that typically run in low-band 5G. For example, a first responder who only used to be able to access various wireless applications from their vehicle would be able to use mobile HD streaming in mid-band 5G. And a surveillance camera network in low-band 5G may already offer multi-camera viewing, but operating in mid-band 5G, surveillance may also include HD visual recognition. Mid-band 5G will also handle augmented reality for commerce and public safety.

High-band 5G is best for applications requiring the highest performance, including artificial intelligence (AI) video recognition, wireless robotics, and wireless fibre replacements. In addition to remote surgeries and factories that can perform preventative self-maintenance, high-band 5G provides business continuity through large-site failover and can accommodate sporting events or large conventions.

There are many uses for 5G. We consider several of them here.

- *Enhanced agricultural productivity.* Smart farming (also called precision agriculture) is under way. 5G is enhancing the data collection and transmission from Internet of Things sensors. It also extends the geographic reach of precision agriculture to rural areas.
- *Improved remote education.* Pandemic-era restrictions that led to remote learning highlighted the vulnerabilities of current networks. 5G networks will provide higher speeds, higher capacities, and greater reliability, all of which will enhance remote education.
- *More intelligent logistics.* The logistics field, including transportation, has been expanding its use of the Internet of Things to monitor shipments in movement. 5G will enable more IoT sensors, all of which will have faster transmission speeds and greater data gathering capacities.
- *Advanced health care.* Health care organizations can use 5G in many ways, such as analytics, patient monitoring, remote diagnostics, and robot-assisted telesurgery.
- *Improved manufacturing operations.* 5G promises more flexibility than wired networks, while retaining the high-capacity, high-reliability, and low latency that manufacturing needs, particularly robotics.

Wireless Broadband, or WiMAX Worldwide Interoperability for Microwave Access, popularly known as WiMAX, is the name for IEEE Standard 802.16. WiMAX has a wireless access range of up to 50 km, compared to 100 m for Wi-Fi. WiMAX also has a data transfer rate of up to 75 Mbps. It is a secure system, and it offers features such as voice and video. WiMAX

antennas can transmit broadband internet connections to antennas on homes and businesses located many kilometres away. For this reason, WiMAX can provide long-distance broadband wireless access to rural areas and other locations that are not currently being served.

Consider this example of the use of WiMAX. On April 1, 2015, a fire broke out in the underground electrical cable ducts in a tunnel under a major highway in London, UK. The fire burned for 36 hours and caused major disruptions to broadband service in the area. With fibre-optics and broadband access to the internet not available, businesses turned to WiMAX from the telecommunications company Luminet (<http://luminet.co.uk>). One business owner noted that Luminet helped his company get its main office back online in less than 24 hours. Furthermore, Luminet's broadband service helped the company quickly move its staff back from its disaster recovery site.

IT's About Business 8.2 illustrates how citizens of Zimbabwe obtain wireless internet access by using the cellular radio network, and citizens of South Africa use Wi-Fi to acquire information about riots and unrest.

IT's About Business 8.2

MIS Wireless Internet Access in Africa

Zimbabwe

At the end of 2020, Econet (<https://www.econet.co.zw>) and NetOne (www.netone.co.zw) had a combined 94.5-percent market share for providing internet access to the African nation of Zimbabwe. Analysts contend that the lack of competition, combined with the expense of operating a telecommunications business in the country—due to import tariffs on communications equipment, foreign currency risk, and weak electricity infrastructure—has kept prices high for consumers. According to the Alliance for Affordable Internet (AAI; <https://a4ai.org>), an internet-access advocacy non-profit, Zimbabwe is one of the most expensive places in Africa to access mobile internet, relative to people's income.

Econet, Zimbabwe's largest telecommunications carrier, sells 1.4 gigabytes of data for 2,000 Zimbabwean dollars (about \$7 at the time of writing), which is more than double AAI's benchmark of 2 percent of mean monthly income. Furthermore, outside big cities such as Harare and Bulawayo, signal strength is often weak. Individuals and businesses have been discouraged from adopting digital services due to their high cost. For the same reason, Zimbabweans find it hard to access online educational materials and health services.

However, Zimbabweans who live near the Mozambican border have discovered a solution. Traders cross the border on foot or on motorbikes and purchase SIM cards in bulk from Movitel (<https://movitel.co.mz>), Mozambique's largest mobile network. They then return to border towns such as Chimanimani, where they distribute the SIM cards to supermarkets and corner stores. These stores sell the SIMs with a markup of more than 50 percent.

Many people in these border towns rely on this black-market trade, where 2 gigabytes of data from Movitel can cost as little as 200 meticals (about \$4). They can access the Web at lower prices and faster speeds, thanks to Movitel wireless signals that extend across the border. Chimanimani's inexpensive foreign broadband access has enabled the town to avoid the fate of other rural districts in Zimbabwe and across Africa, where young workers, including those in vital roles, go to the cities in search of better opportunities.

The availability of cheaper data and faster access has turned Chimanimani into a remote working hub for people who need to be online for work. For example, consider one environmentalist working for Environmental Buddies (www.ebtrust.org), a

Harare-based non-profit that promotes sustainable forestry and waste management across the country. He uses Zoom, WhatsApp, and Skype from Movitel's broadband signals to conduct daily electronic meetings about his work in Chimanimani, a place where hurricanes often damage ecosystems. As another example, the founder of the nongovernment organization Orphans Dreams, which provides free math lessons to orphan children, has been able to stay in the region because cheap internet access enables him to connect to free educational apps such as Khan Academy and Buzzmath that he can use in the classroom.

Some entrepreneurs have moved to Chimanimani to take advantage of the lower cost of online service. For example, a former nurse moved there to start up a business selling traditional Chinese medicine products. She needs broadband internet access to communicate via Zoom or WhatsApp with a medical doctor located in Harare before she gives out prescription dosages of herbs.

Similarly, a bookkeeper relocated from Harare in search of lower internet costs and a more affordable small-town lifestyle. She receives plenty of business from townspeople who file their taxes electronically and from local entrepreneurs who need to prepare car-import customs documents.

South Africa

Zello (<https://zello.com>) is a voice-first “walkie-talkie” app that is faster than typing and requires no literacy skills. Zello's original purpose was to help people regroup and communicate with each other after a natural disaster. Users subscribe to channels to talk to one another, sending live audio files via Wi-Fi that are accessible to anyone listening in on the channel. Users employ Zello to broadcast their location, share tips, and communicate with rescuers or survivors in the aftermath of a hurricane, flood, or other emergency. People who use their vehicles for work, such as taxi drivers, also use Zello when they want to make hands-free calls.

In South Africa, which lacks a formal emergency response system like 911 in the United States, people increasingly are using Zello to coordinate ad hoc ambulances and neighbourhood patrols. One channel, South Africa Community Action Network, has 11,600 paying members who donate for emergency services such as ambulances, along with more than 33,000 nonpaying members. Today, people in areas of unrest are using Zello to connect and communicate.

For example, in 2021, former South African president Jacob Zuma was sentenced to 15 months in prison for corruption during

his presidency. Zuma had a loyal following but also many detractors. His arrest caused protests, and looting broke out in many places, particularly Durban, Zuma's hometown. The violence led to more than 200 deaths and 2,500 arrests.

Many South Africans found it difficult to keep track of what was happening. WhatsApp chats were flooded with confusing and often contradictory reports. As a result, 180,000 people turned to Zello to find reliable reports concerning the unrest. One user asserted that some people were using Zello to identify houses and storefronts that were ripe for looting, while others were tuning in to determine whether they should flee or stay where they were. Another user claimed that live communications over Zello enabled his family to know the whereabouts of looters and that Zello was much faster than the news channels on television and radio.

Questions

1. What steps should the Zimbabwean government take to make internet access more affordable in that country? Why would greater internet access be so important to Zimbabwe?

2. All technologies are double-edged swords. That is, they can be used for both good and bad reasons. Other than the examples noted in this case, provide additional examples of where Zello was used to actually help rioters.

Sources: Compiled from P. Awesu, "The Rise of Internet Access in Africa," *The Circular*, April 26, 2022; N. Bhobo, "Black Market SIM Cards Turned a Zimbabwean Border Town into a Remote Work Hub," *Rest of World*, April 6, 2022; L. Monzon, "The Challenges in Getting Internet Access to All South Africans," *IT News Africa*, March 22, 2022; E. Roux, "Did Looters Use This App to Coordinate Actions and Find 'Weak Points'?" *The South African*, August 20, 2021; "Internet Access and Affordability in Zimbabwe," *zimbabwe.misa.org*, July 28, 2021; S. Smith, "The Reason behind the Riots in South Africa," *yr.media*, July 23, 2021; T. Basu, "How Zello Keeps People Connected during South Africa's Unrest," *MIT Technology Review*, July 20, 2021; U. Chioma, "Mobile Phone User Turn to Black Market for SIM Cards," *The Nigeria Lawyer*, April 26, 2021; V. Muhamba, "Are We Any Closer to Universal Internet Access in Zimbabwe?" *techzim.co.zw*, June 9, 2020; F. Mudzingwa, "Why Is Internet Access in Zimbabwe so Expensive?" *techzim.co.zw*, November 8, 2018.

IT's Personal: Wireless and Mobile

What the GSM3GHSDPA+4GLTE? This chapter explains the many mobile platforms that are available to you as a consumer. Specifically, it discusses cellular, Bluetooth, Wi-Fi, satellite, and other wireless options. Within the cellular area, however, things get confusing because telecommunications companies use so many acronyms. Have you ever wondered if Bell Canada's 3G was equivalent to AT&T Rogers' 3G? What about 4G and 4G LTE? Of course, most people assume that 4G is faster than 3G, but by how much?

Actual connection speeds are described in bit rates, meaning how many bits (1s or 0s) a device can transmit in 1 second. For example, a speed listed as 1.5 Mbps translates to 1.5 million bits per second. That sounds like a tremendous rate. Knowing the bits per second, however, is only part of understanding the actual speed. In reality, connection speed is not the same as *throughput*, which is the amount of bandwidth actually available for you to use. Throughput will always be less than the connection speed.

To understand this point, consider how your car operates. It is probably capable of driving more than 100 k.p.h. However, you are "throttled down" by various speed limits, so you never reach this potential speed. Your actual speed varies, depending on the route you take, the speed limits imposed along that route, the weather, the amount of traffic, and many other factors. In the same way, even though Bell Canada, Rogers, TELUS, and other companies boast incredible wireless speeds ("Up to 20 Mbps!"), they will always say "up to" because they know that you will never actually download a file at that rate.

The best method for determining the actual speeds of the various networks is to go to your local wireless store and run a speed test using the demo model they have on display. This test will give you firsthand experience of the actual throughput speed you can expect from their network. The result is much more realistic than terms such as 3G, 4G LTE, and 5G.

Here is how to perform the test. First, make certain the unit is connected only to a cellular network (not Wi-Fi). Then go to <http://speedtest.net>, and click "Go." Run this test at competing stores (Bell Canada, Rogers, TELUS, etc.), and you will have real data to compare. As names change, you can always run a test to find the facts.

Before you go on...

1. What is Bluetooth? What is a WLAN?
2. Describe Wi-Fi, cellular radio 5G, and WiMAX.

8.3 Mobile Computing and Mobile Commerce

LEARNING OBJECTIVE

Provide a specific example of how each of the five major m-commerce applications can benefit a business.

mobile computing A real-time connection between a mobile device and other computing environments, such as the internet or an intranet.

In the traditional computing environment, users come to a computer, which is connected with wires to other computers and to networks. Because these networks need to be linked by wires, it is difficult or even impossible for people on the move to use them. In particular, salespeople, repair people, service employees, law enforcement agents, and utility workers can be more effective if they can use IT while in the field or in transit. Mobile computing was designed for workers who travel outside the boundaries of their organizations as well as for anyone traveling outside their home.

Mobile computing refers to a real-time connection between a mobile device and other computing environments, such as the internet or an intranet. This innovation is revolutionizing how people use computers. It is spreading at work and at home; in education, health care, and entertainment; and in many other areas. Mobile computing has the ability to literally change lives, particularly because it gives new users internet access. IT's About Business 8.3 illustrates how smartphones are impacting women in India.

IT's About Business 8.3

MIS Indian Women Use Smartphones to Move Online

Historically, the majority of India's smartphone users have been men. According to one analysis, in 2020 more than 40 percent of Indian men but only 25 percent of Indian women owned a smartphone. One report noted that millions of Indian women are prevented from owning a smartphone by their fathers and husbands.

Not having access to a smartphone has worsened an already deep gender gap in India. This gap blocks women from accessing increasingly important ways of communicating and learning, making it more difficult for them to find work, upgrade their skills, and assert their political rights. As a result, Indian women are less likely than men to be literate or employed in India's formal workforce. Further, because India has more than 30 official languages, it is difficult for many women to access the internet using English keyboards.

Fortunately, three changes occurred in 2016 that significantly increased the number of Indian women who have access to smartphones. First, the Chinese manufacturer Xiaomi (<https://www.mi.com>) began to produce smartphones in India. In particular, it introduced entry-level models that cost less than \$100. Second, the Indian telecommunications company Reliance Jio (<https://www.jio.com>) launched a new wireless service that offered free nationwide voice and data for the first year. About 100 million people subscribed to the network in its first six months. From 2016 to 2022, the average cost for accessing 1 gigabyte of data dropped from \$3.10 to \$.09. Third, WhatsApp enabled users to communicate using sounds and images.

These three changes have enabled increasing numbers of Indian women to access the internet. They can find information, network with other women, and participate in the economy.

Let's take a closer look at two Indian women, Diya and Meera. Diya is a member of a nomadic tribe in southern India. Like 200 million other women in India, she is illiterate and has never attended school. She can sign her name and understand where a bus is going or what a road sign says, but not much more. She never owned a full-feature smartphone because it was too expensive. And, even if she could have afforded one, she could not read or write well enough to use it.

As a result of the three changes discussed above, however, Diya could finally afford to purchase a smartphone and use it both visually and orally. This development changed her life. Her access to the internet was no longer blocked by written words. She now uses photographs and audio memos to communicate with friends and family, and she employs voice commands to search for videos. Before Diya purchased her phone, if she wanted to contact the outside world, she had to travel on foot over mountains to the city of Madurai, where she knew some people from outside her village.

Illegal logging is an ongoing problem in the forests near Diya's home. So she joined a WhatsApp group where she documents her local forest in photos and videos. She notes that sometimes teak and sandalwood trees "go missing." To document the missing trees, she takes photos and compares them to earlier pictures of the same sites. She then shares the photos with rangers and forest officials. In the event of a confrontation with illegal loggers, her husband videotapes the situation to protect her. They then send the video, along with a voice message, to journalists.

Meera always wanted to have her own shop. Her family, however, would not allow her to have money of her own. Instead, she would earn money by sewing dresses in her village and give the money to her family.

Fortunately for Meera, Google and Tata Trusts (www.tata-trusts.org) have been working with local Indian organizations

to make it easier for women to access the internet. The two companies operate the Internet Saathi, or Internet Friend, program, which trains rural women to be digital pioneers. In particular, the women learn to use smartphones with voice commands in local languages. The program has trained more than 90,000 women to be Saathis. In turn, the Saathis have helped more than 35 million other women to learn to use smartphones to access the internet.

After Meera became a Saathi, she began to use YouTube to look up new fashion trends and to learn to stitch different designs. She searches for high-quality cloth in the market in a neighbouring town to use to sew dresses, which sell for a premium. In her village, Meera earned 200 rupees (about \$3) per dress. In the market, her dresses sell for 450 to 750 rupees (\$7 to \$12) each.

During the COVID-19 pandemic lockdown, Meera created a WhatsApp group of friends and acquaintances. She shared interesting fashion videos with the group and took preorders for dresses. She created a visual catalogue, and she built up her inventory in anticipation of a future increase in demand.

Wireless service in rural India can be intermittent. Diya often has to seek out specific locations in the forest to get a phone signal, and Meera must frequently wait for videos to load. The Indian government is working to upgrade wireless networks, which will make it even easier for additional women (and men) to access the internet.

Questions

1. We have discussed the difficulties that Indian women experience in obtaining smartphones. What difficulties might they encounter as they continue to use their phones?
2. Other than those discussed in this case, what advantages can Indian women realize from internet access?

Sources: Compiled from “75 Years, 75% Literacy: India’s Long Fight against Illiteracy,” *The Times of India*, August 14, 2022; “Tribal Women Have a Significant Role in India’s Transformation,” *Hindustan Times*, August 9, 2022; S. Sun, “Share of Mobile Phone Owners in India in 2020, by Gender and Type,” *Statista*, April 20, 2022; A. Malhotra, “5G Rollout in India in 2022: Things You Should Know,” *The Mobile Indian*, December 28, 2021; N. Panda, “Upgrading Networks for the Next Era of Connectivity,” *Fortune India*, July 8, 2021; R. Srivastava and A. Nagaraj, “Smartphones Give Rural Women in India a Lifeline,” *BusinessDay*, June 22, 2021; Y. Sampathkumar, “In India, Smartphones and Cheap Data Are Giving Women a Voice,” *Wired*, January 4, 2021; R. Agarwal, *India Connected: How the Smartphone Is Transforming the World’s Largest Democracy*, Oxford University Press, 2018; GSM Association, “Woman and Mobile in India: Realising the Opportunity,” *gsma.com*, October 24, 2016; “The Smartphone Is Hurting India’s Women,” *PYMNTS*, October 13, 2016; E. Bellman and A. Malhotra, “Why the Vast Majority of Women in India Will Never Own a Smartphone,” *Wall Street Journal*, October 13, 2016.

Mobile computing has two major characteristics that differentiate it from other forms of computing: mobility and broad reach. *Mobility* means that users carry a device with them and can initiate a real-time contact with other systems from wherever they happen to be. *Broad reach* refers to the fact that, when users carry an open mobile device, they can be reached instantly, even across great distances.

Mobility and broad reach create five value-added attributes that break the barriers of geography and time: ubiquity, convenience, instant connectivity, personalization, and localization of products and services. A mobile device can provide information and communication regardless of the user’s location (*ubiquity*). With an internet-enabled mobile device, users can access the Web, intranets, and other mobile devices quickly and easily, without booting up a PC or placing a call through a modem (*convenience* and *instant connectivity*). A company can customize information and send it to individual consumers as a short message service (SMS) (*customization*). Further, knowing a user’s physical location helps a company advertise its products and services (*localization*). Mobile computing provides the foundation for mobile commerce (m-commerce), to which we now turn.

Mobile Commerce

Besides affecting our everyday lives, mobile computing is also transforming how organizations conduct business by enabling businesses and individuals to engage in mobile commerce. As you saw at the beginning of this chapter, **mobile commerce** (or *m-commerce*) refers to electronic commerce (EC) transactions that are conducted in a wireless environment, especially on the internet. Like regular EC applications, m-commerce can be transacted on the internet, private communication lines, smart cards, and other infrastructures. M-commerce creates opportunities for businesses to deliver new services to existing customers and to attract new customers. Its development is driven by the widespread availability of mobile devices, the declining prices of such devices, and rapidly improving wireless bandwidth.

Mobile computing and m-commerce include many applications, which result from the capabilities of various technologies. You will examine these applications and their impact on business activities in the next section.

mobile commerce (or m-commerce) Electronic commerce transactions that are conducted with a mobile device.

Mobile Commerce Applications

Mobile commerce applications are many and varied. The most popular applications include location-based applications, financial services, intrabusiness applications, accessing information, and telemetry. The rest of this section examines these various applications and their effects on how people live and do business.

FIN Financial Services Mobile financial applications include banking, wireless payments and micropayments, money transfers, mobile wallets, and bill payment services. The bottom line for mobile financial applications is making it more convenient for customers to transact business regardless of where they are or what time it is.

Web shoppers have historically preferred to pay with credit cards. Because credit card companies typically charge fees on transactions, however, credit cards are an inefficient way to make very small purchases. The growth of relatively inexpensive digital content, such as music (e.g., iTunes), ringtones, and downloadable games, is driving the growth of *micropayments*—that is, very small purchase amounts, usually less than \$10—as merchants seek to avoid paying credit card fees on small transactions.

A **mobile wallet**, also called a digital wallet, is an app that people use to make financial transactions. These apps can be downloaded on users' desktops or smartphones. When the app is on a smartphone, it becomes a mobile wallet. Mobile wallets replace the need to carry physical credit and debit cards, gift cards, and loyalty cards, as well as boarding passes. They may also store insurance and loyalty cards, drivers' licences, ID cards, website passwords, and login information. Furthermore, mobile wallets eliminate the need to enter shipping, billing, and credit card data each time a user makes a purchase at a website. The data are encrypted in the user's phone, tablet, or computer, and the wallet contains a digital certificate that identifies the authorized cardholder.

FIN To use a mobile wallet, consumers wave their phones a few inches above a payment terminal instead of swiping a plastic card. This process uses near-field communication. There are several mobile wallets and payment apps from which to choose.

mobile wallet (m-wallet) A technology that allows users to make purchases with a single click from their mobile devices.

- *Google Wallet* is a mobile wallet that uses NFC to allow its users to store debit cards, credit cards, loyalty cards, and gift cards on their smartphones. With Google Wallet, users launch an app and then type in a PIN so Google can access their stored card credentials. Google Wallet also provides a peer-to-peer payment system that can send money to a real, physical Google Wallet card.
- *Google Pay* (a different app from Google Wallet) allows users to tap and pay in stores and use and redeem loyalty cards, gift cards, and offers in stores.
- *Starbucks' mobile pay app* launched before the other three top payment apps—Apple Pay, Google Pay, and Samsung Pay. The app lets users pay with their phones and earn credits toward future purchases. The Starbucks app is available on both iOS and Android, whereas Apple Pay, Google Pay, and Samsung Pay users are restricted by the type of phone they have.
- *Samsung Pay* is a mobile payment app and digital wallet that lets users make payments using compatible phones. The service supports contactless payments using NFC and also supports magnetic stripe-only payment terminals. In countries like India, the service supports bill payments.
- *Mastercard's Contactless*, *American Express's ExpressPay*, and *Visa's PayWave* are EMV-compatible, contactless payment features. EMV—which stands for Europay, Mastercard, and Visa, the three companies that originally created the standard—is a technical standard for smart payment cards. EMV cards are smart cards that store their data on chips rather than on magnetic stripes. They can be either contact cards that must be physically inserted into a reader or contactless cards that can be read over a short distance using radio-frequency identification (RFID) technology. (We discuss RFID in Section 8.4.) EMV cards are also called chip-and-pin cards.
- *Apple Pay* is a mobile wallet that uses near-field communications to enable users to make payments using various Apple devices. Apple Pay does not require Apple-specific contactless payment terminals; rather, it will work with Visa's PayWave, Mastercard's PayPass, and American Express's ExpressPay terminals. The wallet is similar to other wallets with

the addition of two-factor authentication. Users hold their authenticated Apple device to the point-of-sale system. iPhone users authenticate by holding their fingerprint to the phone's Touch ID sensor, and Apple Watch users authenticate by double-clicking a button on the device.

- *Amazon Pay* is a service that lets customer use the payment methods already associated with their Amazon accounts to make payment for goods and services on third-party websites. Amazon Pay Places allows users to order ahead and pay for goods in-store via the Amazon app.
- *Alipay Wallet* is a mobile and online payment platform from China's Alibaba Group (www.alibabagroup.com). Alipay provides numerous payment services for online purchases.

Users can employ the app to pay for local in-store purchases, credit card bills, bank account management, person-to-person money transfers, train tickets, food orders, ride hailing, taxi fees, water and electricity utility bills, cable television fees, tuition fees, and traffic fines.

- *WeChat Pay* is a digital wallet service incorporated into WeChat. Users who have provided bank account information can use the app to pay bills, order goods and services, transfer money to other users, and pay in stores.

The stakes in this competition are enormous because the small fees generated every time consumers swipe their cards add up to tens of billions of dollars annually in the United States alone. The potential for large revenue streams is real because mobile wallets have clear advantages. For example: Which are you more likely to have with you at any given moment—your phone or your physical wallet? Also, keep in mind that if you lose your phone, it can be located on a map and remotely deactivated. Plus, your phone can be password-protected. Your physical wallet, however, cannot be protected in this way.

Location-Based Applications and Services M-commerce B2C applications include location-based services and location-based applications. Location-based mobile commerce is called **location-based commerce** (or L-commerce).

Location-based services provide information that is specific to a given location. For example, a mobile user can (1) request the nearest business or service, such as an ATM or a restaurant; (2) receive alerts, such as a warning of a traffic jam or an accident; and (3) locate a friend. Wireless carriers can provide location-based services such as locating taxis, service personnel, doctors, and rental equipment; scheduling fleets; tracking objects such as packages and train boxcars; finding information such as navigation, weather, traffic, and room schedules; targeting advertising; and automating airport check-ins.

MKT Consider, for example, how location-based advertising can make the marketing process more productive. Marketers can use this technology to integrate mobile users' current locations and preferences. They can then send user-specific advertising messages concerning nearby shops, malls, and restaurants to consumers' wireless devices.

MKT Mobile Advertising *Mobile advertising* is a form of advertising through cell-phones, smartphones, or other mobile devices. Analysts estimate that mobile advertising revenue will reach approximately \$17 billion by 2025 in Canada alone.

Intrabusiness Applications Although business-to-consumer (B2C) m-commerce receives considerable publicity, most of today's m-commerce applications are actually used *within* organizations. In this section, you will see how companies use mobile computing to support their employees.

POM Mobile devices are increasingly becoming an integral part of workflow applications. For example, companies can use non-voice mobile services to assist in dispatch functions—that is, to assign jobs to mobile employees, along with detailed information about the job. Target areas for mobile delivery and dispatch services include transportation (delivery of food, oil, newspapers, cargo; courier services; tow trucks; taxis), utilities (gas, electricity, phone, water); field service (computers, office equipment, home repair); health care (visiting nurses, doctors, social services); and security (patrols, alarm installation).

location-based commerce (L-commerce) Mobile commerce transactions targeted to individuals in specific locations, at specific times.

telemetry The wireless transmission and receipt of data gathered from remote sensors.

Accessing Information Another vital function of mobile technology is helping users obtain and use information.

POM Telemetry Applications **Telemetry** refers to the wireless transmission and receipt of data gathered from remote sensors. Telemetry has numerous mobile computing applications. For example, technicians can use telemetry to identify maintenance problems in equipment, and doctors can monitor patients and control medical equipment from a distance. Car manufacturers use telemetry applications for remote vehicle diagnosis and preventive maintenance. For instance, drivers of many General Motors cars use its OnStar system (www.onstar.com) in numerous ways.

An interesting telemetry application for individuals is an iPhone app called Find My iPhone. Find My iPhone is a part of the Apple iCloud (www.apple.com/icloud). This app provides several very helpful telemetry functions. If you lose your iPhone, for example, it offers two ways to find its approximate location on a map. First, you can sign in to the Apple iCloud from any computer. Second, you can use the Find My iPhone app on another iPhone or iPad.

If you remember where you left your iPhone, you can write a message and display it on your iPhone's screen. The message might say, "Left my iPhone. Please call me at 301-555-1211." Your message appears on your iPhone, even if the screen is locked. And if the map indicates that your iPhone is nearby—perhaps in your office under a pile of papers—you can tell Find My iPhone to play a sound that overrides the volume or silent setting.

If you left your iPhone in a public place, you may want to protect its contents. You can remotely set a four-digit passcode lock to prevent people from using your iPhone, accessing your personal information, or tampering with your settings. Going further, you can initiate a remote wipe (erase all contents) to restore your iPhone to its factory settings. If you eventually find your phone, then you can connect it to your computer and use iTunes to restore the data from your most recent backup.

If you have lost your iPhone and you do not have access to a computer, you can download the Find My iPhone app to a friend's iPhone or iPad and then sign in to access all the Find My iPhone features.

Before you go on...

1. What are the major drivers of mobile computing?
2. Describe wireless financial services.
3. Discuss some of the major intrabusiness wireless applications.

8.4

The Internet of Things

LEARNING OBJECTIVE

Describe the Internet of Things, and provide examples of how organizations can use the Internet of Things.

Internet of Things (IoT) A scenario in which objects, animals, and people are provided with unique identifiers and the ability to automatically transfer data over a network without requiring human-to-human or human-to-computer interaction.

The **Internet of Things (IoT)** refers to the billions of animate (living) and inanimate objects that are equipped with embedded sensors and connected wirelessly to the internet. Each object has a unique identity (i.e., its own IP address) and is able to send and receive data over the internet without human interaction. Because the IoT generates huge amounts of data, it is a significant driver of analytics (see Chapter 12) and machine learning systems (see Chapter 14).

There are two types of IoT: consumer IoT and industrial IoT. *Consumer IoT* devices include smartwatches, smartphones, wearable devices, smart home speakers, light bulbs, electrical outlets, thermostats, door locks, doorbells, appliances, and other smart home products. For consumers, the smart home is where they most likely come into contact with the consumer IoT.

The *Industrial Internet of Things (IIoT)*, also called the fourth industrial revolution, Industry 4.0, or machine-to-machine (M2M) communication, all refer to the use of IoT technology in a business setting. The basic concept of the IIoT is to use a combination of sensors, wireless networks, Big Data, AI, and analytics to measure and optimize industrial processes. The IIoT refers to the billions of industrial devices—anything from the machines in a factory to the engines on an airplane—that are equipped with sensors, connected to wireless networks, and gather and share data.

Security and privacy are two of the biggest problems with the IoT. Privacy is critically important because sensors are collecting our extremely sensitive data—for example, what you say in your own home or your personal medical data.

The IoT's security track record has been extremely poor. Many IoT devices are small and inexpensive and do not contain the necessary built-in security features to counter threats. Even worse, the majority of IoT transmissions are not encrypted. Therefore, these devices are permanently at risk.

Hackers are now targeting IoT devices because their inherent lack of security makes them easy to compromise and incorporate into botnets. In 2016, attackers used the Mirai worm to compromise hundreds of thousands of IoT devices to form a massive botnet. They then used their botnet to conduct distributed denial-of-service attacks to take down major websites.

Connecting industrial machinery into IIoT networks increases the risk of hackers attacking these devices. Industrial espionage or a destructive SCADA attack (see Chapter 4) are potential risks.

Three technologies have been essential factors in the rapid deployment of the IoT: IPv6 (discussed in Chapter 6), which created a vast number of IP addresses; 5G technologies, which provide a vastly improved communications infrastructure for the IoT; and wireless sensors.

A **wireless sensor** is an autonomous device that monitors its own condition as well as physical and environmental conditions around it, such as temperature, sound, pressure, vibration, and movement. Sensors can also control physical systems, such as opening and closing a valve and adjusting the fuel mixture in your car (see SCADA systems in Chapter 4).

Wireless sensors contain processing, storage, and radio-frequency antennas for sending and receiving messages. Each sensor “wakes up” or activates for a fraction of a second when it has data to transmit. It then relays those data to its nearest neighbour. So, rather than every sensor transmitting its data to a remote computer, the data travel from sensor to sensor until they reach a central computer, where they are stored and analyzed. An advantage of this process is that if one sensor fails, then another one can pick up the data. This process is efficient and reliable, and it extends the sensor's battery life.

Radio-frequency identification tags are one type of wireless sensor. **Radio-frequency identification (RFID)** technology allows manufacturers to attach tags containing antennas and computer chips on products. The tags contain enough data to uniquely identify each item. As RFID tags decrease in size and cost, they will be replacing bar code technology although not entirely.

Bar codes are cheap but do not provide as much data as an RFID chip. Quick response (QR) codes were also developed to replace bar codes. A *QR code* is a two-dimensional code, readable by dedicated QR readers and camera phones. QR codes store much more information than bar codes because they store information horizontally and vertically. **Figure 8.6** illustrates bar codes, QR codes, and an RFID tag. **Figure 8.7** shows a small RFID reader and RFID tag.

There are numerous examples of how the Internet of Things is being deployed. We discuss just a few of them here.

wireless sensor An autonomous device that monitors its own condition as well as physical and environmental conditions around it, such as temperature, sound, pressure, vibration, and movement.

radio-frequency identification (RFID) technology A wireless technology that allows manufacturers to attach tags with antennas and computer chips on goods and then track their movement through radio signals.



FIGURE 8.6 Bar codes, RFID tags, and QR codes.



FIGURE 8.7 Small RFID reader and RFID tag.

The smart home. In a *smart home*, your home computer, television, lighting and heating controls, smart speakers, home security systems (including smart window and door locks), thermostats, and appliances have embedded sensors and can communicate with one another through a home network. You control these networked objects through your smartphone, television, home computer, and even your automobile. Appropriate service providers and homeowners can access the devices for which they are authorized. Smart home technology can be applied to any building, turning it into a smart building.

POM *Smart stores.* A smart store is a brick-and-mortar retail establishment that has deployed smart shelves and smart products. Smart shelves contain embedded weight sensors that automatically keep track of inventory. Smart products have embedded sensors such as RFID tags that uniquely identify each item. Smart stores also use cameras to track shoppers and products. A current example of a smart store is Amazon Go, the cashierless checkout grocery store. Some smart stores have deployed smart mirrors, where customers can virtually try on as many pieces of clothing as they want without needing a fitting room.

POM *Smart cities.* A smart city is an urban area that uses a variety of IoT sensors to analyze data collected from citizens, devices (e.g., smart streetlights, traffic signals, environmental monitoring sensors, surveillance cameras), buildings, and other assets. City employees use the insights to manage assets, resources, and services efficiently to improve city operations. Examples of these operations include monitoring and managing traffic and transportation systems, power plants, utilities, water supply networks, waste systems, crime detection and prevention, libraries, hospitals, and other community services.

The *Array of Things* is a network of *nodes* or interactive sensor boxes that collect and process urban data in real time and pass it on to citizens, scientists, and policy-makers. Each node contains high-resolution cameras and microphones, along with sensors to measure humidity, vibration, magnetic fields, temperature, air pollution, barometric pressure, sound, wind speed and direction, and amount of rain. Each node also has an Nvidia graphics processing unit to perform computations on images out in the field and send only processed data to the network, a form of edge computing.

The Array of Things brings a new depth to the information available on a city's environment and its transportation networks. This process in turn supports more informed, data-driven policy decisions around a range of complex challenges, including flooding, air quality, public health, pedestrian traffic, and road conditions.

The Array of Things is expanding through a project called SAGE. Unlike most other urban sensing systems, which are proprietary, anyone is allowed to write software for SAGE nodes. The library of open-source applications developed for the nodes is available on GitHub. It is growing constantly and includes programs for identifying birds by their songs and classifying funnel clouds from images.

Automotive. Modern cars have many sensors that monitor functions such as engine operation, tire pressure, fluid levels, and many others. Cars can warn drivers of impending mechanical or other problems and automatically summon roadside assistance or emergency services when necessary. Furthermore, sensors provide advanced driver assistance such as automatic parking, monitoring blind spots, detecting driver drowsiness, forward collision warning, and many other functions.

The next evolution in the automotive space is autonomous vehicles. These vehicles must communicate with one another instantaneously many times per second to avoid collisions and operate correctly. 5G's high-bandwidth transmission speed, low latency, low battery consumption, high reliability, and ability to support huge numbers of connected devices are all critically important characteristics that will help to make autonomous vehicles a viable technology.

POM *Smart factories.* A smart factory is a flexible system that optimizes performance across an interconnected network of automated machines, robots, and humans. It can adapt to, and learn from, new conditions in real or near-real time and autonomously operate entire production processes. A network of IoT sensors monitors equipment and flags potential and current issues. For example, sensors using AI may recognize sounds or note other conditions that signal a problem with equipment. These sensors can reduce human site inspections, improve site inspection productivity as problem areas are predicted, reduce safety risks on the production floor, and increase productivity.

POM *Digital twins.* A digital twin is a virtual (digital) representation of a real-world (physical) product or service. When physical entities, such as engines, are modelled in software and real-time sensor data are analyzed, engineers can find potential problems before they actually occur and perform simulations to optimize performance.

Consider the Siemens Internet of Trains project, which has enabled the manufacturer to move from only selling trains to offering a guarantee that its trains will arrive on time. In this project, Siemens embedded sensors in trains and railway tracks in select locations in Spain, Russia, and Thailand. The firm then used those data to train machine-learning models (the digital twin) to discover signs that tracks or trains may be having problems. Detailed insights into which parts of the rail network are most likely to fail, and when, have allowed repairs to be targeted where they are most needed, a process called predictive maintenance. That process, in turn, has enabled Siemens to start selling what it calls *outcome as a service*, which is a guarantee that trains will arrive on time close to 100 percent of the time.

One of the first companies to integrate IoT sensor data with machine learning models was ThyssenKrupp, which operates 1.1 million elevators worldwide and has been feeding data collected by sensors in its elevators into machine-learning models (the digital twin) for years. These models provide real-time updates on the status of elevators and predict which ones are likely to fail, and when, allowing the company to perform preventive maintenance where it is needed. This process reduces elevator outages and saves money on unnecessary servicing.

MKT *Customer service.* The NTT Indycar Series (www.indycar.com) consists of five automobile races including the Indianapolis 500. The organization uses a combination of digital twinning, analytics, and machine learning to give fans access to insights in real time.

NTT creates a digital twin for every car in the series by using historical data as a foundation. Each car is equipped with more than 140 sensors that collect millions of data points during each race to feed the digital twin. The data include variables such as speed, oil pressure, tire wear, and G forces. NTT uses machine learning and predictive analytics on the digital twin data to deliver insights to fans that previously would only have been available to race team engineers, including race predictions, pit-stop performance impact, and the effects of fuel levels and tire wear.

MKT Cushman & Wakefield (www.cushmanwakefield.com), a commercial real estate company with 400 offices across 60 countries, uses digital twins to improve the process of listing and renting commercial properties for both landlords and tenants. The firm scans each property in three dimensions, producing more than 1,000 digital twins of buildings, comprising 306,600 square metres. The firm is now able to show these properties to prospective tenants and buyers in a virtual, three-dimensional environment.

The user is able to “walk through” each property at their own pace, in their own time, as if they were on site in person. Viewing the digital twins saves clients time, effort, and money. Cushman & Wakefield views the technology as complementary to in-person visits, rather than a replacement for them.

POM *Supply chain management.* The IoT can make a company’s supply chain much more transparent. A company can now track the movement of raw materials and parts in real time through the manufacturing process to finished products delivered to the customer. Sensors in fleet vehicles (e.g., trucks) can monitor the condition of sensitive consignments (e.g., the temperature of perishable food). They can also trigger automatic security alerts if a container is opened unexpectedly.

POM *Energy management.* Sensors can be integrated into all forms of energy-consuming devices, such as switches, power outlets, light bulbs, and televisions. They will be able to communicate directly with utility companies through smart meters to balance power generation and energy usage. Another valuable application of sensors is for use in smart electrical meters, forming a *smart grid*.

POM *Transportation.* Sensors placed on complex transportation machines such as jet engines and locomotives can provide critical information on their operations. Consider General Electric (GE; www.ge.com), which embeds “intelligence” in the form of 250 sensors in each of its giant locomotives. The sensors produce 9 million data points every hour. How can these sensors improve the performance of such a huge machine?

One of the biggest problems on locomotives is faulty bearings. If a bearing fails, then an axle might freeze, leaving a train marooned on the tracks. To avoid this type of scenario, GE embeds one sensor inside each locomotive’s gear case that transmits data on oil levels and

contaminants. By examining these data, GE can predict the conditions that cause bearings to fail and axles to freeze. GE data analysts claim that sensors that predict part failures before they occur translate into billions of dollars of savings for GE's rail customers.

POM In another example, Rolls-Royce has deployed digital twin technology to monitor its jet engines. The company can monitor each engine in real time, the conditions in which it is flying, and how the pilot uses it. The manufacturer is tailoring its maintenance programs to ensure that it is optimizing for the life an engine really has, not the life that the manual says it has.

The company has been offering engine monitoring as a service to its customers for years, but its digital twin capability has enabled it to tailor its service for each specific engine. Digital twins have helped Rolls-Royce extend the time between maintenance for some engines by up to 50 percent, dramatically reducing its inventory of parts and spares. The technology has also helped Rolls-Royce improve the efficiency of its engines, saving close to 20 million tonnes of carbon to date.

Health care. In a hospital in Gujarat, India, a patient had a tiny balloon inserted into a blood vessel in his heart. He then had a stent placed in the vessel to keep it wide open. The surgeon who performed these two procedures was 32 km away. The surgeon used augmented reality, high-definition video, and real-time data readings from medical sensors. He received precise three-dimensional data from X-rays sent to his augmented reality headset, which he used to control the remote robotic surgical tool. This process is called *telesurgery*.

Many patients receive care outside traditional hospitals and clinics, such as assisted living facilities or their homes. Patients with non-life-threatening conditions can either wear sensors or have them implanted—for example, to monitor blood pressure or glucose levels. These sensors are monitored by medical staff. In many cases, the patients can be shown how to interpret the sensor data themselves. Consumer-oriented sensors such as the Fitbit and Apple iWatch can also monitor patients' activity levels and overall health.

POM *Agriculture.* Sensors monitor air temperature, humidity, soil temperature, soil moisture, leaf wetness, atmospheric pressure, solar radiation, trunk/stem/fruit diameter, wind speed and direction, and rainfall in real time. The data from these sensors are used in precision agriculture. *Precision agriculture* is a farming technique based on observing, measuring, and responding to inter- and intra-field variability in crops.

Hospitality. The Annex, a boutique hotel in Toronto, has integrated smart hotel technology to improve its guests' experience.

One application involves smart room locks. After a guest makes a reservation, that guest's phone or smart device can access their room once they arrive during the period of time when the reservation is valid. The connected locks enable management to monitor when doors are open or closed, locked or unlocked. If a guest has a reservation for a room and is also renting a meeting room, the app will provide seamless access to both.

Another IoT application involves an occupancy detector, whereby sensors located in the rooms would alert the main control system when a cleaner leaves a room. This would then trigger the room access code to be sent automatically to the customer and set the room lighting and temperature to the guest's preferences.

Another example is the Versante Hotel in Richmond, British Columbia. The luxury hotel has equipped its 100 rooms and suites with smart windows to automatically control the amount of light and heat that enters the room, avoiding the need for blinds. These windows are built with a special coating that can be connected to IoT sensors and adjusted automatically in response to outdoor conditions, increasing the tint when there is too much sunlight and heat.

Before you go on...

1. Define the Internet of Things.
2. Provide two examples (other than those mentioned in this section) of how the Internet of Things benefits organizations (public sector, private sector, for-profit, or not-for-profit).
3. Provide two specific business uses of RFID technology.

What's in IT for me?

ACCT For the Accounting Major

Wireless applications help accountants count and audit inventory. They also expedite the flow of information for cost control. Price management, inventory control, and other accounting-related activities can be improved with the use of wireless technologies.

FIN For the Finance Major

Wireless services can provide banks and other financial institutions with a competitive advantage. For example, wireless electronic payments, including micropayments, are more convenient (anywhere, anytime) than traditional means of payment, and they are less expensive. Electronic bill payment from mobile devices is becoming more popular, increasing security and accuracy, shortening cycle time, and reducing processing costs.

MKT For the Marketing Major

Imagine a whole new world of marketing, advertising, and selling, with the potential to increase sales dramatically. Such is the promise of mobile computing. Of special interest for marketers are location-based advertising and the new opportunities resulting from the Internet of Things and RFID. Finally, wireless technology also provides new opportunities in sales force automation (SFA), enabling faster and better communications with both customers (CRM) and corporate services.

POM For the Production/Operations Management Major

Wireless technologies offer many opportunities to support mobile employees of all kinds. Wearable computers enable offsite employees and repair personnel working in the field to service customers faster, better, and less expensively. Wireless devices can increase productivity within factories by enhancing communication and collaboration as well as managerial planning and control. Mobile computing technologies can also improve safety by providing quicker warning signs and instant messaging to isolated employees.

HRM For the Human Resource Management Major

Mobile computing can improve HR training and extend it to any place at any time. Wireless devices can also make it even more convenient for employees to select their own benefits and update their personal data.

For the MIS Major

MIS personnel provide the wireless infrastructure that enables all organizational employees to compute and communicate anytime, anywhere. This convenience provides exciting, creative, new applications for organizations to reduce expenses and improve the efficiency and effectiveness of operations (e.g., to achieve transparency in supply chains). Unfortunately, as you read earlier, wireless applications are inherently insecure. This lack of security is a serious problem with which MIS personnel must contend.

Summary

8.1 Identify the advantages and disadvantages of wireless devices and each of the three main types of wireless transmission media.

Microwave transmission systems are used for high-volume, long-distance, line-of-sight communication. One advantage is the high volume. A disadvantage is that microwave transmissions are susceptible to environmental interference during severe weather such as heavy rain and snowstorms.

Satellite transmission systems make use of communication satellites and receive and transmit data through line-of-sight. One advantage is that the enormous footprint—the area of Earth's surface reached by a satellite's transmission—overcomes the limitations of microwave data relay stations. Like microwaves, satellite transmissions are susceptible to environmental interference during severe weather.

Radio transmission systems use radio-wave frequencies to send data directly between transmitters and receivers. An advantage is that radio waves travel easily through normal office walls. A disadvantage is that radio transmissions are susceptible to snooping by anyone who has similar equipment that operates on the same frequency.

8.2 Explain how businesses can use short-range, medium-range, and long-range wireless networks.

Short-range wireless networks simplify the task of connecting one device to another, eliminating wires, and enabling people to move around while they use the devices. In general, short-range wireless networks have a range of 30 m or less. Short-range wireless networks include Bluetooth, ultra-wideband, and near-field communication. A business application of ultra-wideband is the PLUS Real-Time Location System from Time Domain. Using PLUS, an organization can locate multiple people and assets simultaneously.

Medium-range wireless networks include Wi-Fi networks. *Wi-Fi* provides fast and easy internet or intranet broadband access from public hotspots located at airports, hotels, internet cafés, universities, conference centres, offices, and homes.

Wide-area wireless networks connect users to the internet over geographically dispersed territory. They include cellular telephones and wireless broadband. *Cellular telephones* provide two-way radio communications over a cellular network of base stations with seamless handoffs. *Wireless broadband* has a wireless access range of up to 50 km and a data transfer rate of up to 75 Mbps. WiMAX can provide

long-distance broadband wireless access to rural areas and remote business locations.

8.3 Provide a specific example of how each of the five major m-commerce applications can benefit a business.

Location-based services provide information specific to a location. For example, a mobile user can (1) request the nearest business or service, such as an ATM or restaurant; (2) receive alerts, such as a warning of a traffic jam or an accident; and (3) find a friend. With *location-based advertising*, marketers can integrate mobile users' current locations and preferences. They can then send user-specific advertising messages about nearby shops, malls, and restaurants to wireless devices.

Mobile financial applications include banking, wireless payments and micropayments, money transfers, wireless wallets, and bill payment services. The bottom line for mobile financial applications is to make it more convenient for customers to transact business regardless of where they are or what time it is.

Intrabusiness applications consist of m-commerce applications that are used *within* organizations. Companies can use non-voice

mobile services to assist in dispatch functions—that is, to assign jobs to mobile employees, along with detailed information about the job.

When it comes to *accessing information*, m-commerce applications are designed to aggregate and deliver content in a form that will work within the limited space available on mobile devices. These portals provide information to users anywhere and anytime.

Telemetry is the wireless transmission and receipt of data gathered from remote sensors. Company technicians can use telemetry to identify maintenance problems in equipment. Car manufacturers use telemetry applications for remote vehicle diagnosis and preventive maintenance.

8.4 Describe the Internet of Things, and provide examples of how organizations can use the Internet of Things.

The Internet of Things (IoT) is a system in which any object, natural or manmade, has a unique identity (using IPv6) and the ability to send and receive information over a network (i.e., the internet) without human interaction.

We leave the examples of various uses of the IoT up to the student.

Key Terms

Bluetooth 245
cellular telephones (cellphones) 248
global positioning system (GPS) 241
hotspot 246
Internet of Things (IoT) 256
location-based commerce 255
microwave transmission 238
mobile commerce 253

mobile computing 252
mobile wallet 254
near-field communication (NFC) 246
personal area network 245
propagation delay 238
radio transmission 243
radio-frequency identification (RFID) 257
satellite radio 243

satellite transmission 238
telemetry 256
ultra-wideband (UWB) 245
wireless 235
wireless access point 246
Wireless Fidelity (Wi-Fi) 246
wireless local area networks (WLANs) 246
wireless sensor 257

Discussion Questions

- Given that you can lose a cellphone as easily as a wallet, which do you feel is a more secure way of carrying your personal data? Support your answer.
- If mobile computing is the next wave of technology, would you ever feel comfortable handing a server your cellphone to make a payment at a restaurant the way you currently hand over your credit or debit card? Why or why not?
- What happens if you lose your NFC-enabled smartphone or it is stolen? How do you protect your personal information?
- In your opinion, is the mobile (or digital) wallet a good idea? Why or why not?
- Discuss how m-commerce can expand the reach of e-business.
- Discuss how mobile computing can solve some of the problems of the digital divide.
- Explain the benefits that wireless commerce gives consumers and the benefits that it gives merchants.
- Discuss the ways in which Wi-Fi is being used to support mobile computing and m-commerce. Describe the ways in which Wi-Fi is affecting the use of cellular phones for m-commerce.
- You can use location-based tools to help you find your car or the closest gas station. However, some people see location-based tools as an invasion of privacy. Discuss the pros and cons of these tools.
- Discuss the benefits of telemetry in health care for everyone during the COVID-19 pandemic.
- Discuss how wireless devices can help people with disabilities.
- Which of the applications of the Internet of Things do you think are likely to gain the greatest market acceptance over the next few years? Why?

Problem-Solving Activities

1. Examine how new data-capture devices such as RFID tags help organizations accurately identify and segment their customers for activities such as targeted marketing. Browse the Web and propose five potential new applications not listed in this chapter for RFID technology. What issues would arise if a country's laws mandated that such devices be embedded in everyone's body as a national identification system?
2. Investigate commercial uses of GPS. Prepare a report with three different recent applications of this technology for consumer-oriented products.
3. Examine the types of products being enhanced with Bluetooth technology. Present two of these products to the class and explain how they are enhanced by Bluetooth technology.
4. Explore www.nokia.com. Prepare a summary of the types of mobile services and applications Nokia currently supports and plans to support in the future.
5. Enter www.ibm.com. Search for "wireless e-business." Research the resulting stories to determine the types of wireless capabilities and applications IBM's software and hardware support. Describe some of the ways these applications have helped specific businesses and industries.
6. Enter www.onstar.com. What types of *fleet* services does OnStar provide? Are these any different from the services OnStar provides to individual car owners? (Play the movie.)
7. Access www.ericsson.com. Read the page on the Internet of Things and watch the video on Connected Mangroves. What do you think of this idea? What other ideas do you have?
8. Visit your cell provider's website and compare its 5G plans. Which 5G-capable phone would you choose and which plan would you take out? Would you change from what you have right now or are you already on a 5G plan?

Closing Case

MIS IoT Transforming Smart City Projects: A Canadian Sampler

Wireless technologies are increasingly pervasive in urban environments, aiding the management of public city infrastructure such as roads, water supply, and street lighting. This integration aims to enhance effectiveness and efficiency, giving rise to what are commonly known as smart cities.

One notable smart city project is the implementation of NoTraffic's (<https://notraffic.tech>) cloud-based smart traffic light system at the University of British Columbia's Vancouver campus. This initiative marks the first deployment of its kind in Canada. Through a collaboration with Rogers Communications, NoTraffic installed a network of cameras and radars on existing traffic light posts. These devices transmit data over the cellular-data network, enabling real-time monitoring of intersections and optimization of traffic flow.

NoTraffic's IoT solution offers advanced capabilities, including the identification of various road users such as cyclists, pedestrians, buses, cars, garbage trucks, and emergency vehicles. The system can accurately determine their speed and prioritize traffic dynamically based on predefined criteria set by the city. By leveraging this technology, the smart traffic light system aims to enhance the efficiency and safety of transportation within the campus area.

Overall, the partnership between NoTraffic and Rogers Communications demonstrates how IoT solutions can be harnessed to transform traffic management in smart cities, offering real-time insights and intelligent decision making to optimize the flow of vehicles and improve the overall urban experience.

NoTraffic claims that its smart traffic light system can achieve a 40-percent reduction in average delay time per vehicle at intersections and increase the time cars spend on green instead of yellow by 14 percent. These improvements have significant direct benefits

not only for the environment and drivers but also for pedestrians, thereby reducing car accidents.

Another example of a smart city project is TELUS's implementation of a 5G data network to monitor water quality in municipalities. This system involves installing sensor boxes at multiple points throughout the municipal water system, including residential and commercial water meters, to measure water quality. When a problem is detected, an alert message is sent through the 5G network. The goal is to provide all municipalities, including small Indigenous and rural communities facing water access challenges, with access to this technology.

IoT technologies are also reshaping waste management and garbage collection in Canadian cities. Superfy (<https://www.superfy.com>), an IoT hardware and software provider, offers a waste bin management system, which equips waste bins with wireless IoT sensors to monitor fill levels, orientation, temperature, and more. The system relays data in near-real time over existing 5G networks, promising improved waste and recycling collection operations, including a reduction in the number of vehicles and waste bins needed.

However, along with the promising benefits, there are important challenges and limitations to address. Cost and maintenance are significant concerns for smart city projects. For instance, the City of Toronto proposed a smart city project involving wireless devices monitoring the use of public benches. However, the poor financial viability of maintaining such a wireless network led to the project's abandonment.

Privacy is another major concern regarding the use of IoT technologies in public infrastructure and services in cities. The collection of personal data, such as activities, interactions, and behaviours, raises concerns about potential misuse.

Unfortunately, many of these challenges have not received adequate attention. Enthusiasts and advocates, including vendors

of smart city IoT hardware and software, often emphasize the benefits while avoiding discussions about the challenges. For instance, the Rogers Smart Cities website (<https://www.rogers.com/business/iot/smart-cities>) does not mention privacy concerns, instead highlighting improved efficiency, sustainability, and economic growth as primary goals. Additionally, there is a need to consider whether optimization efforts align with people's actual needs and preferences. Smart city planners should prioritize responses to real needs rather than focusing solely on what they can achieve.

Questions

1. Should vendors of smart city solutions, including IoT hardware and software providers, and large telecom companies, prioritize transparency by openly discussing the challenges and limitations of IoT technologies for smart city projects?
2. What measures can consumers and citizens take to safeguard their privacy against the potential intrusion caused by the deployment of IoT technologies in smart city projects?
3. Can you provide two additional examples of possible IoT smart city projects that have the potential to be

implemented by your municipality or community, apart from the ones mentioned in the case?

4. Present a business case for your proposed IoT-based smart city project, including a detailed comparison of the projected revenue and costs involved.

Sources: Compiled from P. Wellborn, "UBCO Looks at Smart Technology to Safeguard Drinking Water," *UBC Okanagan News*, August 11, 2022; J. Bronskill, "Canada's Spy Agency Warns 'Smart City' Platforms Pose Security Risks," *The Canadian Press*, March 9, 2023; D. Paterson, "New Smart Cities Can't Escape the Same Old Problems," *The Toronto Star*, October 14, 2022; M. Toljagic, "'Like a Huge Chess Game.' Start-Up Is Revolutionizing Traffic-Light Timing with AI and the Internet of Things," *The Toronto Star*, July 30, 2022; T. Knowlton, "NoTraffic Launches in Canada, Deploying Cloud and AI Tech to Optimize Roads in BC," *Techcouver*, July 6, 2022; M. Bubbers, "Can Smart Traffic Lights Ease Congestion, Reduce Emissions and Make Streets Safer? UBC to Test It Out," *The Globe and Mail*, September 9, 2022; "Smart Cities," *Rogers*, Accessed May 26, 2023; J. Karrie, "Toronto Wants to Kill the Smart City Forever," *MIT Technology Review*, June 29, 2022; "IoT Services," *Bell Canada*, Accessed May 26, 2023; "Connected Community/Smart City TO," *City of Toronto*, Accessed May 26, 2023; C. Abigail, "Canada Is Leading the Way to Smart Cities," *Mediaplanet Content Hub*, Accessed May 26, 2023.

Social Computing

CHAPTER OUTLINE

LEARNING OBJECTIVES

9.1 Web 2.0	9.1 Describe six Web 2.0 tools and two major types of Web 2.0 sites.
9.2 Fundamentals of Social Computing in Business	9.2 Describe the benefits and risks of social commerce to companies.
9.3 Social Computing in Business: Shopping	9.3 Identify the methods used for shopping socially.
9.4 Social Computing in Business: Marketing	9.4 Discuss innovative ways to use social networking sites for advertising and market research.
9.5 Social Computing in Business: Customer Relationship Management	9.5 Describe how social computing improves customer service.
9.6 Social Computing in Business: Human Resource Management	9.6 Discuss different ways in which human resource managers make use of social computing.

Opening Case

MIS MKT Continuing Problems with Reviews

Problems with online reviews have existed since the first review was posted in 1999. Review problems fall into three major categories. First, e-tailers and their customers must deal with an increasing number of fake reviews. Second, online sellers are unethically, and perhaps illegally, contacting customers who leave negative reviews. Third, bad actors are weaponizing reviews as instruments of extortion. Let's take a closer look at each type.

Amazon Fake Reviews

Thousands of fake reviews stimulate sales of products on Amazon's global digital storefront every day. In fact, the huge e-tailers has experienced problems for years with fake reviews that artificially boost product ratings.

Making matters worse, a thriving cottage industry sells fake reviews on Amazon. Sellers court Amazon shoppers and suggest that they join dozens of Facebook groups and provide positive ratings in exchange for various kinds of compensation. These groups include Amazon Review Club and Amazon Reviewers Group. A group called Amazon Product Review, boasted more than 40,000 members until Facebook removed it early in 2022. That group

evaded detection through the algorithm-eluding strategy of swapping a few letters in phrases that would cause it to be detected by Amazon's recognition systems.

Amazon reported more than 1,000 review-selling groups to various social media platforms in the first quarter of 2022, three times the number from the same period the previous year. Significantly, Amazon is placing the responsibility for the prevalence of fake reviews on social media companies for their failure to monitor and remove those groups.

In 2022, Amazon filed a lawsuit against the administrators of more than 10,000 Facebook groups that coordinate rewards of cash or goods for buyers who are willing to post fake product reviews. In addition to Canada, these groups recruit fake reviewers and operate in Amazon's sites in the United States, the United Kingdom, France, Germany, Spain, Italy, and Japan.

Sellers Respond Unethically to Negative Reviews on Amazon

Some Amazon sellers are contacting unhappy buyers directly and asking them to revise or delete their negative reviews in exchange for refunds or gift cards. As the number of unhappy shoppers declines, the overall average star rating of products increases.

In fact, sellers whose products are shipped by Amazon are forbidden to contact customers directly. Doing so violates the terms the sellers agree to on Amazon's platform. These terms specify that both sellers and brands—which can be distinct from sellers—are permitted to communicate with buyers only through Amazon's messaging platform, which hides the customer's email address. They also prohibit sellers and brands from asking a customer to remove a negative review or post a positive one.

Sellers who fulfill orders themselves receive customer names and mailing addresses. However, for orders that Amazon fulfills, customer data are supposed to be hidden from sellers and brands.

Consider one Amazon customer, Joan, who purchased a bottle of household cleaning fluid based on almost 1,000 excellent Amazon reviews. The product did not work the way it was supposed to, so Joan posted a poor review. One week later, she was emailed by someone who claimed to be a member of the customer service team of the household cleaner's brand. That person offered her a refund to remove her negative review. They continued by saying that, if they did not receive a response, they would assume that Joan did not see their email and would continue to send emails.

Joan requested a refund, but she did not want to delete her review. Another representative emailed her the next day and declined to issue her a refund. Instead, the person offered to refund her twice what she paid for the product if she would remove her review. Joan declined.

The company continued to email Joan about removing her negative review. Joan contacted Amazon twice about the matter, but the emails continued. However, when a writer for a well-known technology magazine contacted Amazon to comment on the situation, the listing for the product disappeared, and the emails stopped.

Sellers and brands can find ways to reach customers despite Amazon's regulations. In Joan's case, she believes that a free gift insert in the cleaning fluid's packaging, which prompted her to enter her email address and order ID number, enabled the brand to link her review with her email address. An Amazon spokesperson stated that such inserts violate company policy.

The seller might also have been able to look up Joan's name and mailing address in sales records provided by Amazon and then use that information to track down her email address. Amazon has since stopped including names and mailing addresses in records of most Amazon-fulfilled purchases. Now a seller should see only a buyer's city, province, and postal code.

Compounding the problem are third-party companies that take customers' shipping information and match it to known email addresses, a practice that also violates Amazon's rules. One company offers an email extraction service for Amazon sellers. The company uses Google and social media sites to match buyers' names with contact information. Another company provides email addresses of reviewers for up to US\$60 each. Making matters worse, Amazon employees have been accused of accepting bribes in exchange for information that benefited third-party sellers.

What can all of us do?

- Do not use your name in Amazon reviews.
- Go to Your Account on Amazon. Under "Ordering and Shipping Preferences," click on your Amazon profile. Click "Edit your public profile," then "Edit privacy settings" to manage the information that appears on your profile. You can also hide all of your activity, if you choose.
- Save all the emails you are sent. If you receive questionable emails, make screenshots of them, and forward the screenshots to Amazon customer service.

- Block the seller's email address. By replying to a seller or a brand, you could be confirming that your email address belongs to a legitimate customer.

Google Reviews Used in Extortion

In a new attack strategy, criminals are leaving negative ratings on restaurants' Google pages in an attempt to extort digital gift cards. Restaurateurs first notice a rapid increase in one-star ratings, without any descriptions or photos, from people who have never been customers of their restaurants. Soon after the reviews are posted, they receive emails from a person claiming responsibility and requesting a \$75 Google Play gift card to remove the negative ratings. The emails, from several Gmail accounts, request payment to a private email account such as Proton Mail. If the criminals do not receive the gift card, then more bad ratings will follow.

One chef and owner stated that Google removed her one-star ratings after she tweeted the company to complain. Another restaurant owner claimed that her one-star ratings were taken down after her customers raised an outcry on social media. Some restaurateurs, however, contend that it has been difficult to reach someone at Google to help them. Specifically in the case of one restaurant, Google ruled that one of the recent one-star ratings that the owner reported as fake did not violate the platform's policies and would not be removed.

Law enforcement officials have urged restaurant owners to contact Google if they are targeted by criminal organizations with fake reviews, and to report the crimes to local police departments and the RCMP. One security consultant recommended that, after contacting the authorities, restaurants should inform their customers about the fake reviews, perhaps on social media, in an effort to mitigate the damage. In addition, anyone who comes across fake online reviews is encouraged to report them to the Canadian Competition Bureau.

One final note: A Google spokesperson reported that teams of analysts as well as automated systems monitor reviews for such abuses.

Questions

1. What steps should Amazon take to remove fake reviews from the platform? What about Google?
2. Although not specifically covered in this case, what are the possible impacts of fake reviews on buyers? On sellers?
3. Is it even possible for Amazon or Google to remove fake reviews from such a huge, dynamic, real-time platform? Why or why not?

Sources: Compiled from Institute for Operations Research and the Management Sciences, "Study Examines the Impact of Fake Online Reviews on Sales," *phys.org*, September 9, 2022; A. Friedman, "Study Reveals That You Can't Trust 70% of the Amazon Reviews for This Current iPhone Model," https://www.phonearena.com/news/these-phones-get-the-most-fake-reviews_id142380, September 7, 2022; "The Curious Case of Fake Reviews: How Businesses Are Battling Negative Feedback Online," *The Economic Times*, September 6, 2022; A. Hern, "Amazon Delays the Rings of Power Ratings to Combat Fake Reviews," *The Guardian*, September 4, 2022; C. Morales, "Restaurants Face an Extortion Threat: A Bad Rating on Google," *The New York Times*, July 11, 2022; T. Hatmaker, "Amazon Sues Admins from 10,000 Facebook Groups over Fake Reviews," *TechCrunch*, July 18, 2022; N. Nguyen, "When Amazon Customers Leave Negative Reviews, Some Sellers Hunt Them Down," *Wall Street Journal*, August 8, 2021; M. Grossman, "Six Charged with Bribing Amazon Employees to Boost Third-Party Sellers," *Wall Street Journal*, September 18, 2020; D. Lee and H. Murphy, "Facebook Groups Trading Fake Amazon Reviews Remain Rampant," *Financial Times*, August 12, 2020; J. Emont, L. Stevens, and

R. McMillan, “Amazon Investigates Employees Leaking Data for Bribes,” *Wall Street Journal*, September 16, 2018; E. Dwoskin and C. Timberg, “How Merchants Use Facebook to Flood Amazon with Fake Reviews,” *The Washington Post*, April 23, 2018; N. Philpott, “Fake Reviews Leave Bad Taste in Restaurant Owner’s Mouth,” *Thorold Today*, July 8, 2022;

A. Boutilier, “To Combat the Proliferation of Fake Reviews, Amazon Continues to Take Action,” *Good E Reader*, March 5, 2023; “Amazon Continues to Take Action Against Fake Review Brokers,” <https://www.aboutamazon.com/news/policy-news-views/amazon-continues-to-take-action-against-fake-review-brokers>, March 2, 2023.

Introduction

Humans are social beings. Therefore, human behaviour is innately social. Humans typically orient their behaviour around other members of their community. As a result, people are sensitive to the behaviour of people around them, and their decisions are generally influenced by their social context.

Traditional information systems support organizational activities and business processes and concentrate on cost reductions and productivity increases. A variation of this traditional model, **social computing**, is a type of IT that combines social behaviour and information systems to create value. Social computing focuses on improving collaboration and interaction among people and on encouraging user-generated content.

Significantly, in social computing, social information is not anonymous. Rather, it is important precisely because it is linked to particular individuals, who in turn are linked to their own networks of individuals.

Social computing makes socially produced information available to everyone. This information may be provided directly, as when users rate a movie (e.g., at Rotten Tomatoes), or indirectly (as with Google’s ranking algorithm, which sequences search results). This information may not be accurate, as you saw in this chapter’s opening case.

In social computing, users, rather than organizations, produce, control, use, and manage content via interactive communications and collaboration. As a result, social computing is transforming power relationships within organizations. Employees and customers are empowered by their ability to use social computing to organize themselves. Thus, social computing can influence people in positions of power to listen to the concerns and issues of “ordinary people.” Organizational customers and employees are joining this social computing phenomenon, with serious consequences for most organizations.

Significantly, most governments and companies in modern, developed societies are not prepared for the new social power of ordinary people. Today, managers, executives, and government officials can no longer control the conversation around policies, products, and other issues.

In the new world of business and government, organizational leaders will have to demonstrate authenticity, even-handedness, transparency, good faith, and humility. If they do not, then customers and employees may distrust them, to potentially disastrous effect. For example, customers who do not like a product or service can quickly broadcast their disapproval. Another example is that prospective employees do not have to take their employers at their word for what life is like at their companies—they can find out from people who already work there. A final example is that employees now have many more options to start their own companies, which could compete with their former employers.

As you see from these examples, the world is becoming more democratic and reflective of the will of ordinary people, enabled by the power of social computing. On the one hand, social power can help keep a company vital and can enable customers and employee activists to become a source of creativity, innovation, and new ideas that will move a company forward. On the other hand, companies that show insensitivity toward customers or employees quickly find themselves on a downward slide.

When a series of brushfires caused serious damage in Tasmania, SellItOnline offered to donate generators to Tasmanians impacted by the fires. While the message appeared gracious at first, the company clarified that the number of generators it donated would be completely dependent on how many new fans its Facebook page received. The response was highly negative as SellItOnline appeared to be trying to grow its Facebook fan base in response to a tragedy.

Organizations today are using social computing in a variety of innovative ways, including marketing, production, customer relationship management, and human resource management. In fact, so many organizations are competing to use social computing in as many new ways as possible that an inclusive term for the use of social computing in business has

social computing A type of information system that combines social behaviour and information technology to create value.

emerged: *social commerce*. Because social computing is facilitated by Web 2.0 tools and sites, you will begin this chapter by examining these technologies. You will then turn your attention to a number of diverse social commerce activities, including shopping, advertising, market research, customer relationship management, and human resource management.

When you complete this chapter, you will have a thorough understanding of social computing and the ways in which modern organizations use this technology. You will be familiar with the advantages and disadvantages of social computing, as well as the risks and rewards it can bring to your organization. For example, most of you already have pages on social networking sites, so you are familiar with their positive and negative features. This chapter will enable you to apply this knowledge to your organization's efforts in the social computing arena. You will be in a position to contribute to your organization's policies on social computing. You will also be able to help your organization create a strategy to utilize social computing. Finally, social computing offers incredible opportunities for entrepreneurs who want to start their own businesses.

9.1

Web 2.0

LEARNING OBJECTIVE

Describe six Web 2.0 tools and two major types of Web 2.0 sites.

Web 2.0 Websites that emphasize user-generated content, ease of use, participatory culture, and compatibility with other products, systems, and devices for end users.

The World Wide Web, which you learned about in Chapter 6, first appeared in 1990. Web 1.0 was the first generation of the Web. We did not use this term in Chapter 6 because there was no need to say “Web 1.0” until Web 2.0 emerged.

The key developments of Web 1.0 were the creation of websites and the commercialization of the Web. Users typically had minimal interaction with Web 1.0 sites. Rather, they passively received information from those sites.

Web 2.0 refers to websites that rely on user-generated content, are easy to use, promote a participatory culture, and are compatible with end users' other favourite products, systems, and devices. These websites enrich the user experience by encouraging social interaction, collaboration, and user-centred design. Web 2.0 sites often harness collective intelligence (e.g., wikis); deliver functionality as services, rather than packaged software (e.g., Web services); and feature remixable applications and data (e.g., mashups).

In the following sections, we discuss five Web 2.0 information technology tools: tagging, Really Simple Syndication, blogs, microblogs, and wikis. We then turn our attention to the two major types of Web 2.0 sites: social networking sites and mashups.

Tagging

tag A keyword or term that describes a piece of information.

A **tag** is a keyword or term that describes a piece of information, for example, a blog, a picture, an article, or a video clip. Users typically choose tags that are meaningful to them. Tagging allows users to place information in multiple, overlapping associations rather than in rigid categories. For example, a photo of a car might be tagged with “Corvette,” “sports car,” and “Chevrolet.” Tagging is the basis of *folksonomies*, which are user-generated classifications that use tags to categorize and retrieve Web pages, photos, videos, and other Web content.

One specific form of tagging, known as *geotagging*, refers to tagging information on maps. For example, Google Maps allows users to add pictures and information, such as restaurant or hotel ratings, to maps. Therefore, when users access Google Maps, their experience is enriched because they can see pictures of attractions, reviews, and things to do, posted by everyone and all related to the map location they are viewing.

Really Simple Syndication (RSS) A technology that allows users to receive the information they want, when they want it, without having to surf thousands of websites.

Really Simple Syndication

Really Simple Syndication (RSS) is a Web 2.0 feature that allows you to receive the information you want (customized information), when you want it, without having to surf thousands

CBC RSS Feeds

CBC RSS feeds allow you to access CBC content in a variety of ways at your convenience.

Using an RSS Reader or by integrating an RSS feed into your blog or other interface, you can access updated CBC News, Sports, Entertainment, blogs & other CBC content in the way that works best for you.

CBC's news headline RSS feeds are constantly updated as new stories are published.

GENERAL NEWS	
Top Stories	https://rss.cbc.ca/lineup/topstories.xml
World	https://rss.cbc.ca/lineup/world.xml
Canada	https://rss.cbc.ca/lineup/canada.xml
Politics	https://rss.cbc.ca/lineup/politics.xml
Business	https://rss.cbc.ca/lineup/business.xml
Health	https://rss.cbc.ca/lineup/health.xml
Arts & Entertainment	https://rss.cbc.ca/lineup/arts.xml
Technology & Science	https://rss.cbc.ca/lineup/technology.xml
Offbeat	https://rss.cbc.ca/lineup/offbeat.xml
Indigenous	https://www.cbc.ca/cmlink/rss-cbcaboriginal

SPORTS NEWS	
Sports	https://rss.cbc.ca/lineup/sports.xml
MLB	https://rss.cbc.ca/lineup/sports-mlb.xml

Commercial Use of CBC RSS Feeds

If you are interested in using CBC RSS feed content for a commercial venture, please see our Commercial Use page.

CBC Podcasts

CBC Podcasts provide you with the best of our popular national Radio & TV programs, regional magazines, exclusive musical talent and special podcast-only features.

Podcasting

CBC Help RSS Feeds

Report an RSS problem

[Click here](#)

FIGURE 9.1 RSS feeds from the Canadian Broadcasting Corporation (CBC) website (www.cbc.ca) feeds.

of websites. RSS allows anyone to syndicate (publish) their blog, or any other content, to anyone who has an interest in subscribing to it. When changes to the content are made, subscribers receive a notification of the changes and an idea of what the new content contains. Subscribers can then click on a link that will take them to the full text of the new content.

For example, **CBC.ca** provides RSS feeds for each of its main topic areas, such as world news, sports news, technology news, and entertainment news. **Figure 9.1** illustrates RSS feeds for **CBC.ca**.

To use RSS, you can utilize a special newsreader that displays RSS content feeds from the websites you select. Many such readers are available, several of them for free (see Feedspot; www.feedspot.com). In addition, most browsers have built-in RSS readers. For an excellent RSS tutorial, visit www.mnot.net/rss/tutorial.

Blogs

A **weblog** (**blog** for short) is a personal website, open to the public, in which the site creator expresses their feelings or opinions in a series of chronological entries. *Bloggers*—people who create and maintain blogs—write stories, convey news, and provide links to other articles and websites that are of interest to them. The simplest method of creating a blog is to sign up with a blogging service provider, such as www.blogger.com. The **blogosphere** is the term for the millions of blogs on the Web.

MKT Many companies listen to consumers in the blogosphere who express their views about the companies' products. Marketers refer to these views as *consumer-generated media*. For example, Nielsen (www.nielsen.com) “mines” the blogosphere to provide information for its clients in several areas. Nielsen helps clients find ways to serve potential markets, ranging from broad-based to niche markets. The company also helps clients detect false rumours

blog (weblog) A personal website, open to the public, in which the site creator expresses their feelings or opinions in a series of chronological entries.

blogosphere The term for the millions of blogs on the Web.

before these rumours appear in the mainstream media, and it gauges the potency of a marketing push or the popularity of a new product.

Blogs can provide incredibly useful information, often before that information becomes available in traditional media outlets (e.g., television, newspapers). Although blogs can be very useful, they also have shortcomings. Perhaps the primary value of blogs is their ability to bring current, breaking news to the public in the shortest time possible. Unfortunately, in doing so, bloggers sometimes cut corners, and their blogs can be inaccurate. Regardless of their various problems, however, blogs have transformed the ways in which people gather and consume information.

Microblogging

microblogging A form of blogging that allows users to write short messages (or capture an image or embedded video) and publish them.

X (formerly Twitter) A free microblogging service that allows its users to send messages and read other users' messages and updates.

Microblogging is a form of blogging that allows users to write short messages (or capture an image or embedded video) and publish them. These messages can be submitted via text messaging from mobile phones, instant messaging, email, or simply over the Web. The content of a microblog differs from that of a blog because of the limited space per message. A popular microblogging service is X (formerly Twitter), which allows 280 characters per message. In addition to text, X users can also include links, photos, and videos.

X (www.x.com) formerly **Twitter**, is a free microblogging service that allows its users to send messages and read other users' messages and updates, formerly known as Tweets. Tweets are displayed on the user's profile page and delivered to other users who have signed up to receive them.

MKT X is a very useful business tool. It allows companies to quickly share information with people interested in their products, thereby creating deeper relationships with their customers. Businesses also use X (Twitter) to gather real-time market intelligence and customer feedback. As an individual user, you can use X (Twitter) to inform companies about your experiences with their business, offer product ideas, and learn about great offers.

Microblogging is very popular in China; Weibo (www.weibo.com) is the most popular microblogging service in that country. Weibo has over 580 million monthly active members as of mid-2023.

Wikis

wiki A website on which anyone can post material and make changes to other material.

A **wiki** is a website made up entirely of content posted by users. Wikis have an "edit" link on each page that allows any user to add, change, or delete material, thus fostering easy collaboration.

Wikis take advantage of the combined input of many individuals. Consider Wikipedia (www.wikipedia.org), an online encyclopedia that is the largest existing wiki. Wikipedia contains about 6.5 million articles in English (as of mid-2023), which attract some 250 million views every day. Wikipedia relies on volunteer administrators who enforce a neutral point of view, and it encourages users to delete copy that displays a clear bias. Nevertheless, there are still major debates over the reliability of Wikipedia articles. Many educators will not allow students to cite references from Wikipedia because the content is of uncertain origin. Moreover, Wikipedia does not provide any quality assessment or fact-checking by experts. Therefore, academics and other professionals have major concerns about the accuracy of user-provided content.

POM **MKT** Organizations use wikis in several ways. In project management, for example, wikis provide a central repository for capturing constantly updated product features and specifications, tracking issues, resolving problems, and maintaining project histories. In addition, they enable companies to collaborate with customers, suppliers, and other business partners on projects. Wikis are also valuable in knowledge management. For example, companies use wikis to keep enterprise-wide documents, such as guidelines and frequently asked questions, accurate and current.

Social Networking Websites

social network A social structure composed of individuals, groups, or organizations linked by values, visions, ideas, financial exchange, friendship, kinship, conflict, or trade.

social networking Activities performed using social software tools (e.g., blogging) or social networking features (e.g., media sharing).

A **social network** is a social structure composed of individuals, groups, or organizations linked by values, visions, ideas, financial exchange, friendship, kinship, conflict, or trade. **Social networking** refers to activities performed using social software tools (e.g., blogging) or social networking features (e.g., media sharing). Social networking allows convenient connections to those of similar interest.

A social network can be described as a map of all relevant links or connections among the network's members. For each individual member, that map is their **social graph**. Mark Zuckerberg of Facebook originally coined this term to refer to the social network of relationships among Facebook users. The idea was that Facebook would take advantage of relationships among individuals to offer a richer online experience.

Social networks can also be used to determine the social capital of individual participants. **Social capital** refers to the number of connections a person has within and between social networks.

Participants congregate on *social networking websites*, where they can create their own profile page for free and on which they can write blogs and wikis; post pictures, videos, or music; share ideas; and link to other Web locations they find interesting. Social networkers chat using instant messaging and X (former Twitter), and they tag posted content with their own keywords, making content searchable and facilitating interactions and transactions. Social network members converse, collaborate, and share opinions, experiences, knowledge, insights, and perceptions with one another. They also use these websites to find like-minded people online, either to pursue an interest or a goal or just to establish a sense of community among people who may never meet in the real world.

Participants who post on social networking sites tend to reveal a great deal of personal information. As a result, if they are not careful, their information could be stolen.

Table 9.1 displays the variety of online social networking platforms. Social networking websites allow users to upload their content to the Web in the form of text, voice, images, and videos.

social graph A map of all relevant links or connections for one member of a social network.

social capital The number of connections a person has within and between social networks.

TABLE 9.1 Categories of Social Networking Websites

Socially oriented: Socially focused public sites, open to anyone:

- Facebook (www.facebook.com)

Messaging Apps

- WhatsApp (www.whatsapp.com), owned by Facebook)
- Facebook Messenger (www.messenger.com)
- WeChat (www.wechat.com) is the leading messenger app in China
- Viber (www.viber.com) is the leading app in countries such as Kyrgyzstan, Ukraine, Belarus, Armenia, Azerbaijan, and Bosnia–Herzegovina
- Moya Messenger (<https://moya.app>) is a leading app in South Africa

Professional networking: Focused on networking for business professionals:

- LinkedIn (www.linkedin.com)

Media sharing: Includes podcasting (audio) and videocasting (audio and video):

- Instagram (www.instagram.com)
- Pinterest (www.pinterest.com)
- YouTube (www.youtube.com)

Communication:

- Blogs: Blogger (www.blogger.com)
- Microblogging/Presence applications: X, Tumblr

Collaboration: Wikis:

Wikimedia (www.wikimediafoundation.org)

Wikipedia (www.wikipedia.org)

Social news: Focused on user-posted news stories that are ranked by popularity based on user voting:

- Digg (www.digg.com)
- Reddit (www.reddit.com)

Events: Focused on alerts for relevant events, people you know nearby, etc.:

- Meetup (www.meetup.com)

Virtual meeting place: Sites that are essentially three-dimensional worlds, built and owned by the residents (the users):

- Second Life (www.secondlife.com)

These social networking sites collect a massive amount of data, some of it uploaded by their users and some generated from monitoring user activity on the sites. The vast amount of data gathered by social networks has led to well-documented problems, which became prominent with the Facebook–Cambridge Analytica scandal in 2018.

Problems with Social Networks: Fake News, Deepfakes, Bots, Cyborgs, Trolls, and Content Moderation

Recall our discussions of how social media platforms make money: they offer free services in exchange for users' data. They then analyze the data in order to target advertisements to each user. The more data they collect, the more accurate their targeting, the more likely that visitors will click on an ad, the higher the rates that advertisers will pay the platforms, and the more money the platforms will make.

The platforms pay the most attention to two metrics: the number of unique visitors to their websites and the length of time that each visitor spends on the sites. The more visitors to the site and the more time they spend on the site, the more money the platform can charge the advertising companies.

To attract more users, platforms offer a wide array of free services. For example, consider the large number of free services that social networks such as Facebook and X provide.

Engagement is the process of keeping users on websites as long as possible. Platforms program their algorithms to push (emphasize) content that results in high engagement. Not surprisingly, this content is often sensationalized. Consider the phrase, “If it bleeds, it leads.” This phrase means that the more sensational the content, the more people will read it or watch it. For instance, if a large passenger airliner crashes, the news rapidly spreads globally on news networks, on social media, and in print. In contrast, we do not see content covering the fact that Winnipeg James Armstrong Richardson International Airport handled over 50 flights successfully and safely on a particular day.

There are three serious issues associated with social media platforms. First, they allow almost anyone to publish almost any content. Unfortunately, content on these platforms can consist of false information such as fake news and deepfakes. Second, the platforms employ psychological measures to keep visitors on the sites longer. Third, third-party entities such as marketing agencies, governments, political parties, and publicity managers employ various means in conjunction with social media platforms to spread their messages, both true and false. Let's take a closer look at each of these issues.

False Information There are two kinds of *fake news*: content that is entirely untrue and content that has some truth but is not totally accurate. Unfortunately, it can be difficult for readers to identify fake content. Fortunately, however, there are strategies that you can use to identify fake news.

- Consider the source of the content. Who or what organization is responsible for the content? Is there even a source listed? If so, can you check these sources to determine whether they are legitimate?
- Read beyond the headline. If a piece of content has a provocative headline, then read the entire piece before you decide whether to believe it or to pass it along.
- Check the date. Some content is not completely fake, but it distorts real events. Fake news can claim that something that happened in the past is actually a current event.
- It is likely that some website has already fact-checked the latest viral content that appears in your news feed. You may use any of the following three to check the facts: Canada Fact Check (www.canadafactcheck.ca), AFP Fact Check (www.factcheck.afp.com), and Snopes (www.snopes.com).

Deepfakes are videos that have been digitally created with artificial intelligence to make it appear that something happened that did not. They are an emerging threat because improvements in video-editing software make it possible for bad actors to create increasingly realistic

footage. Deepfakes are expensive and difficult to create. However, advancing technologies are making them easier, faster, and less expensive to create.

In contrast, *shallowfakes*—also called *cheapfakes*—are videos that have been altered with more basic techniques, such as slowing down or speeding up footage or cutting and splicing it. Because shallowfakes are easy and inexpensive to create, they are dangerous as well. One example of a shallowfake would be some gags comparing Ontario Premier Doug Ford to U.S. President Donald Trump.

Psychological Measures Remember that a primary function of social media platforms is to hold visitors' attention as long as possible. To accomplish this goal, the sites employ the infinite scroll and randomly scheduled rewards.

Infinite scroll is a design technique that loads content continuously as the user scrolls down the page, eliminating the need to keep clicking to load additional content. *Doomscrolling* refers specifically to an infinite scroll of bad news.

Randomly scheduled rewards is a strategy in which the platforms give visitors a “reward” at irregular intervals because someone liked a post or a photo that they uploaded, or sent them a text, or reposted (retweeted) one of their messages (Tweets), or any number of other actions. When a visitor receives a reward, their brain releases a neurotransmitter called dopamine. Dopamine creates feelings of pleasure, which motivate a visitor to repeat behaviours such as continuing to click on links or continuing to scroll on social media platforms. The irregularity and unpredictability of the rewards are what make these platforms so addictive.

Third-Party Entities Various entities use an assortment of methods to spread their agendas around the world via social media. These methods include social bots, cyborgs, and troll factories.

Social bots are a type of chatbot (see Chapter 7) that automatically produce content on social media. This content can be either in support of or in opposition to campaigns, brands, politicians, and issues. For example, social bots can be programmed to leave supportive comments on a politician's Facebook page, target journalists with a number of angry posts, or engage with a post to artificially inflate its popularity. Social bots are typically programmed to conceal the fact that they are bots so that they appear to be humans.

Some social bots are programmed to follow people, resulting in millions of *fake followers* for internet influencers, politicians, and the platforms themselves. For example, researchers contend that bot software automatically operates nearly 50 million X accounts. On Facebook, social bots are used to automate group pages and spread political advertisements.

Marketing agencies, governments, political parties, publicity managers, and other entities pay humans to create hundreds of fake accounts, operated by bots, that disseminate ambiguous or false information to influence and manipulate public opinion on social media, especially Facebook and X. The humans and the bots they create are called *cyborgs*. Although it is not ethical or legal to use cyborgs to manipulate public opinion, the practice is widespread around the world.

A *troll* is a person who intentionally initiates online conflict or offends other users to distract or create divisions by posting inflammatory or off-topic posts in an online community or on a social media platform. The goal is to provoke others and derail discussions. A *troll farm* is a group of internet trolls who interfere with the political process in various countries. One study revealed that 30 governments worldwide paid trolls in troll farms to spread propaganda and attack critics.

A combination of social bots, cyborgs, and trolls is very effective at manipulating public discussion on social media. Here is how the process works:

- Any one, or a combination, of social bots, cyborgs, or trolls begins the conversation, seeding new ideas and driving discussion in online communities.
- Another type of social bot called an amplifier bot escalates the importance of the new ideas by repurposing, reposting, and republishing them.
- Yet another type of social bot, an approval bot, engages with specific posts or comments, “liking,” “reposting,” or “replying” to make the ideas appear more credible and legitimate.

- Along with the first three functions, in hotly contested topic areas, other social bots harass and attack individuals and organizations in an attempt to push them out of the conversation.

In the most successful bot- and cyborg-aided campaigns, real human social media users are influenced to the point that they willingly participate in sharing fake or inflammatory content with their own social groups. This process often leads to mainstream media coverage, which provides additional legitimacy to the ideas even when the media coverage is intended to debunk false or misleading information.

A very serious problem of social networks is their difficulty in moderating the content on their sites. IT's About Business 9.1 addresses how Facebook is trying to manage this issue.

IT's About Business 9.1

Moderating the Content on Facebook

For years, Facebook has been under scrutiny and widely criticized for the violent and hateful content that appears on the platform. Facebook CEO Mark Zuckerberg has repeatedly pledged to clean up the platform. He has also promoted the use of machine learning algorithms (see Chapter 14) to remove toxic posts, and he has announced efforts to hire thousands of content moderators to remove the messages that the algorithms do not catch.

Rather than hiring content moderators itself, Facebook has contracted with outside companies to assume that responsibility. Since 2012, Facebook has hired at least 10 consulting and staffing companies worldwide to moderate its content.

The consulting firm Accenture (www.accenture.com) has become Facebook's largest partner in moderating content. Accenture's contract with Facebook is worth US \$500 million per year. The firm employs more than 5,000 of the 15,000 people whom Facebook claims to have hired to inspect content on the platform.

Unfortunately, Accenture has absorbed the worst facets of moderating content and made Facebook's content issues its own. The relationship between Facebook and Accenture highlights Facebook's effort to distance itself from the most damaging, toxic part of its business. In short, Accenture has to manage the mental health issues that its workers have developed from reviewing Facebook content. Those issues are intensified by Facebook's performance goals and the numerous changes it makes in its content policies.

Much of Facebook's work with Accenture goes back to the nudity problem. In 2007, millions of users were joining the platform every month, and many of them posted nude photos. Facebook reached a settlement that year that required the company to take down pornographic posts flagged by users within 24 hours.

As a result of that settlement, Facebook employees who policed content were quickly overwhelmed by the volume of work. Facebook executives urged the moderation team to come up with automated solutions able to inspect the content. The company also looked to outsource content moderation, which cost less than engaging new staff, provided tax and regulatory benefits, and allowed it to expand or reduce its services flexibly in places where it had no offices or language expertise.

In 2012, Accenture signed on as a contractor to moderate content, especially outside North America. Facebook then sent employees to Accenture's locations in the Philippines and Poland to teach Accenture employees how to inspect content. The

Accenture workers learned to use a Facebook software system as well as the platform's guidelines for leaving content up, taking it down, or sending the content to a manager for review.

In 2016, U.S. federal authorities discovered that Russian agents had spread divisive posts on Facebook, targeting American voters before the presidential election. In response, the company hired more than 3,000 people, in addition to the 4,500 employees it already had, to police the platform.

Moderating content is challenging, to say the least. Although algorithms remove more than 90 percent of objectionable material on Facebook and Instagram, outsourced moderators must decide what to do with posts that the algorithms do not catch. These workers receive a performance score that is based on correctly reviewing posts that violate Facebook's policies. If they make mistakes more than 5 percent of the time, they can be fired.

However, Facebook's rules about what was acceptable changed constantly, creating confusion and stress. For instance, when people used a gas station emoji as slang for selling marijuana, workers deleted the posts for violating the company's content policy on drugs. Facebook then told moderators not to remove the posts, but later reversed its policy.

By now, tension was high within Accenture. Moderators worked eight-hour shifts examining Facebook's most noxious posts, trying to shut them down before they spread. Some of the moderators reported that they had begun experiencing feelings of depression and anxiety. Accenture responded by hiring mental health counsellors.

In 2018, Accenture introduced new policies regarding its content moderators' mental health. The company changed the counsellors' titles to "wellness coaches" and instructed them not to attempt to assess or diagnose employees' psychological well-being. Instead, they were to offer them "short-term support" such as suggesting that workers go for a walk or listen to soothing music. Mental health counsellors responded that these policies made it hard for them to treat workers.

By 2019, the moderation situation was deteriorating. That year, another technology consulting company hired to moderate Facebook content, Cognizant, said that it was leaving content moderation after the technology site *The Verge* described the low pay and mental health effects on workers at one of its offices. Cognizant said that its decision would cost the company at least US \$240 million in revenue and lead to 6,000 job cuts.

In 2019, Julie Sweet was named CEO of Accenture. She quickly ordered a review of the firm's moderation business and

subsequently implemented several changes. In December of that year, Accenture created a two-page legal disclosure document to tell moderators about the risks their job posed to them. The document stated that the work had “the potential to negatively impact your emotional or mental health.” In October 2020, for the first time, Accenture listed content moderation as a risk factor in its annual report, asserting that it could leave the firm vulnerable to media scrutiny and legal troubles.

In 2020, U.S. moderators filed a class-action lawsuit against Facebook. Facebook argued that it was not liable because the workers were employed by contractors such as Accenture. Regardless, in May of that year, Facebook settled with the moderators for US \$52 million.

In August 2022, Accenture terminated 60 of its content moderators without giving them any explanation. The company informed the workers during a video call in which its representatives claimed that the terminated workers had been selected at random by an algorithm. The representatives reportedly told the workers that they could reapply and interview for new positions in the company.

In 2023, an employee from Kenya-based outsourcing firm Sama sued Meta, Facebook’s parent company, over alleged poor working conditions. In June of the same year, a Kenyan judge temporarily blocked the laying off of some 260 Facebook content moderators working for Sama.

Questions

1. How should Accenture handle the negative impacts of reviewing toxic Facebook content on its moderators? Is the company doing enough to help these workers with

their mental health? Why or why not? Support your answer.

2. Refer to Chapter 14. With enough data, which Facebook certainly has, is it possible to train its machine learning algorithms to catch more than 90 percent of toxic content on the site? Why or why not? Support your answer.

Sources: Compiled from “Artificial Intelligence Is Now Used to Track Down Hate Speech,” *ABC News*, September 9, 2022; K. Bell, “Dozens of Facebook Contractors Lost their Jobs after an Algorithm Reported Chose Them ‘at Random,’” *Engadget*, August 18, 2022; A. Satariano and M. Isaac, “The Silent Partner Cleaning up Facebook for \$500 Million a Year,” *The New York Times*, August 31, 2021; H. Messenger and K. Simmons, “Facebook Content Moderators Say They Receive Little Support, Despite Company Promises,” *NBC News*, May 10, 2021; C. Newton, “Facebook Will Pay \$52 Million in Settlement with Moderators Who Developed PTSD on the Job,” *The Verge*, May 12, 2020; Q. Wong, “Facebook Content Moderation Is an Ugly Business. Here’s Who Does It,” *CNET*, June 19, 2019; C. Newton, “The Trauma Floor,” *The Verge*, February 25, 2019; S. Frenkel and K. Benner, “To Stir Discord in 2016, Russians Turned Most Often to Facebook,” *The New York Times*, February 17, 2018; N. Hopkins, “Facebook Moderators: A Quick Guide to their Job and Challenges,” *The Guardian*, May 21, 2017; A. Newitz, “Will Facebook Actually Hire 3,000 Content Moderators, or Will They Outsource?” *Ars Technica*, May 4, 2017; V. Goel, “Facebook Scrambles to Police Content Amid Rapid Growth,” *The New York Times*, May 3, 2017; “Good Question: How Does Facebook Monitor Its Content?” *CBS News*, April 18, 2017; “Facebook Settles New York Child Safety Probe,” *Reuters*, October 16, 2007; “Kenyan judge temporarily blocks mass layoff of Facebook moderators,” *Reuters*, March 21, 2023.

Enterprise Social Networks

MIS Business-oriented social networks can be public, such as [LinkedIn.com](https://www.linkedin.com). As such, they are owned and managed by an independent company.

However, an increasing number of companies have created in-house, private social networks for their employees, former employees, business partners, and/or customers. Such networks are “behind the firewall” and are often referred to as *corporate social networks*. Employees utilize these networks to create connections that allow them to establish virtual teams, bring new employees up to speed, improve collaboration, and increase employee retention by creating a sense of community. Employees are able to interact with their coworkers on a level that is typically absent in large organizations or in situations where people work remotely.

Corporate social networks are used for many processes, including:

- Networking and community building, both inside and outside an organization
- *Social collaboration*: Collaborative work and problem-solving using wikis, blogs, instant messaging, collaborative office, and other special-purpose Web-based collaboration platforms
- *Social publishing*: Employees and others creating, either individually or collaboratively, and posting content—photos, videos, presentation slides, and documents—into a member’s or a community’s accessible-content repository such as YouTube, Flickr, and SlideShare
- Social views and feedback
- *Social intelligence and social analytics*: Monitoring, analyzing, and interpreting conversations, interactions, and associations among people, topics, and ideas to gain insights. Social intelligence is useful for examining relationships and work patterns of individuals and groups and for discovering people and expertise.

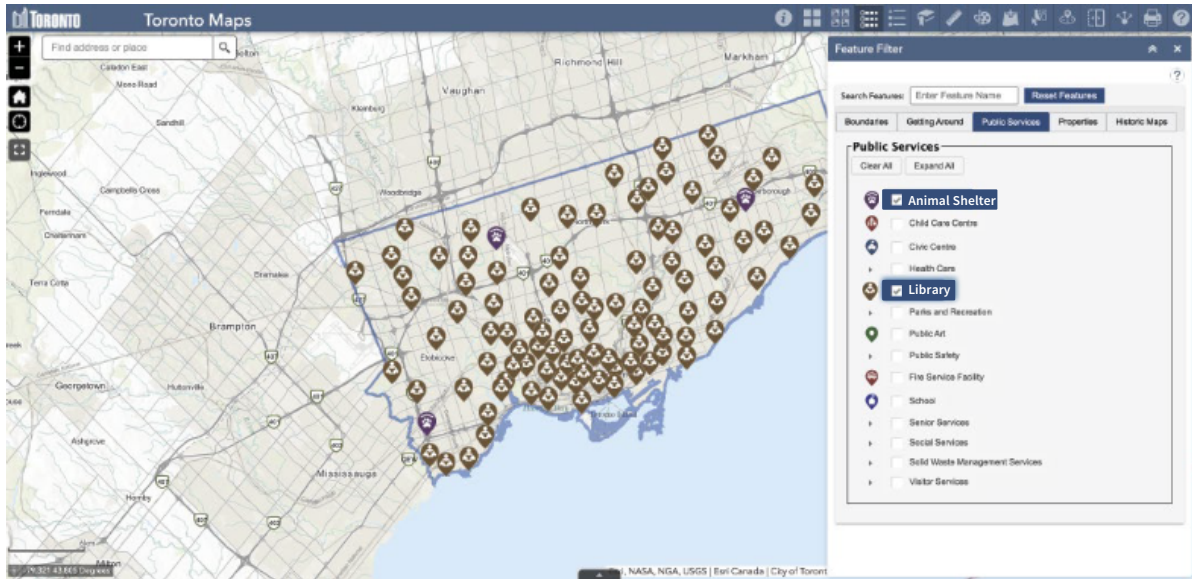


FIGURE 9.2 City of Toronto mashup displaying locations for animal shelters and libraries.

Map Mashups

mashup A website that takes different content from a number of other websites and mixes them together to create a new kind of content.

A **map mashup** is a website that takes different content from a number of other websites and mixes them together to create a new kind of content all displayed on a map. The launch of Google Maps is credited with starting map mashups. A user can take a map from Google, add their data, and then display a map mashup on their website that plots restaurants, gas stations, subway stops, etc. Many cities across Canada have developed dynamic maps with information. For example, [Figure 9.2](#) shows the example of a City of Toronto mashup showing animal shelters and libraries.

Before you go on...

1. Differentiate between blogs and wikis.
2. Differentiate between social networking websites and corporate social networks.

9.2 Fundamentals of Social Computing in Business

LEARNING OBJECTIVE

Describe the benefits and risks of social commerce to companies.

social commerce The delivery of electronic commerce activities and transactions through social computing.

Social computing in business, or **social commerce**, refers to the delivery of electronic commerce activities and transactions through social networking sites. Social commerce also supports social interactions and user contributions, allowing customers to participate actively in

the marketing and selling of products and services in online marketplaces and communities. With social commerce, people can collaborate online, obtain advice from trusted individuals, and find and purchase goods and services. A few examples of social commerce include:

- **POM** Subway Canada allows people to start their orders on Facebook without leaving the social network.
- **MKT** PepsiCo provides a live notification when its customers are close to physical stores (grocery stores, restaurants, gas stations) that sell Pepsi products. The company then uses Foursquare to send them coupons and discount information.
- **MKT** General Motors Canada launched a campaign on X about the world's first all-electric supertruck, the GMC Hummer EV. Thousands of Canadians then tuned in to the livestreamed spot on X, increasing product and brand awareness.

Benefits and Risks of Social Commerce

Social commerce offers numerous benefits to both customers and vendors, as described in [Table 9.2](#). Despite all of its benefits, social commerce does involve risks. It is problematic, for example, to advertise a product, brand, or company on social computing websites where content is user-generated and is not edited or filtered. Companies that employ this strategy must be willing to accept negative reviews and feedback. Of course, negative feedback can be some of the most valuable information that a company receives, if it uses this information properly.

Companies that engage in social computing are always concerned about negative posts. For example, when a company creates a Facebook business page, by default the site allows other members of the website—potentially including disgruntled customers or unethical competitors—to post notes on the firm's Facebook page and to comment on what the firm has posted.

Going further, if the company turns off the feature that lets other users write on its page, people may wonder what it is afraid of. The company will also be eliminating its opportunity to engage in customer conversations, particularly conversations that could market the firm's products and services better than it could do itself. Similarly, the company could delete posts. However, that policy only encourages the post author to scream even louder about being censored.

Another risk is the 20–80 rule of thumb, which posits that a minority of individuals (20 percent) contribute most of the content (80 percent) to blogs, wikis, social computing

TABLE 9.2 Potential Benefits of Social Commerce

Benefits to Customers

- Better and faster vendor responses to complaints, because customers can air their complaints in public (on X, Facebook, YouTube, etc.)
- Customers can assist other customers (e.g., in online forums)
- Customers' expectations can be met faster and more fully
- Customers can easily search, link, chat, and buy while staying on a social network's page

Benefits to Businesses

- Can test new products and ideas quickly and inexpensively
- Learn a lot about their customers
- Identify problems quickly and alleviate customer anger
- Learn about customers' experiences via rapid feedback
- Increase sales when customers discuss products positively on social networking sites
- Create more effective marketing campaigns and brand awareness
- Use low-cost user-generated content, for example, in marketing campaigns
- Obtain free advertising through viral marketing
- Identify and reward influential brand advocates

websites, and so on. For example, in an analysis of thousands of submissions to the news voting site Digg over a three-week time frame, it was reported that roughly 33 percent of the stories that made it to Digg's homepage were submitted by 30 contributors (out of 900,000 registered members).

Other risks of social computing include:

- Information security concerns
- Invasion of privacy
- Violation of intellectual property and copyright
- Employees' reluctance to participate
- Data leakage of personal information or corporate strategic information
- Poor-quality or biased user-generated content
- Cyberbullying/cyberstalking and employee harassment

Another risk of social commerce occurs when social networks disrupt existing businesses. For example, Craigslist (www.craigslist.org) began disrupting local newspapers and Nextdoor is continuing that disruption, as you see in this chapter's closing case.

Companies are engaged in many types of social commerce activities, including shopping, advertising, market research, customer relationship management, and human resource management. In the next sections of this chapter, you will learn about each social commerce activity.

Before you go on...

1. Briefly describe the benefits of social commerce to customers.
2. Briefly describe the risks of social commerce to businesses.

9.3

Social Computing in Business: Shopping

LEARNING OBJECTIVE

Identify the methods used for shopping socially.

social shopping A method of electronic commerce that takes all of the key aspects of social networks (friends, groups, voting, comments, discussions, reviews, etc.) and focuses them on shopping.

Social shopping is a method of electronic commerce that takes all of the key aspects of social networks—friends, groups, voting, comments, discussions, reviews, and others—and focuses them on shopping. Social shopping helps shoppers connect with one another based on taste, location, age, gender, and other selected attributes.

The nature of shopping is changing, especially shopping for brand-name clothes and related items. For example, popular brands such as Gap, Shopbop, Old Navy, or Gucci are joining communities on Stylehive (www.stylehive.com) to help promote the season's latest fashion collections.

There are several ways to shop socially. You will learn about each of them in the next section.

Ratings, Reviews, and Recommendations

Retailers are aware that customers not only want to be heard but also want to know whether other customers agree with them. Consequently, retailers are increasingly opening up their websites to customers, allowing them to post product reviews, ratings, and, in some cases, photos and videos.

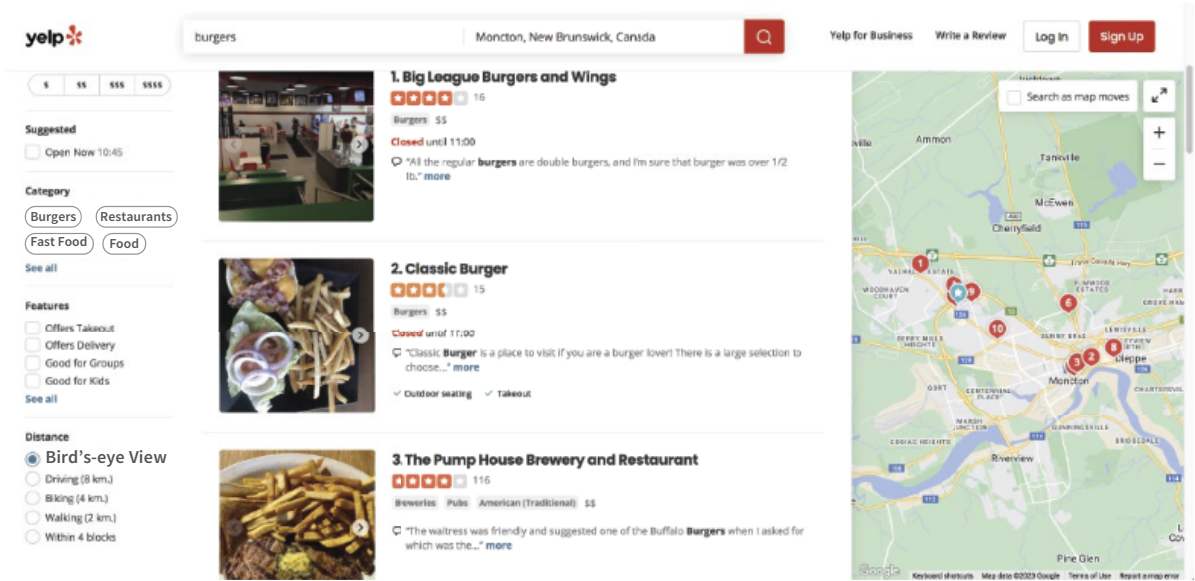


FIGURE 9.3 Yelp (www.yelp.com) users submit reviews of local businesses.

As a result of this strategy, customer reviews are emerging as prime locations for online shoppers to visit. Approximately one-half of consumers consult reviews before making an online purchase, and almost two-thirds are more likely to purchase from a site that offers ratings and reviews.

Ratings, reviews, and recommendations are usually available in social shopping. In addition to seeing what is already posted, shoppers have an opportunity to contribute their own ratings and reviews and to discuss ratings and reviews posted by other shoppers (see [Figure 9.3](#)).

Online customers obtain this information via shopping aids such as comparison agents and websites. Today, customers also use social networking to guide their purchase decisions. They are increasingly utilizing ratings, reviews, and recommendations from friends, fans, followers, and experienced customers. Significantly, this chapter's [opening case](#) illustrates how common fake reviews are and how careful we must all be when considering reviews about a product or a service. The opening case provides the example of fake reviews in Amazon and Google.

Social recommendation websites such as Yelp (www.yelp.com) encourage conversations about purchases. The product recommendations are submitted by users' friends and acquaintances and arguably are more trustworthy than reviews posted by strangers.

Group Shopping

Individuals can shop together virtually in real time. In this process, shoppers log on to a website and then contact their friends and family. Everyone then shops online at the same time. Some real-time shopping providers, such as DoTogether (www.dotogether.com), have integrated their shopping service directly into Amazon and Facebook. Customers log in to Facebook, install the firm's app, and then invite their friends to join them on a virtual retail shopping experience at Amazon.ca.

Shopping Communities and Clubs

MKT Shopping clubs host sales for their members that last just a few days and usually feature luxury brands at heavily discounted prices. Club organizers host three to seven sales per day, usually via email messages that entice club members to shop at more than 70 percent off retail prices—but quickly, before supplies run out.

Luxury brands effectively partner with online shopping clubs to dispose of special-run, sample, overstock, or liquidation goods. These clubs are rather exclusive, which prevents the brands' images from being diminished. Examples are Beyond the Rack (www.beyondtherack.com), Gilt Groupe (www.gilt.com), Rue La La (www.ruelala.com), and One King's Lane (www.onekinglane.com).

Closely related to shopping community and clubs is live shopping or livestream shopping. One example of a live shopping platform is Buywith (www.buywith.com) where influencers, experts, celebrities, and store representatives can host virtual shopping events on the e-commerce site and create direct sales for brands and retailers. The host features products in real-time video on the online platform and shoppers can buy these products in real-time. In the case of Buywith.com, these livestreams are often run by product influencers, but they can also be run as a group of friends or community members using popular social media platforms such as Amazon Live and Poshmark's Posh Shows.

Social Marketplaces and Direct Sales

social marketplaces Websites that act as online intermediaries that harness the power of social networks for introducing, buying, and selling products and services.

MKT Social marketplaces act as online intermediaries that harness the power of social networks for introducing, buying, and selling products and services. A social marketplace helps members market their own creations (see the example of Etsy in [Figure 9.4](#)). Other examples are as follows:

- Kijiji (www.kijiji.ca) and Craigslist (www.craigslist.com) provide online classifieds in addition to supporting social activities such as meetings and events.
- Facebook Marketplace (<https://www.facebook.com/marketplace>) has online listings for items ranging from furniture to used cars.

A new business model has emerged, enabled by social computing and the sharing economy. This business model is called *collaborative consumption*.

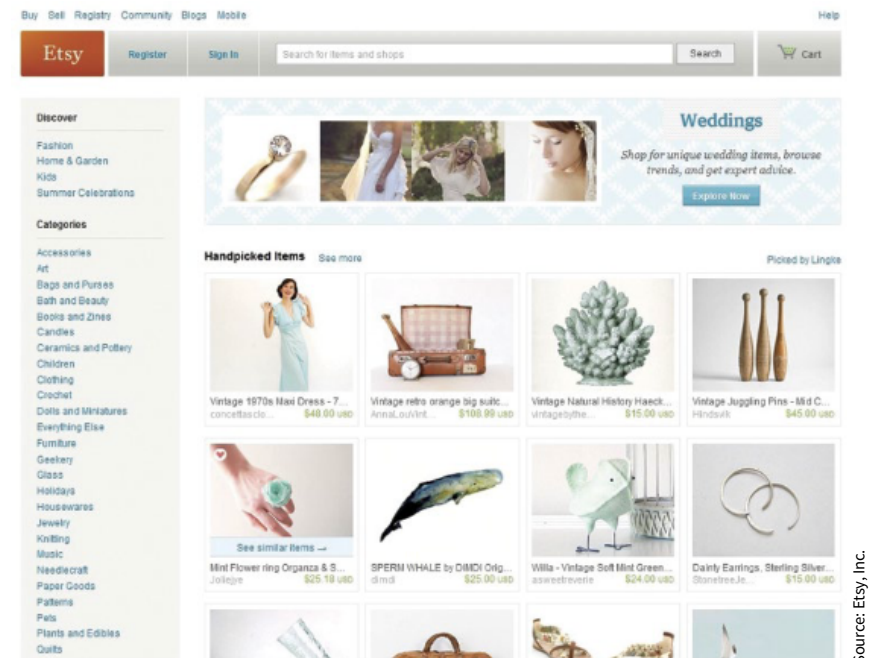


FIGURE 9.4 Etsy (www.etsy.com) is a social marketplace for handmade or vintage items.

Collaborative Consumption

Collaborative consumption is an economic model based on sharing, swapping, trading, or renting products and services, which prioritizes access over ownership. The premise of collaborative consumption is that having access to goods and services is more important than owning them.

Collaborative consumption is a broad term that includes many practices, such as collaborative production, crowdfunding, peer-to-peer lending, and others. In collaborative production, users sell the extra power generated from their solar panels back to the utility company's grid to help power someone else's home. Crowdfunding is the practice of funding a project by raising money from a large number of people, typically via the internet. Peer-to-peer lending is the practice of lending money to unrelated individuals without using a traditional financial institution such as a bank.

Collaborative consumption is a very old concept. We have been bartering and co-operating throughout human history. If we did not have money, we traded time, meals, favours, or personal belongings, and many cultures today do the same. On the Web, the peer-to-peer model started with eBay (www.ebay.com) in 1995. Then Craigslist (www.craigslist.com) began in the late 1990s, followed by Zipcar (www.zipcar.com) in 2000, and Airbnb (www.airbnb.com) in 2007.

Trust is the greatest concern in this new economic model. Sharing works well only when the participants' reputations are involved. Most sharing platforms try to address this issue by creating a self-policing community. Almost all platforms require profiles of both parties, and they feature community rating systems.

Collaborative consumption does have advantages, including self-management, variety, and the flexibility that comes from being able to set one's own schedules. The model can be beneficial for part-time workers, young people such as students, the unemployed, stay-at-home parents, and retired persons. This approach allows people to share their underused assets and earn income.

For example, according to data from Airbnb, the average Airbnb host makes around \$924 per month. The average Uber driver working 20 hours per week would make around \$370. According to the Canada West Foundation, in 2023 the sharing economy was worth \$1.2 billion in Canada, while a "Sharing Economy Market" research report states that the sharing economy (i.e., collaborative consumption) will reach US \$600 billion globally by 2027.

Collaborative consumption has positive environmental impacts. As our population grows, we are using valuable resources—water, food, oil—in a way that is not sustainable. The new model helps us to utilize our natural resources more wisely by sharing, not owning.

On the other hand, collaborative consumption also has its disadvantages. Law and regulatory agencies are trying to keep abreast of the rapidly growing companies in this economy. Consider these examples:

- Residents in Toronto are prohibited from renting for under 28 days (although the practice still occurs).
- Residents in the province of Quebec require a permit from the agency that manages the province's tourist accommodation act in order to list their properties on Airbnb.
- Uber and Lyft often function as taxi companies but do not have to follow worker regulations or laws that apply to existing taxi companies because the services consider their employees to be independent contractors rather than employees.

People working for collaborative consumption services often work seven-day weeks, performing a series of one-off tasks. They have little recourse when the services for which they work change their business models or pay rates. To reduce the risks, workers typically sign up for multiple services. Another disadvantage is that the pay may be less than expected when participants factor in the time spent, expenses, insurance costs, and taxes on self-employment earnings.

Participants have no basic employee benefits or protections. As independent contractors, they do not qualify for employee benefits such as health insurance, disability insurance, payroll deductions for Social Security, retirement savings plans, or unemployment benefits. They do not have the right to organize as a union, meaning that they do not have access to

collaborative consumption

An economic model based on sharing, swapping, trading, or renting products and services, enabling access over ownership.

union-based collective bargaining processes. They also do not have the right to due process should a service remove them from its platform. Uber continues to face class-action lawsuits regarding whether its drivers should be classified as employees or independent contractors.

There are numerous, highly diverse companies in the collaborative consumption market including:

- Uber (www.uber.com) operates the Uber mobile app, which allows consumers with smartphones to submit a trip request that is sent to Uber drivers who use their own cars.
- Airbnb (www.airbnb.com) is a website for people to list, find, and rent lodgings.
- Zipcar (www.zipcar.com) and Turo (<http://turo.com>) are car-sharing services.
- Skillshare (www.skillshare.com) provides access to top-class tutors very cheaply.
- Vestiaire Collective (www.vestiairecollective.com) lets users sell and buy used clothes from well-known brands.
- Bla Bla Car (www.blablacar.com) lets you rent out extra seats in your car when you go on a trip.
- Olio (www.olioex.com) is an app where users can share food and household items.
- LiquidSpace (www.liquidspace.com) is an online marketplace that allows businesses to offer their unused space to people who are interested in renting office space by the hour or the day. BOSS Business Centres in Burnaby, BC, now list meeting spaces for \$42/hour.
- FLOOW2 (www.floow2.com), based in the Netherlands, calls itself a “business-to-business sharing marketplace where companies and institutions can share equipment, as well as the skills and knowledge of personnel.” The company lists more than 25,000 types of equipment and services in industries such as construction, agriculture, transportation, real estate, and health care.

The collaborative consumption model is transforming social, economic, and environmental practices. IT’s About Business 9.2 showcases the example of Canadian-based collaborative platform Wattpad.

IT’s About Business 9.2

Canadian-Born Wattpad Helps Online Writers Get to the TV Screen!

Have you ever thought of writing a book? How about having your story turned into a TV series or a movie? With 94 million users, Toronto-based Wattpad (<https://www.wattpad.com>) is one of Canada’s most recent success stories in the tech sector. Founded by Allen Lau, a former IBM software developer turned entrepreneur, Wattpad was established in 2006 as an online literature platform hosting user-generated stories. At that time, when the first iPhone and Android smartphones were released, the only way to publish a story would have been to send it to a publisher and hope that someone would publish it. There was no direct way to connect readers with writers.

Wattpad capitalizes on the power of social computing and collaborative consumption to create a community-based online platform, where users can write, read, and share stories. The platform employs social computing algorithms to recommend stories to users based on their reading preferences. Users can follow each other, leave comments on stories, and vote for the ones they like. The more votes a story receives, the more visibility it gains on the platform. This encourages writers to engage with their audience and create content that resonates with them. In addition, readers can support authors by reading their paid stories.

While Wattpad leverages on the power of social computing to engage with its audience, it also employs it to support its estimated

network of more than 5 million writers. For instance, the company partnered with YouTube to launch a series of videos to teach Wattpad writers and contributors about the book-writing process. Since writing and distributing an online novel differs significantly from traditional paper-based publishing, Wattpad has produced episodes covering topics, such as overcoming “writer’s block,” what makes a story successful, and the keys to successful serialized storytelling.

In 2022, Wattpad introduced its Creators Program, which would provide up to \$25,000 in compensation for qualified writers. The program guidelines included writing in eligible genres such as general fiction, romance, vampire, action, teen fiction, and horror. Stories’ effectiveness and reader satisfaction are assessed using an audience meter. Other competing platforms like Medium, Ghost, Scribd, Facebook’s Bulletin, and Substack employ similar programs to promote writing and incentivize authors. Some focus on the number of paying subscribers to distribute the funds among writers after deducting a percentage, while others consider the amount of time a reader spends on a story.

Wattpad also operates a studio arm, Wattpad Webtoon Studios (WWS), to leverage its vast pool of user-generated artwork and facilitate connections between writers and production studios. In fact, several Wattpad writers have seen their stories adapted into movies and TV shows. For instance, Netflix released *The Kissing Booth* in 2018. Indonesian streaming platform Vidio plans to run a second season of *Turn On*, a popular story about

a girl from a humble home and an affluent tech executive. The first season launched on Vidio in 2021 and remains the platform's most-watched program, with a record 10 million views. Another example is *Perfect Addiction*, a movie released in March 2023 based on a book by Wattpad author Claudia Tan. According to Wattpad, nearly 1,500 stories on the platform have been adapted for TV or film or published as books.

In addition to its partnerships with production studios and distributors in Indonesia, the Philippines, and India, Wattpad has also partnered with studios in North America, including ViacomCBS International Studios, Fremantle, Leone Film Group, Roy Lee's Vertigo Entertainment, and Constantin Film. It aspires to one day compete with industry giants like Marvel Studios or Disney Channel. However, the recent economic uncertainties have forced the company to lay off 15 percent of its workforce. Will it ultimately achieve its goal? Wattpad writers and readers will tell!

Questions

1. What advantages does Wattpad have over traditional book publishers?

2. In your opinion, do you believe Wattpad has the potential to compete with giants like Marvel Studios or Disney Channel? Why or why not?
3. Can you provide one example of another industry that has undergone significant transformation due to the influence of social computing?

Sources: Compiled from I. Mehta, "Wattpad Introduces a Creator Program That Can Pay Writers up to \$25,000," *TechCrunch*, June 30, 2022; T. L. Agrba, "'I Wanted More of That Feeling': How Wattpad Co-founder Allen Lau Built a \$750-Million Business," *Canadian Business*, December 13, 2022; L. Grady, "How Wattpad Boss Jeanne Lam Is Helping Aspiring Writers Give Up Their Day Jobs," *Toronto Star*, October 25, 2022; J. Hale, "Wattpad's Taking 5 Million Authors to School with New YouTube Series (Exclusive)," *TubeFilter*, June 2, 2023; A. Malik, "Wattpad Is Revamping Its Creator Program and Making It More Accessible," *TechCrunch*, June 1, 2023; J. Hugues, "These Movies & TV Series Are Based on Wattpad Stories," *MovieWeb*, October 12, 2022; J. Hale, "Writing on Wattpad? You Could Get \$25,000," *TubeFilter*, June 30, 2022; M. Simpson, "Wattpad Lays Off 15 Percent of Workforce," *BetaKit*, March 8, 2023.

Before you go on...

1. Why are ratings, reviews, and recommendations so important to potential customers before they make a purchase?
2. Define collaborative consumption, and describe how collaborative consumption is a "green" phenomenon.

9.4

Social Computing in Business: Marketing

LEARNING OBJECTIVE

Discuss innovative ways to use social networking sites for advertising and market research.

MKT *Marketing* can be defined as the process of building profitable customer relationships by creating value for customers and capturing value in return. There are many components to a marketing campaign, including (1) define your target audience; (2) develop your message (i.e., how you will solve their problem); (3) decide on how you will deliver your message (e.g., email, snail mail, Web advertising, social networks); and (4) follow up. IT's About Business 9.3 shows how different Canadian businesses are using social networks for marketing purposes.

IT's About Business 9.3

Marketing through Social Networks in Canadian Businesses

According to We Are Social, a leading social media advertising agency, in 2023 there were 4.76 billion active social media users worldwide, 33.10 million of which were Canadians, representing 86 percent of the Canadian population. According to another report, 94 percent of Canadians active on the internet use at least

one social media platform, and the estimates suggest that the proportion will increase to 96 percent by 2026, for a total of 38.18 million people. Of those Canadians who are active on social media, eight in every ten access a social media platform every day, spending anywhere between 1.6 and 2 hours per day, according to the most recent estimates.

In addition, 25 percent of Canadian internet users aged 16 to 64, that is, one in every four Canadians, searches for information about

new brands, products, and services on social media, and 17.8 percent of users in the same age bracket discover brands, products, and services through a recommendation or comment on social media. These statistics are the reason why Canadian businesses spend over US \$3.93 billion annually on social media advertising. Now let's take a look at some examples of how Canadian companies are marketing their goods and services using social media platforms.

Tim Hortons, the Canadian coffee chain, has been advertising on social media platforms such as Instagram, Facebook, X, and TikTok, among others. It often runs social media campaigns based on current events and activities in Canada to let everyone know more about Canadian culture, such as hockey. For example, in late 2022, the coffee chain launched a social media campaign in which two former players of the Rimouski Océanic junior ice hockey team bought Tim's coffees for a lineup of fans waiting to buy playoff tickets in icy weather conditions in 2005. The company encouraged Canadians to engage on social media by sharing their stories via the #TimsHockeyMemories hashtag.

Shopify, the Canadian e-commerce icon, has partnered with YouTube to enable content creators to leverage their social media presence to drive sales and monetize their content. Specifically, the partnership will allow YouTubers to sell products directly to consumers from their videos, through interactive product displays and checkout buttons on their videos. This integration between YouTube and Shopify will enable YouTubers to convert their videos into a sales channel, offering them an opportunity for monetization beyond traditional advertising revenue. Since then, Shopify has entered into similar partnerships with other social media platforms, including TikTok, Facebook, Instagram, Snap, Pinterest, and X; Shopify promotes its products and uses these platforms to give consumers links and shortcuts to buy those products.

lululemon has made significant investments in social media and influencers to increase sales of its merchandise and customer engagement. This is crucial for the company, as its marketing campaigns build upon the importance of loyalty to its customers. Most recently, its "Feel Good" campaign highlights and promotes the brand's sustainable products and encourages consumers to choose lululemon as their desired activewear brand. The focus on sustainability and customer engagement will not only ensure that customers feel long-term loyalty to the brand, but also bring in new ones. lululemon used Instagram, X, Facebook, and other social applications to increase brand awareness, direct contact with consumers, and customer support.

Ubisoft, a Canadian gaming software company based in Montreal, utilizes social media platforms to advertise its latest releases. It has accounts on Facebook, X, Instagram, YouTube, and a mobile app. It uses these accounts to host marketing campaigns for events from its games, such as the Rainbow Six Siege invitationals. Ubisoft's accounts help to promote the events, direct fans to watch the livestream of these games, and engage with viewers.

WestJet, Canada's second largest airline, uses social media platforms such as Facebook, X, and Instagram to stay connected with consumers, reach new customers, provide customer service, launch new promotions, advertise, and enhance brand awareness. As an example of a brand awareness social media campaign, WestJet launched a fake space program called WestJet-X, a comical copy of Elon Musk's SpaceX rocket and spacecraft launch company, in order to get everyone talking about the brand. As part of this social media campaign, WestJet CEO Alexis von Hoensbroech appeared dressed in a spacesuit with the Canadian flag in the background joking about WestJet-X being the next logical step for WestJet, as the company offers guests "more choice, decreased cost and exceptional service on their journey through the Milky Way."

Whistle Buoy Brewing (WBB), a small microbrewery located in the heart of downtown Victoria, British Columbia, launched a social media campaign advertising a new beer based on the output from artificial intelligence bot ChatGPT. The new beer is called Robo Beer Hazy Pale Ale and is available on draught and in cans at the brewery's physical location and online. WBB utilized social media to advertise its new product and engage with customers. While WBB doesn't plan to use this method for brewing in the future, the customer response was very positive, although some consumers did question "how 'craft' the beer was if it was developed by AI."

Questions

1. What is the value of social commerce for businesses?
2. What types of companies would have social networking sites as part of their strategic information systems? Provide an example.

Sources: Compiled from Relevantly, "Tim Hortons Marketing Strategy Case Study: Selling a Feeling," <https://relevantlymarketing.com/news/tim-hortons-marketing-strategy-case-study-selling-a-feeling>, Tim Hortons Case Study, October 4, 2021; N. Balu and S. Kuber, "Shopify Partners with YouTube to Shore Up Sales from Content Creators," *Reuters*, July 19, 2022; H. Mazouri, "Social Spotlight: How Tim Hortons Puts People First in Its Social Strategy," *Sprout Social*, April 1, 2021; "What Lululemon's Latest Campaign Tells Us about Loyalty," *Forbes*, August 31, 2021; K. Sehl, "Social Media for Big Companies: 10+ Inspiring Examples," *Hootsuite Blog*, May 10, 2021; Z. Stambor, "Shopify Looks to Logistics, Social Commerce to Spur Growth," *Insider Intelligence*, July 20, 2022; P. Adams, "How Molson Coors Tackles the Cost and Clutter of Football Marketing," <https://www.marketingdive.com/news/molson-coors-football-marketing-draftings-podcasting/643089/>, February 21, 2023; "How WestJet Reached a Third of Canadians by Launching a Fake Space Program," *The Drum*, December 9, 2022; C. Dickson, "This Vancouver Island Brewery Hopped onto ChatGPT for Marketing Material," *CBC News*, February 22, 2023; M. McKinnon, "Social Media Use in Canada (Statistics)," *Online Business Canada*, April 23, 2023.

Advertising

social advertising Advertising formats that make use of the social context of the user viewing the ad.

MKT Social advertising refers to advertising formats that make use of the social context of the user viewing the ad. Social advertising is the first form of advertising to leverage forms of social influence such as peer pressure and friend recommendations and likes.

Many experts believe advertising is the solution to the challenge of making money from social networking sites and social commerce sites. Advertisers have long noted the large number of visitors on social networks and the amount of time they spend there. As a result, they are willing to pay to place ads and run promotions on social networks. Advertisers now post ads on all major social networking websites.

Most ads in social commerce consist of branded content paid for by advertisers. These ads belong to two major categories: *social advertisements* (or *social ads*) and *social apps*. Social advertisements are ads placed in paid-for media space on social media networks.

Viral marketing—that is, word-of-mouth advertising—lends itself especially well to social networking. For example, consider the Dove Real Beauty Sketch campaign (www.dove.com). The campaign employed a forensic sketch artist who would draw two different sketches of the same person. One sketch was drawn based on how the people described themselves, and the other sketch was based on an acquaintance's description of that person.

The campaign triggered a sensation, as it showed how harshly people see themselves compared to the favourable way they view other people. The campaign video was viewed over 69 million times on YouTube, and the overall campaign garnered more than 4 billion media impressions.

The campaign was such a huge success because it appealed to people's emotions and made them want to share it with friends. Consumers now associate Dove's brand with body positivity, and this campaign is just one of the reasons why. Not only did it go viral, but it had the exact effect the brand wanted to achieve.

There are other innovative methods to advertise in social media. Consider the following:

- Posting in X business success stories to your customers.
- Integrate ads into YouTube videos.

Market Research

MKT Traditionally, marketing professionals used demographic information compiled by market research firms as one of their primary tools to identify and target potential customers. Obtaining this information was time-consuming and costly because marketing professionals had to ask potential customers to provide it. Today, however, members of social networks provide this information voluntarily on their pages! (Think about all the information that you post on your favourite social networking websites.) Because of the open nature of social networking, merchants can easily find their customers, see what they do online, and learn who their friends are.

This information opens up a new opportunity to assess markets in near real time. Word of mouth has always been one of the most powerful marketing methods: more often than not, people use products that their friends like and recommend. Social media sites can provide this type of data for numerous products and services.

Companies are utilizing social computing tools to obtain feedback from customers. This trend is referred to as *conversational marketing*. These tools enable customers to supply feedback via blogs, wikis, online forums, and social networking sites. Again, customers are providing much of this feedback to companies entirely voluntarily and free of charge. Social computing not only generates faster and cheaper results than traditional focus groups but also fosters closer customer relationships.

Retailers are aware that customers, especially younger ones, not only want to be heard but also want to know whether other customers agree with them. Consequently, retailers are increasingly opening up their websites to customers, allowing them to post product reviews, ratings, and, in some cases, photos and videos.

As a result of this strategy, customer reviews are emerging as prime locations for online shoppers to visit. Approximately half of consumers consult reviews before making an online purchase, and almost two-thirds are more likely to purchase from a site that offers ratings and reviews.

Using social computing for market research is not restricted to businesses. Customers also enjoy the capabilities that social computing offers when they are shopping.

Conducting Market Research Using Social Networks

MKT Customer sentiment expressed on X, Facebook, and similar sites represents an incredibly valuable source of information for companies. Customer activities on social networking sites generate huge amounts of data that must be analyzed, so that management

social intelligence The monitoring, collection, and analysis of socially generated data and the resultant strategic decisions.

can conduct better marketing campaigns and improve their product design and their service offerings. The monitoring, collection, and analysis of socially generated data, and the resultant strategic decisions are combined in a process known as **social intelligence** (also called *social listening*).

MKT An example of social intelligence comes from Gillette (www.gillette.com), which launched the Gillette TREO in 2018. The TREO was the first razor specifically designed to shave someone else, in response to comments shared by caregivers on social media. Through social media listening, Gillette realized that there was a need for such a product as many people shave another person every day.

With the increase in awareness around high sodium intake, fast food customers were hesitating to buy certain foods. Wendy's (www.wendys.com) wanted to keep the favourability of its french fries high. Through social intelligence, Wendy's discovered that "sea salt" was perceived much more positively than "salt" or "sodium." The chain added sea salt to the marketing and advertising for its french fries, which helped improve its sales.

Luxury automobile brands such as BMW (www.bmw.com) are interested in which vehicle features drivers like the most. The automaker measured sentiment levels to understand how consumers felt about new features of its cars. With social intelligence, BMW found that its new laser-guided headlights had high conversation volume and favourability levels. The firm began to emphasize the headlights in its advertising as an exciting new feature.

Social networks are excellent sources of valuable information for market research. In this section, you will see illustrative examples of how to use Facebook, X, and LinkedIn for this purpose.

Using Facebook for Market Research There are several ways to use Facebook for market research. Consider the following examples:

- Obtain feedback from your Facebook fans (and their friends if possible) on advertising campaigns, market research, and so on. It is the equivalent of holding a free focus group.
- Test-market your messages. Provide two or three options, and ask fans which one they prefer and why.
- Use Facebook for survey invitations (i.e., to recruit participants). Essentially, turn Facebook into a giant panel, and ask users to participate in a survey. Facebook offers a self-service model for displaying ads, which can function as invitations to take a survey. Facebook also allows you to target your audience very specifically based on traditional demographic criteria such as age and gender.

Using X for Market Research Your customers, your prospects, and industry thought leaders all use X, making it a rich source of instantly updated information. Consider the following examples:

- Explore Twitter (www.twitter.com/explore). Enter a company's username or handle. Not only can you follow what the company is saying, you can also follow what everyone is saying to them. Monitoring replies to your competitors and their employees will help you develop your own strategy by enabling you to observe what your competitors are doing and, more important, what people think about them. You can also follow the company's response to this feedback.
- An increasing number of companies are utilizing X to solicit information from customers and to interact with them. Examples are Dell (connecting with customers), WestJet (connecting with customers), Molson Canadian (gathering feedback, sharing information), and Tim Hortons (rapid response time in dealing with complaints).

Using LinkedIn for Market Research Post a question (e.g., solicit advice) regarding the topic or issue you are interested in. You may obtain a better result if you go to a specific LinkedIn group.

Before you go on...

1. Is social advertising more effective than advertising without a social component? Why or why not?
2. Describe how marketing professionals use social networks to perform marketing research.

9.5 Social Computing in Business: Customer Relationship Management

LEARNING OBJECTIVE

Describe how social computing improves customer service.

The customer service profession has undergone a significant transformation, both in the ways that customer service professionals conduct business and in the ways that customers adapt to interacting with companies in a newly connected environment. Social computing has vastly altered both customers' expectations and corporations' capabilities in the area of customer relationship management. (We discuss customer relationship management in detail in Chapter 11.)

Customers are now incredibly empowered. Companies are closely monitoring social computing not only because they are mindful of the negative comments posted by social network members but also because they perceive an opportunity to involve customers proactively and thus to reduce problems through improved customer service.

Empowered customers know how to use the wisdom and power of crowds and communities to their benefit. These customers choose how they interact with companies and brands, and they have high expectations concerning their experiences with a company. They are actively involved with businesses, not just as purchasers but also as advocates and influencers. As a result, businesses must respond to customers quickly and appropriately. Fortunately, social computing provides many opportunities for businesses to do just that, thereby offering them the opportunity to turn disgruntled customers into champions for the firm.

Before you go on...

1. Discuss why social computing is so important in customer relationship management.
2. Describe how social computing improves customer service.

9.6 Social Computing in Business: Human Resource Management

LEARNING OBJECTIVE

Discuss different ways in which human resource managers make use of social computing.

HRM Human resource (HR) departments in many organizations use social computing applications outside their organizations (recruiting) and inside their organizations (employee development). For example, Deloitte Touche Tohmatsu (www.deloitte.com) created a social network to assist its HR managers in downsizing and regrouping teams.

Recruiting

HRM Both recruiters and job seekers are moving to online social networks as recruiting platforms. Enterprise recruiters are scanning online social networks, blogs, and other social resources to identify and find information about potential employees. If job seekers are online and active, there is a good chance that they will be seen by recruiters. In addition, there are many passive job seekers—people who are employed but would take a better job if one appeared—on social networks. So, it is important that both active and passive job seekers maintain online profiles that accurately reflect their background and skills.

Some HR directors use the HR social media management software Bullhorn (www.bullhorn.com), which allows them to post jobs to eight different social networks simultaneously. Bullhorn also enables them to analyze metrics that measure the effectiveness of their social recruiting efforts.

Onboarding

HRM *Onboarding* is how new employees acquire the necessary knowledge, skills, and behaviours to become effective members of the organization. Through the use of social media, new hires can learn what to expect in their first few days on the job and find answers to common questions. Because they are available inside the company's firewall, these social communities can provide detailed information about corporate policies, as well as giving employees the opportunity to complete necessary forms online. These communities also provide introductory training, such as workplace safety information and how to use enterprise applications.

Employee Development

HRM Human resource managers know that the best strategy to enable, encourage, and promote employee development is to build relationships with employees. To this end, many HR professionals are using enterprise social tools such as Chatter (www.salesforce.com/chatter), Yammer (www.yammer.com), and Microsoft's Viva platform (<https://www.microsoft.com/en-ca/microsoft-viva>) to tap in to the wisdom of every employee. These tools help connect employees so they can work efficiently across organizations and to collaborate on sales opportunities, campaigns, and projects. They help companies simplify workflows and capture new ideas. They enable HR managers to find subject matter experts within the organization, recommending relevant people for every project team, sales team, and other functions.

As HR managers learn more about employees' skills, expertise, and passions through such tools, they can better motivate them, thereby helping them become more engaged and excited about their work. Employees can then be better rewarded for their expertise.

Another area of employee development is training. The time and expense of employee education and learning management can be minimized by utilizing e-learning and interactive social learning tools. These tools help create connections among learners, instructors, and information. Companies find that these tools facilitate knowledge transfer within departments and across teams. One example of such tools is LinkedIn Learning (www.linkedin.com/learning), LinkedIn's online education site, which offers thousands of video courses in software, creative, and business skills. The company produces video tutorials taught by industry experts. LinkedIn members have unlimited access to watch the videos.

Finding a Job

The other side of organizational recruiting is people looking for jobs. Let's say you want to find a job. Like the majority of job hunters, you will probably conduct at least part of your search online because the vast majority of entry-level positions in the United States are now listed

only online. Job sites are the fastest, least expensive, and most efficient method to connect employers with potential employees.

Today, job searchers use both traditional job sites and social networks such as LinkedIn. To find a job, your best bet is to begin with LinkedIn (www.linkedin.com), which has roughly 165 million members. You should definitely have a profile on LinkedIn, which, by the way, is free. (See the bulleted list that follows for mistakes to avoid on your LinkedIn profile.)

LinkedIn's success comes from its ability to accurately identify its market segment. The company's automated approach does not lend itself well to the upper tier of the job market—for example, CEO searches—where traditional face-to-face searches continue to be the preferred strategy. At the other end of the spectrum—that is, low-paying, low-skill jobs such as cashiers and truck drivers—job boards provide faster results. LinkedIn targets the vast sweet spot between these two extremes, helping to fill high-skill jobs that pay anywhere from \$50,000 to \$250,000 or more per year. This is the spot you will likely occupy when you graduate.

Several job-search companies are competing with LinkedIn. These companies are trying to create better-targeted matching systems that leverage social networking functionality. These companies include Indeed (www.indeed.com), Glassdoor (www.glassdoor.ca), and Jobboom (www.jobboom.com), which is Quebec's largest job site and offers services in both of Canada's official languages, Monster (www.monster.com), SimplyHired (www.simplyhired.com), CareerBuilder (www.careerbuilder.com), and many others.

The most important secret to making online job search sites work for you is to use them carefully. Job coaches advise you to spend 80 percent of your day networking and directly contacting the people in charge of jobs you want. Devote another 10 percent to headhunters. Spend only the remaining 10 percent of your time online.

Here is how to make your time online count. To start with, as you saw above, you should have a profile on LinkedIn. This list shows you the mistakes you should NOT make on your LinkedIn profile.

- Do have a current, *professional* picture. (No dogs, no spouses, no babies, etc.)
- Do make certain your LinkedIn Status is correct and current.
- Do join groups related to your field of study or even to your personal interests.
- Do list an accurate skill set. Do not embellish.
- Do not use the standard connection request. Do some research on the person you want to connect with and tailor your connection request to that person.
- Do not neglect LinkedIn's privacy settings. When you have a job and are looking for another one, you will want to be discreet. You can set your privacy settings so that your boss does not see that you are looking for opportunities.
- Do not skip the Summary. The Summary is a concise way of selling yourself. Write it in the first person.
- Do not fail to mention past jobs or volunteer work.
- Do not say you have worked with someone when you have not.

Next, access job sites such as those listed previously. These sites list millions of jobs and they make it easy to narrow your search using filters. These filters include title, company name, location, and many others. Indeed allows you to search within a specific salary range. SimplyHired lets you sort for friendly, socially responsible, and even dog-friendly workplaces.

These sites have advanced search options. Try plugging in the name of a company you might want to work for or an advanced degree that qualifies you for specialized work. For example, you could enter "CFA" if you are a certified financial analyst or "LEED" if you are a building engineer with expertise in environmental efficiency.

SimplyHired has a useful tool called "Who do I know?" If you have a LinkedIn profile, then this tool will instantly display your LinkedIn contacts with connections to various job listings. "Who do I know?" also syncs with Facebook.

One more trick to using the aggregators: configure them to deliver listings to your inbox. Set up an email alert that delivers new job postings to you every day.

You should also search for niche sites that are specific to your field. For technology-related jobs, for instance, Dice (www.dice.com) and ITjobs (www.itjobs.ca) have a strong reputation for IT jobs in Canada. For nonprofit jobs, try Idealist (www.idealists.org) or Work-inNonProfits (www.workinnonprofits.ca). For government jobs in Canada, the Canadian federal government website (www.jobbank.gc.ca) is an excellent resource.

One more great online resource is Craigslist (www.craigslist.com). It is one site the aggregators do not tap. Craigslist focuses on local listings, and it is especially useful for entry-level jobs and internships.

Beyond locating listings for specific jobs, career coaches contend that job sites can be a resource for keywords and phrases that you can pull from job descriptions and include in your resumé, cover letters, and emails. Use the language from a job description in your cover letter.

Websites like Firsthand (formerly Vault; <https://firsthand.co>), Monster, and CareerBuilder provide some helpful career tips. Vault-Firsthand, in particular, offers very useful career guides.

The bottom line: it is critical to extend most of your efforts *beyond* an online search.

Before you go on...

1. Explain why LinkedIn has become so important in the recruiting process.
2. If you are looking for a job, what is the major problem with restricting your search to social networks?

What's in IT for me?

ACCT For the Accounting Major

Audit teams use social networking technologies internally to stay in touch with team members who are working on multiple projects. These technologies serve as a common channel of communications. For example, an audit team manager can create a group, include their team members as subscribers, and then push information regarding projects to all members at once. Externally, these technologies are useful in interfacing with clients and other third parties for whom the firm and its staff provide services.

FIN For the Finance Major

Many of the popular social networking sites have users who subscribe to finance-oriented subgroups. Among these groups are finance professionals who collaborate and share knowledge, as well as nonfinancial professionals who are potential clients.

MKT For the Marketing Major

Social computing tools and applications enable marketing professionals to become closer to their customers in a variety of ways, including blogs, wikis, ratings, and recommendations. Marketing professionals now receive almost-real-time feedback on products.

POM For the Production/Operations Management Major

Social computing tools and applications enable production personnel to “enlist” business partners and customers in product development activities.

HRM For the Human Resource Management Major

Social networks offer tremendous benefits to human resource professionals. HR personnel can perform a large proportion of their recruiting activities by accessing such sites as LinkedIn. They can also check out potential new hires by accessing numerous social networking sites. Internally, HR personnel can utilize private, internal social networks for employee expertise and experience in order to find the best person for a position or project team.

MIS For the MIS Major

The MIS department is responsible for two aspects of social computing usage: (1) monitoring employee usage of social computing applications while at work—both time and content—and (2) developing private, internal social networks for company employees and then monitoring the content of these networks.

Summary

9.1 Describe six Web 2.0 tools and two major types of Web 2.0 sites.

A *tag* is a keyword or term that describes a piece of information (e.g., a blog, a picture, an article, or a video clip).

Really Simple Syndication (RSS) allows you to receive the information you want (customized information), when you want it, without having to surf thousands of websites.

A *weblog* (*blog* for short) is a personal website, open to the public, in which the site creator expresses their feelings or opinions with a series of chronological entries.

Microblogging is a form of blogging that allows users to write short messages (or capture an image or embedded video) and publish them. A *wiki* is a website on which anyone can post material and make changes to already posted material. Wikis foster easy collaboration and harness the collective intelligence of internet users.

Social networking websites allow users to upload their content to the Web in the form of text (e.g., blogs), voice (e.g., podcasts), images, and videos (e.g., videocasts).

A *mashup* is a website that takes different content from a number of other websites and mixes them together to create a new kind of content.

9.2 Describe the benefits and risks of social commerce to companies.

Social commerce refers to the delivery of electronic commerce activities and transactions through social computing.

Benefits of social commerce to customers include: better and faster vendor responses to complaints; customers can assist other customers; customers' expectations can be met faster and more fully; customers can easily search, link, chat, and buy while staying in the social network's page.

Benefits of social commerce to vendors include: test new products and ideas quickly and inexpensively; learn much about their customers; identify problems quickly and alleviate anger; learn from customers' experiences with rapid feedback; increase sales when customers discuss products positively on social networking site; create better marketing campaigns and brand awareness; use low-cost user-generated content, for example, in marketing campaigns; get free advertising through viral marketing; identify influential brand advocates and reward them.

Risks of social computing include information security concerns; invasion of privacy; violation of intellectual property and copyright; employees' reluctance to participate; data leakage of personal information or corporate strategic information; poor-quality or biased user-generated content; cyberbullying or cyberstalking and employee harassment.

9.3 Identify the methods used for shopping socially.

Social shopping is a method of electronic commerce that takes all of the key aspects of social networks—friends, groups, voting, comments, discussions, reviews, and others—and focuses them on shopping.

Methods for shopping socially include tracking what other shoppers say, group shopping, shopping communities and clubs, social marketplaces and direct sales, and peer-to-peer shopping.

9.4 Discuss innovative ways to use social networking sites for advertising and market research.

Social advertising represents advertising formats that employ the social context of the user viewing the ad.

Different ways to advertise in social media include: create a company Facebook page; post on X about business success stories to your customers; integrate ads into YouTube videos; add a Facebook “Like” button with its sponsored story to your product; use sponsored stories.

- *Using Facebook for market research:* Get feedback from your Facebook fans (and their friends if possible) on advertising campaigns, market research, etc.; test-market your messages; use Facebook for survey invitations.
- *Using X for market research:* Use Explore / Twitter search.
- *Using LinkedIn for market research:* Post a question (e.g., solicit advice) regarding the topic or issue you are interested in.

9.5 Describe how social computing improves customer service.

Customers are now incredibly empowered. Companies are closely monitoring social computing not only because they are mindful of the negative comments posted by social network members but also because they see an opportunity to involve customers proactively to reduce problems by improving customer service.

Empowered customers know how to use the wisdom and power of crowds and communities to their benefit. These customers choose how they interact with companies and brands, and they have high expectations. They are actively involved with businesses, not just as purchasers but also as advocates and influencers. As a result, businesses must respond to customers quickly and accurately. Fortunately, social computing provides many opportunities for businesses to do just that, thereby giving businesses the opportunity to turn disgruntled customers into champions for the firm.

9.6 Discuss different ways in which human resource managers make use of social computing.

- *Recruiting:* Both recruiters and job seekers are moving to online social networks as new recruiting platforms. Enterprise recruiters are scanning online social networks, blogs, and other social resources to identify and find information about potential employees. If job seekers are online and active, there is a good chance that they will be seen by recruiters. In addition, there are many passive job seekers—people who are employed but would take a better job if it appeared—on social networks. So, it is important that both active and passive job seekers maintain profiles online that truly reflect them.
- *Onboarding:* The use of social media to help new employees acquire the necessary knowledge, skills, and behaviours to become effective members of the organization.
- *Employee development:* HR managers are using social tools to build relationships with employees. As HR managers learn more about employees, they can help them become more engaged and excited about their work.

Key Terms

blog (weblog) 269
blogosphere 269
collaborative consumption 281
mashup 276
microblogging 270
Really Simple Syndication (RSS) 268
social advertising 284

social capital 271
social commerce 276
social computing 267
social graph 271
social intelligence 286
social marketplaces 280
social network 270

social networking 270
social shopping 278
tag 268
X post (formerly Tweet) 270
X (formerly Twitter) 270
Web 2.0 268
wiki 270

Discussion Questions

1. How would you explain the value of Web 2.0 for companies to someone who has not taken a course in information systems?
 2. If you were the CEO of a company, would you pay attention to blogs about your company? Why or why not? If yes, would you consider some blogs to be more important or more reliable than others? If so, which ones? How would you find blogs relating to your company?
 3. Do you have a page on a social networking website? If yes, why? If no, what is keeping you from creating one? Is there any content that you definitely would not post on such a page?
 4. How can an organization best employ social computing technologies and applications to benefit its business processes?
 5. What factors might cause an individual, an employee, or a company to be cautious in the use of social networks?
 6. Why are advertisers so interested in social networks?
 7. What sorts of restrictions or guidelines should firms place on the use of social networks by employees? Are social computing sites a threat to security? Can they tarnish a firm's reputation? If so, how? Can they enhance a firm's reputation? If so, how?
 8. Why are marketers so interested in social networks?
 9. Why are human resource managers so interested in social networks?
-

Problem-Solving Activities

1. Do a search on Google on how to create your own map. Learn how to create map mashups and then propose a map mashup of your own. Present your mashup to the class.
2. Go to Amazon's Mechanical Turk website (www.mturk.com). View the available Human Intelligence Tasks (HITs). Are there any HITs that you would be interested in to make some extra money? Why or why not?
3. Access Spotify (www.spotify.com). Would you consider Spotify a social networking site? Why or why not?
4. Using a search engine, look up the following:
 - *Most popular or most visited blogs.* Pick two and follow some of the posts. Why do you think these blogs are popular?
 - *Feedly* (www.feedly.com). Do a search for Best Canadian Blogs and Websites. Pick two and consider why they might be the "best blogs."
5. Research how to be a successful blogger. What does it take to be successful as a blogger? What time commitment might be needed? How frequently do successful bloggers post?
6. Go to www.shopify.com. Describe the shopping experience. How does it compare to www.amazon.ca?
7. Visit www.yelp.com. Look up your favourite restaurant. Do you agree with the reviews? Why or why not?
8. Create an account on www.linkedin.com if you do not already have one. Describe the methods you can use for updating your profile and how you think this can help you in a future career search.
9. Visit www.wikihow.com. Explain the process for creating a new wiki.

Closing Case

MIS Nextdoor

Between 2008 and 2020, Canada lost 258 local newspapers. In many neighbourhoods, Nextdoor (<https://nextdoor.com>) has begun to assume the roles once filled by those newspapers. Nextdoor is becoming the platform for people to discuss local news and events. It provides a hyperlocal social networking service for neighbourhoods. *Hyperlocal* refers to information oriented around a well-defined community, with its primary focus directed to the population of that community.

Nextdoor was designed as a site to trade gardening tips, offer babysitting services, or complain about homeowners who did not clean up after their dogs. Significantly, Nextdoor requires users to submit their real names and addresses to the service. This policy ensures that users know who is providing information or posting complaints.

The way Nextdoor makes its money is by charging businesses to have their ads appear in users' feeds, along with other posts. In general, the platform focuses on local advertisers, including many of the same ones who had previously sustained local newspapers.

Nextdoor operates in 305,000 neighbourhoods in 11 countries. The app became much more popular during the COVID-19 pandemic. In the first two weeks of March 2020 alone, user engagement increased by 80 percent as neighbours searched for advice on where to find toilet paper and masks and stay-at-home orders hindered in-person interactions. The app also became an important tool for local authorities to communicate information regarding shutdown measures, mask mandates, and testing sites.

As with all social media sites, Nextdoor has both positive and negative features. Let's consider both aspects here.

Positive aspects. Nextdoor's algorithm that ranks posts does not seem to be as aggressive as those of large social media sites. Nextdoor has no followers, so there is little incentive for users to post clickbait or engagement bait. *Clickbait* or *engagement bait* is deceptive, sensationalized, or misleading content, such as a headline or link, that is designed to attract attention and to entice users to read, view, or listen to the content. Because each user is labelled with their actual first name, last initial, and home neighbourhood, Nextdoor can feel almost like talking to your neighbours in real life. In addition, good news, which can be difficult to find on local television newscasts or newspapers, often features prominently on Nextdoor.

Negative aspects. Nextdoor is fundamentally opaque. Users cannot view posts from outside their location, and there are no public analyses about what types of posts perform well or poorly. In addition, several of the app's design features tend to direct users toward the "noisiest" posts, sometimes at the expense of the truth.

Furthermore, Nextdoor seems to be most effective at amplifying the quality-of-life concerns of the more affluent residents. For example, because it requires a verified mailing address in order to sign up, the platform prevents homeless people from joining. Also, although the platform's user guidelines discourage users from discussing national politics, Nextdoor has drawn scrutiny for its role in not promoting diversity. Consequently, the platform had to

redesign and update its systems to combat racial profiling because of allegations of suspicious activity targeting visible minorities.

Another problem is that Nextdoor can make it difficult for users to distinguish between truth and misinformation. Users can post an image, but the majority of posts are text-only. Posts that include a link to another website do not display any preview of the headline or image to encourage readers to click through, as Facebook and X do. As a result, "facts" cited in support of users' opinions often appear without citations. Although the app is growing in popularity, it shows few signs that it is capable of developing the accountability that local newspapers often demonstrated.

Whereas many social platforms favour original posts more than replies and comments, reply threads form the heart of Nextdoor's content, a feature the app shares with Reddit. However, Nextdoor does not have Reddit's upvoting and downvoting mechanism for raising some replies over others. Instead, Nextdoor highlights and even sends push notifications for posts that receive lots of replies. As a result, controversial comments that cause many people to reply angrily are spread rather than buried.

Compounding these issues is the fact that Nextdoor relies entirely on unpaid, volunteer moderators who are not always well equipped to handle these problems. These moderators can decide whether to take posts down or leave them up and to close discussions or leave them open. However, they have few in-between options.

Nextdoor's success attracted the interest of Facebook, which launched a Nextdoor clone, Neighborhoods. This Facebook site had special features, like subprofiles for members and appointed moderators who would review comments and posts, among other things; however, the social network giant closed Neighborhoods in late 2022 due to low uptake from its user base. Local neighbours on Facebook typically use Facebook's Groups feature to post updates about their local community. Nextdoor recently announced a partnership with Toronto FC as a way to promote the social networking app among soccer fans and also as a way to promote the sport among Nextdoor neighbourhoods. With the COVID-19 pandemic behind us and as neighbours return to outdoor activities, will Nextdoor succeed in keeping and growing its user base?

Questions

1. Should Nextdoor rank the importance of posts as Reddit does? Why or why not? Support your answer.
2. Is it a good idea for Nextdoor to require a user's real name and address to upload a post and consume the content from the user's neighbourhood? Why or why not? Support your answer.
3. Should people in one neighbourhood (as defined by Nextdoor) be permitted to read content from an adjoining neighbourhood? Why or why not? Support your answer.
4. Using the example of a local business in your neighbourhood, explain how it could use Nextdoor for the four different types of social computing in business. Provide detailed examples.

Sources: Compiled from A. Rutledge and T. Francisco, “Verizon and Nextdoor Connecting Neighborhoods,” <https://wgntv.com/daytime-chicago/daytime-chicago-sponsored/verizon-and-nextdoor-connecting-neighborhoods/>, September 7, 2022; “Small-Town Newspapers Struggling to Survive,” *Yahoo! News*, December 23, 2021; “With Local News Struggling, the Nextdoor App Is Shaping Local Politics,” [NPR.org](https://www.npr.org/2021/02/04/968888888/), February 4, 2021; J. Low, “Nextdoor App Is Replacing Local Newspapers with Gossip, Innuendo, and Rumor,” *The Lowdown*, January 27, 2021; W. Oremus, “Nextdoor Is Quietly Replacing the Small-Town Paper,” *OneZero*, January 27, 2021; R. Heilweil, “The Messy Politics of Nextdoor,” *Vox*, October 26, 2020; M. Kelly, “Inside Nextdoor’s ‘Karen Problem,’” *The Verge*, June 8, 2020; R. Paulas, “On Nextdoor,

the Homeless Are the Enemy,” *OneZero*, September 30, 2019; J. Fallows, “There’s Hope for Local Journalism,” *The Atlantic*, September 18, 2019; “Many Small Newspapers Struggle to Survive, but a Few Are Thriving,” *The Daily Universe*, April 18, 2019; A. Robinette, “Small Town Newspapers Swimming against the Social Media Wave,” *Delta Business Journal*, June 15, 2018; J. McLeod, “Nextdoor Launches in Canada, Promising a More Intimate, Neighbourly Social Network,” *Toronto Star*, September 23, 2019; S. Perez, “Facebook Is Shutting Down Its Nextdoor Clone Next Month, Following Tests in the US and Canada,” *TechCrunch+*, September 1, 2022; L. Papadopoulos, “Nextdoor Sponsors Toronto FC,” *Media in Canada*, September 15, 2022; Nextdoor, <https://nextdoor.com>, accessed May 9, 2023.

Information Systems within the Organization

CHAPTER OUTLINE

LEARNING OBJECTIVES

10.1 Transaction Processing Systems	10.1 Explain the purpose of transaction processing systems.
10.2 Functional Area Information Systems	10.2 Explain the types of support that information systems can provide for each functional area of the organization.
10.3 Enterprise Resource Planning (ERP) System	10.3 Identify advantages and drawbacks to businesses of implementing an enterprise resource planning (ERP) system.
10.4 ERP Support for Business Processes	10.4 Describe the three main business processes supported by ERP systems.

Opening Case

Composable Business

Background

Modern organizations must be able to adapt quickly to changing customer expectations and industry regulations and to respond to competitive pressures. Technology has flattened competition and, in some ways, has turned it upside down. Large organizations that have invested significant time and money in their information systems often struggle to respond to market changes as quickly as smaller, more agile organizations. To compete, organizations must offer an experience that differentiates them from the competition, while also meeting customers' expectations.

For example, imagine that you were working in the banking industry in the early 1990s. For most banks, the status quo for the customer experience had changed little in more than a decade. Banks had invested millions of dollars and countless person-hours to implement internal systems to support the existing customer experience. These systems were composed of technologies that were tightly integrated and very rigid.

Often, these systems were provided by a single vendor, meaning that an entire suite of software options was provided by one company. There were no options for outside integration. These single-vendor technology stacks are referred to as "monolithic." The term "monolithic" refers to a single large block of stone and

is used for such systems because they are single, large, "heavy," and difficult to upgrade. For many years, monolithic systems were sufficient because the user experience had not changed. Bank customers would visit physical branches to deposit, transfer, and withdraw money. They also kept personal records to maintain their account balances and reconciled their accounts with a monthly statement, just as they had for almost a century.

In the early 1990s, bank administrators might have heard about offering online services to their customers. Still, these services were not imminent enough for banks to consider updating their systems. Furthermore, any upgrades depended on the resources and policies of their current technology provider. For most banks, switching the entire technology stack to offer additional tools was simply not practical.

This stability began to change rapidly at the turn of the twenty-first century. Amazon.com was six years into changing how we shop and, in 2004, Facebook began to transform how we connect. These developments led customers to demand more from their banking experience. Specifically, they wanted to access their bank accounts online just as they accessed their store accounts, library cards, and work information. The first banks to offer online banking were able to capitalize on the innovative differentiator. But other banks responded, and by 2006, more than 80 percent of banks offered some version of online banking. Customers could

now log into their accounts and check their current (or pending) balances. These websites and applications, however, functioned only on computers. They did not work on mobile, tablet, or other app-related platforms.

In 2007, Apple introduced the iPhone, and consumer habits began to shift to a mobile-first mindset. Similar to online banking, mobile banking was initially a differentiator. Within a few years, however, being able to log into your account through a mobile app became a mainstream customer expectation that no longer conferred a competitive advantage.

Since then, the banking industry has undergone many dramatic changes. The monolithic technology stacks of the past can no longer support the rate of change necessary for banks to remain relevant. Modern commerce requires much more agility than a monolithic system can provide. Leading bankers are increasingly shifting away from these monolithic systems to keep up with the speed of change, fluctuations in customer demand, and disruptive new trends. Research suggests that almost half (47 percent) of consumers across all generational segments would switch banks to access better digital capabilities.

The IT Solution

Banks often consider basic technology changes only when their current technology can no longer address their unique needs or their customers' expectations. They realize they are limited to their platform's current offerings or future features roadmap, which might not align with their needs or strategies. Not only does this problem affect their day-to-day decisions or ongoing operations, but it also limits their future growth opportunities.

The solution to this problem, which we discuss below, is called a composable system. Creating this type of system requires an entirely new mindset. The monolithic mindset was based on the belief that IT systems are complicated and the safest way to build them is to go with a single vendor where everything is designed to work together seamlessly. But what if customers want a feature—for example, Alexa integration—and the existing system doesn't have a mechanism for integrating it? Should a bank change to a new monolithic system that will support Alexa? If it does, then which features that it currently has will it lose?

Now, imagine a technology that would enable the bank to add new features to any system regardless of whether the same provider built them. What if businesses could seamlessly interchange components, systems, and options without touching backbone systems? This flexibility would enable banks to implement new features, rapid updates, and better customer service. By utilizing this type of technology, known as a *composable system*, banks can add, remove, and change features without disrupting the entire system.

The most important component of a composable system is the application programming interface (API), which is a set of instructions that enables two applications to speak to each other. Banks can employ APIs to provide access in multiple languages, support customers with visual impairments, and enhance their customer interfaces with graphics, support chatbots, artificial intelligence, and more. Customers can access all their information through whichever tool they prefer. In essence, APIs allow for an endless degree of customization.

Composable systems give banks the option to pick and choose software components. Gartner describes these components as “packaged business capabilities” that any vendor can provide. In other words, packaged business capabilities are software components that represent and perform a clearly defined business

capability. Composable systems also enable banks to develop a commerce suite using the best vendors for each job—from promotions to transfers to account set-up.

In contrast to monolithic systems, which require extensive, risky upgrades every few years, a composable architecture favours constant development. Because composable architectures leverage the cloud (see Technology Guide 3), banks can instantly roll out updates for their customers without system downtime for maintenance. As a result, they can swap out components as their needs or preferences change, reducing—or even eliminating—the need to change platforms. Further, composable architecture tools enable banks to choose the exact components they need to configure new products with limited IT involvement.

The Results

As an industry, banks are still transitioning to a composable platform. It took years to adopt the monolithic systems, and change doesn't happen overnight. Some banks, however, have taken major steps toward implementing a composable system. For example, in 2019 Banca Mediolanum Group (www.bancamediolanum.it) an Italian commercial banking group created a new, digital-first bank called Flowe (www.flowe.com) from the bottom up. In the past, this system would have taken years to build. But using a composable platform, Flowe was able to go live in 2020. In just five months, it grew to 600,000 customers.

In May 2022, Canadian Tire Bank (CTB), the financial arm of Canadian Tire Corporation, announced that it had selected the Temenos open platform for composable banking to replace its legacy systems. Temenos provides banks and financial institutions with a complete core banking system that employs APIs, which enable its customers to quickly access a wide range of internal or external sources. This partnership aims to help CTB to streamline the processes related to its digital accounts and extend its buy now, pay later capability. The partnership also improves the integration across Canadian Tire Corporation's retail brands and the Triangle Rewards loyalty program, which has 11 million members.

Questions

1. Define a monolithic platform, and identify its major advantages and disadvantages.
2. Define a composable system, and identify its major advantages and disadvantages.
3. How has technology changed the information systems used in the banking industry?

Sources: Compiled from P. Varadhan, “Why the Future of Banking Is Composable,” <https://www.finextra.com/blogposting/22987/why-the-future-of-banking-is-composable>, September 30, 2022; J. Cottrell, “Three Composable Commerce Myths,” *Forbes*, September 27, 2022; D. Mistry, “Making Composable Banking Work,” *Fintech Futures*, September 23, 2022; D. Swanson, “The Future of Commerce: Going Headless,” *Total Retail*, September 22, 2022; A. Denizeri, “Making Supply Chain Planning Agile with Modular Planning Technologies,” *Logistics Viewpoints*, September 20, 2022; S. Govindu, “From Cacophony to Symphony: Composable Enterprise and the Customized Experience,” *Forbes*, September 16, 2022; S. Remekie, “Composable: The Marketer's Perspective and Roadmap,” <https://www.cmswire.com/digital-experience/composable-the-marketers-perspective-and-roadmap/>, September 14, 2022; R. Harbols, “Outpace the Competition with Composable Commerce,” *Forbes*, September 6, 2022; J. Jarmon, “Introducing the Composable Business: How Customer-Centered APIs Are Empowering Executives to Open New Markets,” *Forbes*, June 15, 2022; J. England, “Technology

in Fintech and the Story of Online Banking,” *FinTech*, June 8, 2022; R. Shevlin, “Which Bank Has the Best Mobile Banking App?” *Forbes*, June 6, 2022; J. Cottrell, “Why Composable Commerce Is Gaining Traction,” *Forbes*, March 31, 2022; P. Varadhan, “Why Composability Is the Future of Banking,” *International Banker*, May 30, 2022; S. Zimberg, “How Banks Can Catch Up to the Speed and Scale of Fintechs,” *The Financial Brand*, May 27, 2022; A. Pugh, “Canadian Tire Bank Taps Temenos for Digital-First Core Banking Upgrade,” *FinTech Futures*, May 25, 2022; “Canadian Tire Bank Selects Temenos Open Platform to Gain Best-in-Class Digital Banking Capabilities,”

Yahoo! News, May 18, 2022; B. Nixon, “How CIOs Can ‘Tune Up’ for the IT Composability Paradigm,” *Forbes*, February 22, 2022; V. Afshar, “Next Generation Business Applications Are Scalable, Composable and Intelligent,” <https://www.zdnet.com/article/next-generation-business-applications-are-scalable-composable-and-intelligent/>, June 23, 2021; K. Panetta, “Gartner Keynote: The Future of Business Is Composable,” *Gartner*, October 19, 2020; S. Mahalingam, “Composable Banking Platform through Open Bank APIs,” <https://www.finextra.com/blogposting/12234/composable-banking-platform-through-open-bank-api>, February 16, 2016.

Introduction

The opening case illustrates the importance of agility in today’s fast-paced, volatile market. Businesses must be able to adapt their systems to customers’ changing needs and demands. Although this case focuses on the impact of technology on the banking industry, the application of composable architecture affects almost all industries.

It is important to note that “systems within organizations” do not have to be owned by the organization itself. Instead, organizations can deploy very productive ISs that are owned by an external vendor. The key point is that “systems within an organization” are intended to support internal processes, regardless of who actually owns the systems.

It is important for you to have a working knowledge of ISs within your organization for a variety of reasons. First, your job will require you to access corporate data that are supplied primarily by your firm’s transaction processing systems and enterprise resource planning systems. Second, you will have a great deal of input into the format and content of the reports that you receive from these systems. Third, you will use the information contained in these reports to perform your job more productively.

This chapter will teach you about the various information systems that modern organizations employ. We begin by considering transaction processing systems, the most fundamental organizational information systems. We continue with functional area management information systems and conclude with enterprise resource planning systems.

10.1 Transaction Processing Systems

LEARNING OBJECTIVE

Explain the purpose of transaction processing systems.

Millions (sometimes billions) of transactions occur in large organizations every day. A **transaction** is any business event that generates data worthy of being captured and stored in a database. Examples of transactions are a product manufactured, a service sold, a person hired, and a payroll cheque generated. In another example, when you are checking out of Walmart, each time the cashier swipes an item across the bar code reader, that is one transaction.

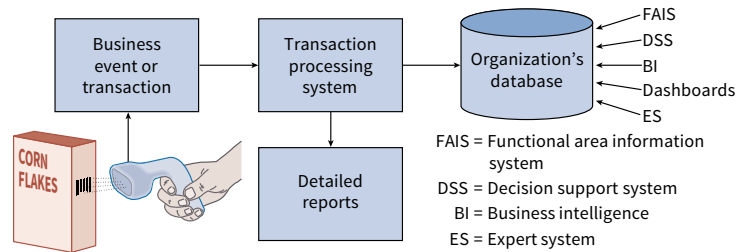
A **transaction processing system (TPS)** supports the monitoring, collection, storage, and processing of data from the organization’s basic business transactions, each of which generates data. The TPS collects data continuously, typically in *real time*—that is, as soon as the data are generated—and it provides the input data for the corporate databases. TPSs are critical to the success of any enterprise because they support core operations.

In the modern business world, TPSs are inputs for functional area information systems and business intelligence systems, as well as business operations such as customer relationship management, knowledge management, and e-commerce. TPSs have to efficiently handle both high volumes of data and large variations in those volumes (e.g., during peak processing periods). They must also avoid errors and downtime, record results accurately and securely,

transaction Any business event that generates data worth capturing and storing in a database.

transaction processing system (TPS) Information system that supports the monitoring, collection, storage, and processing of data from the organization’s basic business transactions, each of which generates data.

FIGURE 10.1 How transaction processing systems manage data.



and maintain privacy and security. **Figure 10.1** illustrates how TPSs manage data. Consider these examples of how TPSs handle the complexities of transactional data:

- When more than one person or application program can access the database at the same time, the database has to be protected from errors resulting from overlapping updates. The most common error is losing the results of one of the updates.
- When processing a transaction involves more than one computer, the database and all users must be protected against inconsistencies arising from a failure of any component at any time. For example, an error that occurs at some point in an ATM withdrawal can enable a customer to receive cash, even if the bank's computer indicates that they did not. (Conversely, a customer might not receive cash, although the bank's computer indicates that they did.)
- **ACCT** It must be possible to reverse a transaction in its entirety if it turns out to have been entered in error. It is also necessary to reverse a transaction when a customer returns a purchased item. For example, if you return a sweater that you have purchased, then the store must credit your credit card for the amount of the purchase, refund your cash, or offer you an in-store credit to purchase another item. The store must also update its inventory.
- **ACCT** It is frequently important to preserve an audit trail. In fact, an audit trail is legally required for many transactions.

These and similar issues explain why organizations spend millions of dollars on expensive mainframe computers. In today's business environment, firms must have the dependability, reliability, and processing capacity these computers offer to handle their transaction processing loads.

Regardless of the specific data processed by a TPS, the actual process tends to be standard, whether it occurs in a manufacturing firm, a service firm, or a government organization. As the first step in this procedure, people or sensors collect data, which are entered into the computer through any input device. Generally speaking, organizations try to automate the TPS data entry as much as possible because of the large volume involved, a process called *source data automation* (discussed in Technology Guide 1).

Next, the system processes data in one of two basic ways: batch processing and online processing. In **batch processing**, the firm collects data from transactions as they occur, placing them in groups, or *batches*. The system then prepares and processes the batches periodically (say, every night).

In **online transaction processing (OLTP)**, business transactions are processed online as soon as they occur. For example, when you pay for an item at a store, the system records the sale by reducing the inventory on hand by one unit, increasing sales figures for the item by one unit, and increasing the store's cash position by the amount you paid. The system performs these tasks in real time by means of online technologies.

batch processing Transaction processing system (TPS) that processes data in batches at fixed periodic intervals.

online transaction processing (OLTP) Transaction processing system (TPS) that processes data after transactions occur, frequently in real time.

Before you go on...

1. Define TPS.
2. List the key functions of a TPS.

10.2

Functional Area Information Systems

LEARNING OBJECTIVE

Explain the types of support that information systems can provide for each functional area of the organization.

Each department or functional area within an organization has its own collection of application programs, or information systems. Each of these **functional area information systems (FAISs)** supports a particular functional area by increasing its internal efficiency and effectiveness. FAISs often convey information in a variety of reports, which you will see later in this chapter. Examples of FAISs are accounting IS, finance IS, production/operations management (POM) IS, marketing IS, and human resources (HR) IS.

Before we present each functional area, we will discuss a historical debate among organizations: Should IT exist as its own centralized functional area? Or should IT support be decentralized within each functional area? The pendulum has swung both ways over the years. Today, however, cloud technology raises a new consideration. IT's About Business 10.1 presents this debate.

functional area information systems (FAISs) Systems that provide information to managers (usually mid-level) in the functional areas to better support the managerial tasks of planning, organizing, and controlling operations.

IT's About Business 10.1

IT: Centralized versus Decentralized

Who should IT workers report to? They work *with* everyone in an organization, but do they work *for* everyone in the organization? Should there be an IT area in each department to handle the technology needs of that department? Or, should IT be centralized in a single department that everyone goes to for all technology issues?

The dilemma of designing the IT department has been around since the twentieth century. Technology tended to be costly and complex. Moreover, most workers did not grow up using technology in their daily lives. As a result, there was a need for experts to build and maintain the technology. This need led most organizations to establish a centralized, company-wide technology department. Throughout the 1980s and 1990s, this arrangement was the “correct” way to deploy and manage technology. Now, fast-forward to the twenty-first century. Most organizations continue to maintain centralized technology departments, even though younger, tech-savvy generations are entering the workforce.

The centralized IT department provided organizational direction and standardization. IT departments became “Dell shops” or “Oracle shops” based on the hardware and software decisions made by leadership. This standardization and consistency reduced costs and streamlined maintenance. Decentralized IT, on the other hand, is an organizational structure in which daily operations and decision-making responsibilities are delegated to the respective business units.

Many expensive and complex areas, such as cybersecurity, have benefited from centralized management. For other areas, however, having a single point of responsibility created a bottleneck because organizations' IT needs outgrew the department's capability. Some IT departments have reported being 18 months behind on fulfilling system or application updates.

When a department is 18 months behind, people begin to look elsewhere for solutions. Today, according to a 2022 ManageEngine (a provider of enterprise software systems) study, *IT at Work: 2022 and Beyond* (www.manageengine.com/survey/it-at-work-2022/us-canada.html), an increasing number of IT-related decisions are being made outside the formal IT department. Additionally, cloud computing (we will discuss cloud computing in Technology Guide 3)

has changed the IT Department's business requirements because the amount of on-premise hardware is significantly reduced. Furthermore, tech-savvy employees can participate in DevOps, an interdepartmental effort between an IT Development group and Business Operations, regardless of the departmental structure.

In some ways, the department designed to foster innovation and business success has hindered the services it is intended to provide. As a result, some IT experts have called for the end of the traditional IT department. For example, a November 2021 article in *The Wall Street Journal* asserted that it is time for the IT department to, “shape up or ship out.” Of course, this article elicited a lot of feedback.

In the following section, we examine the advantages of both centralized and decentralized structures. We then consider how the changing nature of IT decision making, the cloud, and a more tech-savvy workforce might change the design of the IT department.

Centralized IT Departments

The benefits of a centralized structure are often associated with increased purchasing power, improved information flow among IT team members, and an overview of the enterprise's technical infrastructure from both an operational network and a security perspective. Specifically, consider the following benefits.

- A centralized IT Department can help to lower hardware costs by keeping all servers and networking equipment in one place. However, this benefit applies only if your employees are centralized or can securely connect to the local servers. Today, a cloud-based solution can provide most of the functions provided by local servers and mainframes, almost eliminating this advantage.
- A centralized structure can lower initial and ongoing software costs. It is easier to negotiate the pricing of software licences and support contracts for an entire company than for individual departments. For this reason, a centralized IT structure will increase purchasing power, resulting in better contract terms and better support. A central design also gives the IT staff better

oversight and makes routine tasks easier. Regular maintenance, such as software installations, updates, and security patches, can be accomplished from one location, thereby lowering the overall cost of ownership. In decentralized IT set-ups, completing these tasks would require staff to manage each area separately, which can drive up costs and decrease productivity. As with hardware, however, a cloud-based solution removes the need to maintain separate sites, thus reducing this advantage.

- Centralized IT can more readily comply with industry regulations. Some industries have specific rules. For example, in Canada many industries, including but not limited to health care, banking, and telecommunications, must comply with the standards of the Personal Information Protection and Electronic Documents Act (PIPEDA), and financial companies must meet the requirements in Bill 198. However, modern, cloud-based solutions often satisfy these regulations for their customers, eliminating this advantage.

In sum a centralized IT department provides several advantages. These advantages, however, have changed as technology has increasingly shifted to the cloud. Now, let's consider the advantages of a decentralized IT department.

Decentralized IT Departments

As stated earlier, decentralized IT is an organizational structure in which daily operations and decision-making responsibilities are delegated to the business units. This structure offers several advantages. It is especially practical when the various departments or business units have different IT needs and strategies.

- When all departments have decision-making authority, they can choose and configure IT resources to match their specific needs. Decision making is quick and does not require a chain of approvals.
- Decentralization creates greater organizational redundancy and a more resilient IT structure. If all departments maintain individual servers, then one server can go down, and the others will not be affected. Moreover, one server can function as a backup for another department during a network failure.
- Less bureaucracy enables an organization to respond more quickly to IT trends. Departments can make independent decisions, so it is easier for them to leverage new technologies. Quicker responses to emerging technology trends can be a competitive advantage.

These benefits aside, the 2022 ManageEngine Survey, *IT at Work: 2022 and Beyond*, revealed that 99 percent of respondents reported that their organization faces challenges due to IT decentralization. The most notable are maintaining IT security (more than 50 percent), overall quality maintenance (more than 40 percent), and the reliability of ongoing support (37 percent).

Conclusion

How to decide? Large organizations with multiple legacy systems are almost always moving elements of their IT department away from a centralized system. The reason is that the role of the IT department is changing (see Table 1.2: The Changing Role of the Information Systems Department). In turn, the organizational structure must adapt to these changes.

Companies that need to respond quickly to new IT developments are less likely to establish a centralized IT management structure. Cloud computing solutions enable organizations to build and deliver a unique customer experience much faster than centralized structures do.

The way forward is most likely a hybrid structure that will offer the benefits of both approaches. The aspects of IT management that provide an advantage at an overarching level—for example, security, compliance, and API standards—are centralized. However, a department can make purchases directly if it complies with the established standards. Overall, hybrid IT models will support but not control the technology decisions the various departments make.

Changing business processes to adopt a hybrid system will not be easy. Start-ups have an advantage because they can build modern technological possibilities into their organizational structure from the ground up. In contrast, established companies must determine how to reallocate and redeploy IT resources in a new, decentralized world to meet the constantly changing needs of different departments.

Questions

1. Describe a centralized IT department and discuss its advantages.
2. Describe a decentralized IT department and discuss its advantages.
3. How does the cloud change the advantages you discussed in these questions?
4. Describe a hybrid IT structure.

Sources: Compiled from J. Peppard, "Get Rid of the IT Department? Some People Think Otherwise," *The Wall Street Journal*, September 18, 2022; D. Weldon, "Centralized vs. Decentralized Data Systems—Which Choice Is Best?" *VentureBeat*, September 12, 2022; J. Erolin, "Is It Time for Decentralized IT?" *BairesDev.com*, May 13, 2022; C. Betz and W. McKeon-White, "3 Reasons the IT Department Is Here to Stay," *CIO Dive*, December 13, 2021; J. Peppard, "It's Time to Get Rid of the IT Department," *The Wall Street Journal*, November 27, 2021; J. Chapel, "How Cloud Has Affected the Centralization vs. Decentralization of IT," *Dataversity.net*, August 9, 2021; R. Kumar, "Your IT Organizational Structure: Should You Centralize or Decentralize?" *SoftwareAdvice.com*, May 20, 2020; <https://www.manageengine.com/survey/it-at-work-2022/us-canada.html>, accessed October 10, 2022.

As illustrated in Figure 10.1, FAISs access data from the corporate databases. The following sections discuss the support that FAISs provide for these functional areas.

ACCT FIN Information Systems for Accounting and Finance

A primary mission of the accounting and finance functional areas is to manage money flows into, within, and out of organizations. This mission is very broad because money is involved in all organizational functions. Therefore, accounting and finance information systems are

very diverse and comprehensive. In this section, you will focus on selected activities of the accounting and finance functional area.

Financial Planning and Budgeting Appropriate management of financial assets is a major task in financial planning and budgeting. Managers must plan for both acquiring and using resources. For example:

- *Financial and economic forecasting:* Knowledge about the availability and cost of money is a key ingredient for successful financial planning. Cash flow projections are particularly important because they inform organizations of what funds they need, when they need them, and how they will acquire them.

Funds for operating organizations come from multiple sources, including shareholders' investments, bond sales, bank loans, sales of products and services, and income from investments. Decisions concerning funding for ongoing operations and for capital investment can be supported by decision support systems and business analytics applications (discussed in Chapter 12). Numerous software packages for conducting economic and financial forecasting are also available. Many of these packages can be downloaded from the internet, some of them free of charge.

- *Budgeting:* An essential component of the accounting and finance function is the annual budget, which allocates the organization's financial resources among participants and activities. The budget allows management to distribute resources in the way that best supports the organization's mission and goals.

Several software packages are available to support budget preparation and control and facilitate communication among participants in the budget process. These packages can reduce the time involved in the budget process. Furthermore, they can automatically monitor exceptions for patterns and trends.

Managing Financial Transactions Many accounting and finance software packages are integrated with other functional areas. For example, Sage 50cloud Accounting by Sage (www.sage.com/en-ca/products/sage-50cloud/) offers a sales ledger, a purchase ledger, a cash book, sales order processing, invoicing, inventory control, a fixed assets register, and more.

Companies involved in electronic commerce need to access customers' financial data (e.g., credit line), inventory levels, and manufacturing databases (to determine available capacity and place orders). For example, Microsoft Dynamics GP (formerly Great Plains Software) offers 50 modules that meet the most common financial, project, distribution, manufacturing, and e-business needs.

Organizations, business processes, and business activities operate with, and manage, financial transactions. Consider these examples:

- *Global stock exchanges:* Financial markets operate in global, 24/7/365, distributed electronic stock exchanges that use the internet both to buy and sell shares and to broadcast real-time share prices.
- *Managing multiple currencies:* Global trade involves financial transactions that are carried out in different currencies. The conversion ratios of these currencies are constantly in flux. Financial and accounting systems use financial data from different countries and convert the currencies from and to any other currency in seconds. Reports based on these data, which formerly required several days to generate, can now be produced in just seconds. In addition to currency conversions, these systems manage multiple languages.
- *Virtual close:* Companies traditionally closed their books (accounting records) quarterly, usually to meet regulatory requirements. Today, many companies want to be able to close their books at any time, on very short notice. Information systems make it possible to close the books quickly in what is called a *virtual close*. This process provides almost real-time information on an organization's financial health.
- *Expense management automation:* Expense management automation (EMA) refers to systems that automate the data entry and processing of travel and entertainment expenses. EMA systems are Web-based applications that enable companies to quickly

and consistently collect expense information, enforce company policies and contracts, and reduce unplanned purchases as well as airline and hotel expenses. They also allow companies to reimburse their employees more quickly because expense approvals are not delayed by poor documentation.

Investment Management Organizations invest large amounts of money in shares, bonds, real estate, and other assets. Managing these investments is a complex task for several reasons. First, organizations have literally thousands of investment alternatives, dispersed throughout the world, to choose from. These investments are also subject to complex regulations and tax laws, which vary from one location to another.

Investment decisions require managers to evaluate financial and economic reports provided by diverse institutions, including federal and state agencies, universities, research institutions, and financial services firms. Thousands of websites also provide financial data, many of them free of charge.

To monitor, interpret, and analyze the huge amounts of online financial data, financial analysts employ two major types of IT tools: internet search engines and business intelligence and decision support software.

Control and Auditing One major reason why organizations go out of business is an inability to forecast or secure a sufficient cash flow. Underestimating expenses, overspending, engaging in fraud, and mismanaging financial statements can lead to disaster. Consequently, it is essential that organizations effectively control their finances and financial statements. Let's examine some of the most common forms of financial control.

- *Budgetary control:* After an organization has finalized its annual budget, it divides those monies into monthly allocations. Managers at various levels monitor departmental expenditures and compare them against the budget and the operational progress of corporate plans.
- *Auditing:* Auditing has two basic purposes: (1) to monitor how the organization's monies are being spent and (2) to assess the organization's financial health. *Internal audits* are performed by the organization's accounting and finance personnel. The Institute of Internal Auditors (www.theiia.org) explains that internal auditors should remain independent of management by reporting to the audit committee of the board of directors. Then, the internal auditors can assess the controls at an organization and evaluate its risk assessment and governance processes. These employees can also prepare for periodic external audits by outside public accounting firms.
- *Financial ratio analysis:* Another major accounting and finance function is to monitor the company's financial health by assessing a set of financial ratios, including liquidity ratios (measure the availability of cash to pay debt), activity ratios (measure how quickly a firm converts noncash assets to cash assets), debt ratios (measure the firm's ability to repay long-term debt), and profitability ratios (measure the firm's use of its assets and control of its expenses to generate an acceptable rate of return).

MKT Information Systems for Marketing

It is impossible to overestimate the importance of customers to any organization. Therefore, any successful organization must understand its customers' needs and wants and then develop its marketing and advertising strategies around them. Information systems provide numerous types of support for the marketing function. Customer-centric organizations are so important that we cover this topic in detail in Chapter 11.

POM Information Systems for Production/Operations Management

The production/operations management (POM) function in an organization is responsible for the processes that transform inputs into useful outputs as well as for the overall operation of the business. The POM function is responsible for managing the organization's supply chain.

Since supply chain management is vital to the success of modern organizations, we address this topic in detail in Chapter 11. Because of the breadth and variety of POM functions, we discuss only four here: in-house logistics and materials management, planning production and operation, computer-integrated manufacturing (CIM), and product life cycle management (PLM).

Blockchain (see Chapter 7) is radically transforming manufacturing. IT's About Business 10.2 presents several ways that blockchain has impacted, and will continue to impact, manufacturing.

IT's About Business 10.2

Blockchain and Manufacturing

Blockchain. What a strange word. It brings to mind an image of a very impractical tool. What could you do with a chain made of blocks? In the digital world, the answer is, quite a lot!

What exactly is blockchain (see Chapter 7)? Perhaps it would help to explain how things work without blockchain. Imagine that you work for a local hardware store, and a customer returns a can of spray paint because it was the wrong colour. The packaging indicates that the paint is blue, but when the customer used it, the paint was red. Your supervisor tasked you with calling the distributor to inform it and to find out how many other items might have the same problem.

You start by examining your shipments to see when they were delivered and in which order. You need to know how many other items in that order might be incorrectly labelled. Armed with this information, you call your distributor. It takes your order numbers and delivery dates and begins to match that information with its records. It finds that the order originated from a single supplier. Now, with the information about the supplier, the products, and the orders, the distributor reaches out to the supplier.

The supplier takes all the information from the hardware store and the distributor and matches this information to its own. It identifies the incorrectly labelled batch and discovers that it was produced and labelled by one of its partners. The supplier reaches out to the partner with the information from the hardware store, distributor, and supplier to determine the extent of the incorrect labelling. It has to wait five business days for a response because the partner is sick with COVID-19. Overall, it takes two weeks for all parties to collect their information and communicate with the other parties.

This scenario illustrates the challenges that result when each company keeps an independent list of product information. These lists are called *ledgers*. Sometimes ledgers are kept on paper, or there is only one digital copy, and they are not easy to access and share. Researching the incorrectly labelled spray paint took several phone calls and extensive employee time.

What if there were a better way? This is where blockchain technology comes in. Blockchain is an open, shared, encrypted, and redundant digital ledger. It is everywhere—at least for people who have access—and is available 24/7.

Put simply, blockchain enables organizations to keep track of transactions and records in a way that is fast, secure, and highly reliable. Because the blockchain is shared, all information is transparent and available to everyone with access. Clearly, then, a blockchain would have significantly reduced the work required for the hardware store employee to research the improperly labelled spray paint. Rather than requiring multiple phone calls to gather data, blockchain would have answered the questions

in a matter of seconds. Further, the hardware store could have viewed the entire path of that particular can and identified the source of the incorrect labelling. The hardware manager would have known the extent of the problem and could have taken corrective action.

Who Is Using Blockchain?

Several industries are making use of blockchain. One prominent example is the supply chain industry. A 2021 industry report revealed that 10 percent of companies surveyed planned to invest in blockchain by 2024. Furthermore, 12 percent had already implemented blockchain, and 41 percent predicted they would be using it by 2026.

Blockchain is also the technology behind cryptocurrency. In fact, cryptocurrency doesn't exist without blockchain. However, blockchain will impact many other businesses. Home Depot and IBM, for example, have already adopted the technology to improve their supplier relationships. These companies have reported that vendor disputes have declined significantly and transaction times are shorter.

In addition, blockchain has gained a footing in the grocery industry, where knowing the source of a product can literally be a matter of life or death. The technology is enabling retailers to quickly pinpoint the source of outbreaks of pathogens like *E. coli*. Blockchain-based traceability will reduce the time required to resolve food-related scandals and outbreaks of food-borne illnesses. Moreover, it will help companies comply with government regulations, and enhance consumer confidence. Finally, allowing consumers to access blockchain via a QR code can provide a competitive advantage.

Walmart, which employs IBM's blockchain platform, claims that it used to take at least six days to trace the source of mangos. Now, blockchain can trace the origin of mangos in 2.2 seconds.

How Will Blockchain Transform Manufacturing?

Manufacturing is as much about managing product flows as it is about producing goods. Tracking items along the supply chain, managing inventory, securing data, and ensuring payments are critical to a manufacturer's success. Let's examine how blockchain can help manufacturers carry out each of these functions.

Improved Traceability. Blockchain is a decentralized ledger, meaning that each person associated with the manufacturer's supply chain can effectively store and share information. This information can include the origin of materials, shipping status, compliance measures, and other details. All members have access to these data. Greater traceability creates greater transparency. When there is greater transparency in operations, there is greater transparency in the product, and the customer has an enhanced purchase experience.

Optimized Inventory Management. Inventory management is where blockchain is proving to be a game changer for manufacturers. With distributed blockchain ledgers, manufacturers can track the location of supplies throughout all stages of assembly. Furthermore, monitoring supplies and processed goods in real time enables manufacturers to make more accurate delivery commitments to their customers.

Enhanced Data Security. Blockchain solutions keep data more secure through encryption and nearly uneditable data. With the integration of blockchain solutions, manufacturers do not have to worry about a breach of large volumes of client and supplier data. Blockchains are distributed, duplicated, and synchronized, providing several layers of data security. This security instills trust in the shared data among partners.

Automated Payments with Smart Contracts. Because blockchain records are nearly perfect, members can make payments quickly and automatically. When smart contracts are run on a blockchain, companies can automatically make a payment when the prerequisite conditions are met. In addition, blockchain eliminates many—or even most—of the human errors in transactions.

Conclusion

Manufacturers are searching for ways to reduce costs in today's global supply chain. Customers want to know where their products were sourced. Government agencies want to quickly identify the source of product recalls to limit the societal impact. Businesses want data that are secure and easily accessible. Blockchain addresses these needs and solves many problems with its open, secure, distributed ledger platform.

Questions

1. What is a ledger?
2. What is a digital ledger?
3. Describe three ways blockchain will improve manufacturing processes.

Sources: Compiled from J. Speakman, "How Blockchain and IoT are Changing the World for the Better," <https://blockzeit.com/how-blockchain-and-iot-are-changing-the-world-for-the-better/>, October 4, 2022; R. Kohil, A. Srivastava, and C. Varshneya, "Industry 5.0: The Next Paradigm Shift In Manufacturing," <https://zinnov.com/digital-technologies/industry-5-0-the-next-paradigm-shift-in-manufacturing-blog/>, September 30, 2022; A. Tuncurk, "Blockchain 101—The Ultimate Guide for Beginners," <https://coincodex.com/article/19566/blockchain-101-the-ultimate-guide-for-beginners/>, September 29, 2022; K. Adams, "Blockchain Technology: The Future of the Manufacturing Industry," *TechTarget*, August 30, 2022; K. Miller, "5 Ways Blockchain Can Revolutionize the Manufacturing Industry," *ReadWrite*, August 27, 2022; E. Boer, Y. Friligos, Y. Giraud, D. Liang, Y. Malik, N. Mellors, R. Shahani, and J. Wallace, "Transforming Advanced Manufacturing through Industry 4.0," *McKinsey & Company*, June 27, 2022; D. Edwards, "The Real-World Use Cases for Blockchain Technology," *Robotics & Automation News*, May 20, 2022; J. Miller, "Blockchain Drives Transparency in the Supply Chain," *Supply Chain Dive*, March 22, 2022; M. del Castillo and M. Schiffrin (Eds.), "Forbes Blockchain 50 2022," *Forbes*, February 8, 2022; D. Turpitka, "Blockchain in the Automotive Sector: Three Use Cases and Three Challenges," *Forbes*, December 22, 2021; W. Henry and L. Pawczuk, "Blockchain: Ready for Business," <https://www2.deloitte.com/us/en/insights/focus/tech-trends/2022/blockchain-trends.html>, December 7, 2021.

In-House Logistics and Materials Management Logistics management deals with ordering, purchasing, inbound logistics (receiving), and outbound logistics (shipping) activities. Related activities include inventory management and quality control.

Inventory Management As the name suggests, inventory management determines how much inventory an organization should maintain. Both excessive inventory and insufficient inventory create problems. Overstocking can be expensive because of storage costs and the costs of spoilage and obsolescence. However, keeping insufficient inventory is also expensive because of last-minute orders and lost sales.

Operations personnel make two basic decisions: when to order and how much to order. Inventory models, such as the economic order quantity (EOQ) model, support these decisions. Many commercial inventory software packages are available that automate the application of these models.

Many large companies allow their suppliers to monitor their inventory levels and ship products as they are needed. This strategy, called *vendor-managed inventory (VMI)*, eliminates the need for the company to submit purchasing orders. We discuss VMI in Chapter 11.

Quality Control Quality control systems used by manufacturing units provide information about the quality of incoming material and parts, as well as the quality of in-process, semifinished, and finished products. These systems record the results of all inspections and then compare these results with established metrics. They also generate periodic reports that contain information about quality—for example, the percentage of products that contain defects or that need to be reworked. Quality control data, collected by Web-based sensors, can be interpreted in real time. Alternatively, they can be stored in a database for future analysis.

Planning Production and Operations In many firms, POM planning is supported by IT. POM planning has evolved from material requirements planning (MRP) to manufacturing resource planning (MRP II), to enterprise resource planning (ERP). We briefly discuss MRP and MRP II here, and we examine ERP in detail later in this chapter.

Inventory systems that use an EOQ approach are designed for items for which demand is completely independent—for example, the number of identical personal computers a computer manufacturer will sell. In manufacturing operations, however, the demand for some items is interdependent. Consider, for example, a company that makes three types of chairs, all of which use the same screws and bolts. In this case, the demand for screws and bolts depends on the total demand for all three types of chairs and their shipment schedules. The planning process that integrates production, purchasing, and inventory management of interdependent items is called *material requirements planning (MRP)*.

MRP deals only with production scheduling and inventories. More complex planning also involves allocating related resources, such as money and labour. For these cases, more complex, integrated software, called *manufacturing resource planning (MRP II)*, is available. MRP II integrates a firm's production, inventory management, purchasing, financing, and labour activities. Thus, MRP II adds functions to a regular MRP system. In fact, MRP II has evolved into *enterprise resource planning (ERP)*.

Computer-Integrated Manufacturing **Computer-integrated manufacturing (CIM)** (also called *digital manufacturing*) is an approach that integrates various automated factory systems. CIM has three basic goals: (1) to simplify all manufacturing technologies and techniques, (2) to automate as many of the manufacturing processes as possible, and (3) to integrate and coordinate all aspects of design, manufacturing, and related functions through computer systems.

computer-integrated manufacturing (CIM)

An information system that integrates various automated factory systems; also called *digital manufacturing*.

Product Life Cycle Management Even within a single organization, designing and developing new products can be expensive and time-consuming. When multiple organizations are involved, the process can become very complex. *Product life cycle management (PLM)* is a business strategy that enables manufacturers to share product-related data that support product design and development and supply chain operations. PLM applies Web-based collaborative technologies to product development. By integrating formerly disparate functions, such as a manufacturing process and the logistics that support it, PLM enables these functions to collaborate, essentially forming a single team that manages the product from its inception through its completion, as shown in **Figure 10.2**.

HRM Information Systems for Human Resource Management

Initial human resource information system (HRIS) applications dealt primarily with transaction processing systems such as managing benefits and keeping records of vacation days. As organizational systems have moved to intranets and the Web, so have HRIS applications.

Many HRIS applications are delivered through an HR portal. (See our discussion of LinkedIn in Chapter 9.) For example, numerous organizations use their Web portals to advertise job openings and conduct online hiring and training. In this section, you consider how organizations are using IT to perform some key HR functions: recruitment, HR maintenance and development, and HR planning and management.

Recruitment Recruitment involves finding potential employees, evaluating them, and deciding which ones to hire. Some companies are flooded with viable applicants; others have difficulty finding the right people. IT can be helpful in both cases. IT can also assist in related activities such as testing and screening job applicants.

With millions of resumé available online (in particular, on LinkedIn), it is not surprising that companies are trying to find appropriate candidates on the Web, usually with the help of specialized search engines. Companies also advertise hundreds of thousands of jobs on the Web. Online recruiting can reach more candidates, which may bring in better applicants. The costs of online recruitment are

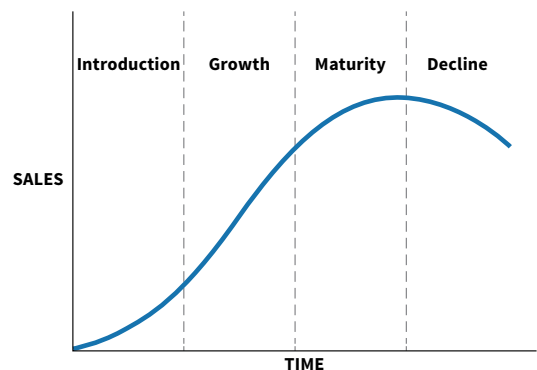


FIGURE 10.2 Product life cycle.

also usually lower than traditional recruiting methods such as advertising in newspapers or trade journals.

Human Resources Development After employees are recruited, they become part of the corporate human resources pool, which means they must be evaluated and developed. IT provides support for these activities. Throughout their career, employees have access to various internal resources, and IT helps to manage their access levels.

Most employees are periodically evaluated by their immediate supervisors. In some organizations, peers or subordinates also evaluate other employees. Evaluations are typically digitized, and they are used to support many decisions, ranging from rewards to transfers to layoffs.

IT also plays an important role in training and retraining. Some of the most innovative developments are taking place in the areas of intelligent computer-aided instruction and the application of multimedia support for instructional activities. For example, companies conduct much of their corporate training over their intranet or on the Web.

Human Resources Planning and Management Managing human resources in large organizations requires extensive planning and detailed strategy. IT support is particularly valuable in the following three areas:

1. *Payroll and employees' records:* The HR department is responsible for payroll preparation. This process is typically automated, meaning that paycheques are printed or money is transferred electronically into employees' bank accounts.
2. *Benefits administration:* In return for their work contributions to their organizations, employees receive wages, bonuses, and various benefits. These benefits include health care and dental care, pension contributions (in a decreasing number of organizations), RRSP contributions, wellness centres, and child care centres.
Managing benefits is a complex task because organizations typically offer multiple options, allowing employees to choose and trade off their benefits. In many organizations, employees can access the company portal to self-register for specific benefits.
3. *Employee relationship management:* In their efforts to better manage employees, companies are developing *employee relationship management* (ERM) applications, for example, a call centre for employees to discuss problems.

Table 10.1 provides an overview of the activities that FAISs support. **Figure 10.3** identifies many of the information systems that support these five functional areas.

TABLE 10.1
Activities Supported by Functional Area Information Systems

ACCT	FIN	Accounting and Finance
		Financial planning and cost of money
		Budgeting—allocating financial resources among participants and activities
		Capital budgeting—financing of asset acquisitions
		Managing financial transactions
		Handling multiple currencies
		Virtual close—being able to close the books at any time on short notice
		Investment management—managing organizational investments in shares, bonds, real estate, and other investment vehicles
		Budgetary control—monitoring expenditures and comparing them against the budget
		Auditing—ensuring the accuracy of the organization's financial transactions and assessing the condition of the organization's financial health
		Payroll
MKT		Marketing and Sales
		Customer relations—knowing customers and treating them appropriately
		Customer profiles and preferences
		Salesforce automation—using software to automate the business tasks of sales, thereby improving salespeople's productivity

(continued)

TABLE 10.1 Activities Supported by Functional Area Information Systems *(continued)***POM** Production/Operations and Logistics

Inventory management—determining when to order new inventory, how much inventory to order, and how much inventory to keep in stock

Quality control—controlling for defects in incoming materials and goods produced

Materials requirements planning (MRP)—planning process that integrates production, purchasing, and inventory management of interdependent items

Manufacturing resource planning (MRP II)—planning process that integrates an enterprise's production, inventory management, purchasing, financing, and labour activities

Just-in-time systems (JIT)—a principle of production and inventory control in which materials and parts arrive precisely when and where needed for production

Computer-integrated manufacturing—a manufacturing approach that integrates several computerized systems, such as computer-assisted design (CAD), computer-assisted manufacturing (CAM), MRP, and JIT

Product life cycle management—business strategy that enables manufacturers to collaborate on product design and development efforts, using the Web

HRM Human Resource Management

Recruitment—finding employees, testing them, and deciding which ones to hire

Performance evaluation—periodic evaluation by superiors

Training

Employee records

Benefits administration—retirement, disability, unemployment, and so on

Profitability Planning	Financial Planning	Employment Planning, Outsourcing	Product Life Cycle Management	Sales Forecasting, Advertising Planning	STRATEGIC
Auditing, Budgeting	Investment Management	Benefits Administration, Performance Evaluation	Quality Control, Inventory Management	Customer Relations, Sales Force Automation	
Payroll, Accounts Payable, Accounts Receivable	Manage Cash, Manage Financial Transactions	Maintain Employee Records	Order Fulfillment, Order Processing	Set Pricing, Profile Customers	
ACCOUNTING	FINANCE	HUMAN RESOURCES	PRODUCTION/ OPERATIONS	MARKETING	OPERATIONAL

FIGURE 10.3 Examples of information systems supporting the functional areas.

Reports

All information systems produce reports: transaction processing systems, functional area information systems, ERP systems, customer relationship management systems, business intelligence systems, and so on. We discuss reports here because they are so closely associated with FAIS and ERP systems. These reports generally fall into three categories: routine, ad hoc (on-demand), and exception.

routine reports Reports produced at scheduled intervals.

ad hoc (on-demand) reports Nonroutine reports that often contain special information that is not included in routine reports.

drill-down reports Reports that show a greater level of detail than is included in routine reports.

key indicator reports Reports that summarize the performance of critical activities.

comparative reports Reports that compare the performances of different business units or times.

exception reports Reports that include only information that exceeds certain threshold standards.

Routine reports are produced at scheduled intervals. They range from hourly quality control reports to daily reports on absenteeism rates. Although routine reports are extremely valuable to an organization, managers frequently need special information that is not included in these reports. At other times, they need the information that is normally included in routine reports, but at different times (“I need the report today, for the last three days, not for one week”). Such out-of-the routine reports are called **ad hoc (on-demand) reports**.

Routine and ad hoc reports can include the following types of information:

- **Drill-down reports** display a greater level of detail. For example, a manager might examine sales by region and decide to “drill down” by focusing specifically on sales by store and then by salesperson.
- **Key indicator reports** summarize the performance of critical activities. For example, a chief financial officer might want to monitor cash flow and cash on hand.
- **Comparative reports** compare, for example, the performances of different business units or of a single unit during different times.

Some managers prefer exception reports. **Exception reports** include only information that falls outside certain threshold standards. To implement *management by exception*, management first establishes performance standards. The company then creates systems to monitor performance (through the incoming data about business transactions such as expenditures), to compare actual performance to the standards, and to identify exceptions to the standards. The system alerts managers to the exceptions through exception reports.

MKT Let’s use sales as an example. First, management establishes sales quotas. The company then implements a FAIS that collects and analyzes all of the sales data. An exception report would identify only those cases in which sales fell outside an established threshold—for example, more than 20 percent short of the quota. It would *not* report expenditures that fell *within* the accepted range of standards. By leaving out all “acceptable” performances, exception reports save managers time, thus helping them focus on problem areas.

Before you go on...

1. Define a functional area information system and list its major characteristics.
2. How do information systems benefit the finance and accounting functional area?
3. Explain how POM personnel use information systems to perform their jobs more effectively and efficiently.
4. What are the most important HRIS applications?
5. Compare and contrast the three basic types of reports.

10.3

Enterprise Resource Planning Systems

LEARNING OBJECTIVE

Identify advantages and drawbacks to businesses of implementing an enterprise resource planning system.

enterprise resource planning (ERP) systems Information systems that take a business process view of the overall organization to integrate the planning, management, and use of all of an organization’s resources, employing a common software platform and database.

Historically, functional area information systems were developed independently of one another, resulting in *information silos*. These silos did not communicate well with one another, and this lack of communication and integration made organizations less efficient. This inefficiency was particularly evident in business processes that involve more than one functional area, such as procurement and fulfillment.

Enterprise resource planning (ERP) systems are designed to correct a lack of communication among FAISs. ERP systems resolve this problem by tightly integrating the FAIS through a common database. For this reason, experts credit ERP systems with greatly

increasing organizational productivity. ERP systems adopt a business process view of the overall organization to integrate the planning, management, and use of all of its resources, employing a common software platform and database.

The major objectives of ERP systems are tightly integrating the functional areas of the organization and enabling information to flow seamlessly across them. Tight integration means that changes in one functional area are immediately reflected in all other pertinent functional areas. In essence, ERP systems provide the information necessary to control the organization's business processes.

It is important to understand that ERP systems are an evolution of FAISs. That is, they have much the same functionality as FAISs, and they produce the same reports. ERP systems simply integrate the functions of the individual FAISs.

Although some companies have developed their own ERP systems, most organizations use commercially available ERP software. The leading ERP software vendor is SAP (www.sap.com/canada/index.html). Another major vendor is Oracle (www.oracle.com/ca-en/).

ERP II Systems

ERP systems were originally deployed to facilitate business processes associated with manufacturing, such as raw materials management, inventory control, order entry, and distribution. However, these early ERP systems did not extend to other functional areas, such as sales and

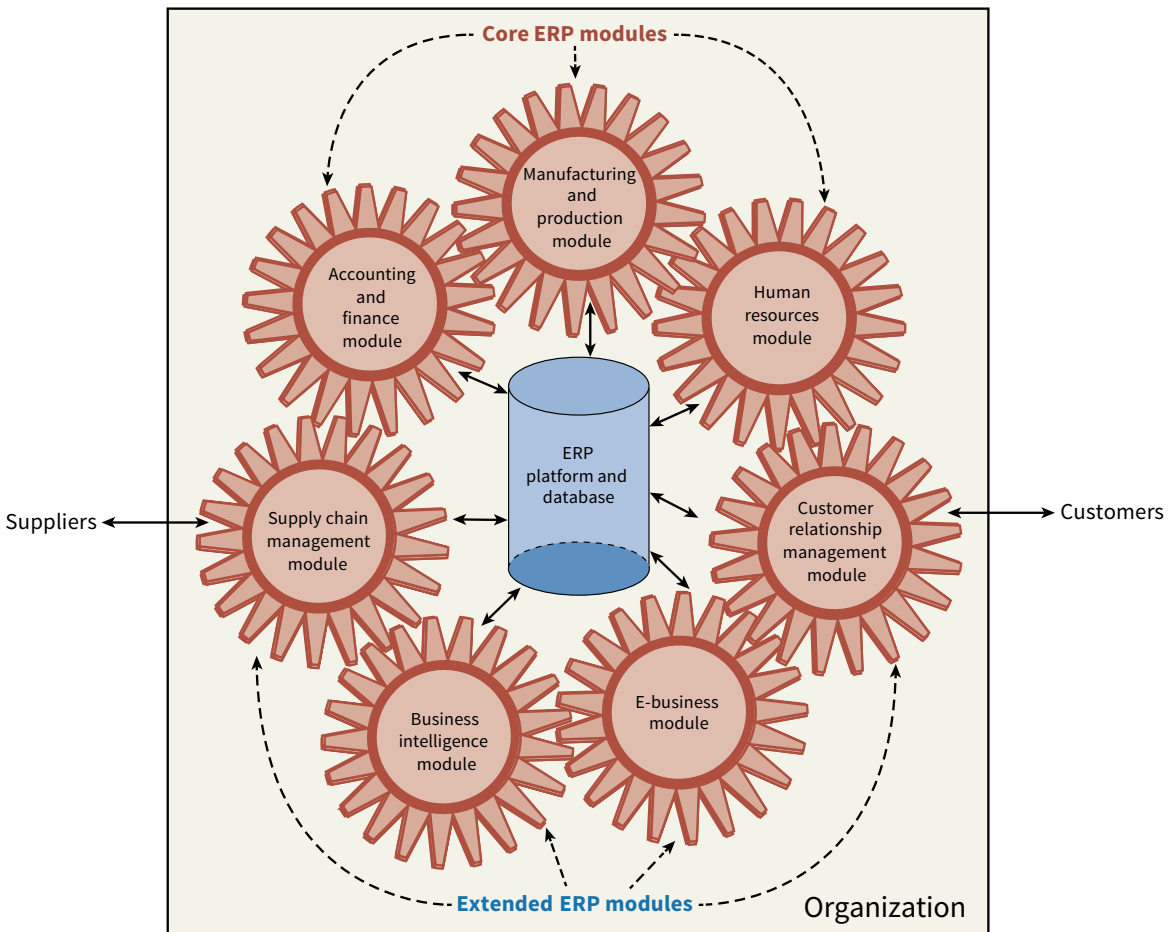


FIGURE 10.4 ERP II system.

marketing. They also did not include any customer relationship management (CRM) capabilities that enable organizations to capture customer-specific information. Finally, they did not provide Web-enabled customer service or order fulfillment.

Over time, ERP systems evolved to include administrative, sales, marketing, and human resources processes. Companies now employ an enterprise-wide approach to ERP that uses the Web and connects all facets of the value chain. (You might want to review our discussion of value chains in Chapter 2.) These systems are called ERP II systems.

ERP II systems are interorganizational ERP systems that provide Web-enabled links among a company’s key business systems—such as inventory and production—and its customers, suppliers, distributors, and other relevant parties. These links integrate internal-facing ERP applications with the external-focused applications of supply chain management and customer relationship management. **Figure 10.4** illustrates the organization and functions of an ERP II system.

The various functions of ERP II systems are now delivered as e-business suites. The major ERP vendors have developed modular, Web-enabled software suites that integrate ERP, customer relationship management, supply chain management, procurement, decision support, enterprise portals, and other business applications and functions. Examples are Oracle’s e-Business Suite and SAP’s mySAP. The goal of these systems is to enable companies to execute most of their business processes using a single Web-enabled system of integrated software rather than a variety of separate e-business applications.

ERP II systems include a variety of modules that are divided into core ERP modules—financial management, operations management, and human resource management—and extended ERP modules—customer relationship management, supply chain management, business intelligence, and e-business. If a system does not have the core ERP modules, then it is not a legitimate ERP system. The extended ERP modules, in contrast, are optional. **Table 10.2** describes each of these modules.

ERP II systems
Interorganizational ERP systems that provide Web-enabled links among key business systems (e.g., inventory and production) of a company and its customers, suppliers, distributors, and others.

TABLE 10.2
ERP Modules

Core ERP Modules	
ACCT	FIN Financial Management. These modules support accounting, financial reporting, performance management, and corporate governance. They manage accounting data and financial processes such as general ledger, accounts payable, accounts receivable, fixed assets, cash management and forecasting, product-cost accounting, cost-centre accounting, asset accounting, tax accounting, credit management, budgeting, and asset management.
POM	Operations Management. These modules manage the various aspects of production planning and execution such as demand forecasting, procurement, inventory management, materials purchasing, shipping, production planning, production scheduling, materials requirements planning, quality control, distribution, transportation, and plant and equipment maintenance.
HRM	Human Resource Management. These modules support personnel administration (including workforce planning, employee recruitment, assignment tracking, personnel planning and development, and performance management and reviews), time accounting, payroll, compensation, benefits accounting, and regulatory requirements.
Extended ERP Modules	
MKT	Customer Relationship Management. (Discussed in detail in Chapter 11.) These modules support all aspects of a customer’s relationship with the organization. They help the organization to increase customer loyalty and retention, and thus improve its profitability. They also provide an integrated view of customer data and interactions, helping organizations to be more responsive to customer needs.
POM	Supply Chain Management. (Discussed in detail in Chapter 11.) These modules manage the information flows between and among stages in a supply chain to maximize supply chain efficiency and effectiveness. They help organizations plan, schedule, control, and optimize the supply chain from the acquisition of raw materials to the receipt of finished goods by customers.
MIS	Business Analytics. (Discussed in detail in Chapter 12.) These modules collect information used throughout the organization, organize it, and apply analytical tools to assist managers with decision making.
MIS	E-Business. (Discussed in detail in Chapter 7.) Customers and suppliers demand access to ERP information, including order status, inventory levels, and invoice reconciliation. Furthermore, they want this information in a simplified format that can be accessed on the Web. As a result, these modules provide two channels of access into ERP system information—one channel for customers (B2C) and one for suppliers and partners (B2B).

Benefits and Limitations of ERP Systems

ERP systems can generate significant business benefits for an organization. The major benefits fall into the following three categories:

1. *Organizational flexibility and agility:* As you have seen, ERP systems break down many former departmental and functional silos of business processes, information systems, and information resources. In this way, they make organizations more flexible, agile, and adaptive. The organizations can therefore respond quickly to changing business conditions and capitalize on new business opportunities.
2. *Decision support:* ERP systems provide essential information on business performance across functional areas. This information significantly improves managers' ability to make better, more timely decisions.
3. *Quality and efficiency:* ERP systems integrate and improve an organization's business processes, generating significant improvements in the quality of production, distribution, and customer service.

Despite all of their benefits, however, ERP systems do have drawbacks. The major limitations of ERP implementations include the following:

- The business processes in ERP software are often predefined by the best practices that the ERP vendor has developed. *Best practices* are the most successful solutions or problem-solving methods for achieving a business objective. As a result, companies may need to change their existing business processes to fit the predefined business processes incorporated into the ERP software. For companies with well-established procedures, this requirement can create serious problems, especially if employees do not want to abandon their old ways of working and resist the changes.
- At the same time, however, an ERP implementation can provide an opportunity to improve and in some cases completely redesign inefficient, ineffective, or outdated procedures. In fact, many companies benefit from implementing best practices for their accounting, finance, and human resource processes, as well as other support activities that they do not consider a source of competitive advantage.

Recall from Chapter 2, however, that different companies organize their value chains in different configurations to transform inputs into valuable outputs and achieve competitive advantages. Therefore, although the vendor's best practices, by definition, are appropriate for most organizations, they might not be the "best" one for your company if they change the processes that give you a competitive advantage.

- ERP systems can be extremely complex, expensive, and time-consuming to implement. (We discuss the implementation of ERP systems in detail in the next section.) In fact, the costs and risks of failure in implementing a new ERP system are substantial. Quite a few companies have experienced costly ERP implementation failures. Specifically, they have suffered losses in revenue, profits, and market share when core business processes and information systems failed or did not work properly. In many cases, orders and shipments were lost, inventory changes were not recorded correctly, and unreliable inventory levels caused major stockouts. Companies such as Hershey Foods, Nike, A-DEC, and Connecticut General sustained losses in amounts up to hundreds of millions of dollars. In the case of FoxMeyer Drugs, a US \$5-billion pharmaceutical wholesaler, the ERP implementation was so poorly executed that the company had to file for bankruptcy protection.

In almost every ERP implementation failure, the company's business managers and IT professionals underestimated the complexity of the planning, development, and training that were required to prepare for a new ERP system that would fundamentally transform their business processes and information systems. The following are the major causes of ERP implementation failure:

- Failure to involve affected employees in the planning and development phases and in change management processes
- Trying to accomplish too much too fast in the conversion process

- Insufficient training in the new work tasks required by the ERP system
- Failure to perform proper data conversion and testing for the new system

Implementing ERP Systems

Companies can implement ERP systems by using either on-premise software or software-as-a-service (SaaS). We differentiate between these two methods in detail in Technology Guide 3.

On-Premise ERP Implementation Depending on the types of value chain processes managed by the ERP system and a company's specific value chain, there are three strategic approaches to implementing an on-premise ERP system:

1. *The vanilla approach:* In this approach, a company implements a standard ERP package using the package's built-in configuration options. When the system is implemented in this way, it will deviate only minimally from the package's standardized settings. The vanilla approach can enable the company to perform the implementation more quickly. However, the software will not be very well adapted to the organization's specific processes. Fortunately, a vanilla implementation provides general functions that can support the firm's common business processes with relative ease, even if they are not a perfect fit.
2. *The custom approach:* In this approach, a company implements a more customized ERP system by developing new ERP functions designed specifically for that company. Decisions concerning the ERP's degree of customization are specific to each organization. To use the custom approach, the organization must carefully analyze its existing business processes to develop a system that conforms to its particular characteristics and processes. Customization is also expensive and risky because computer code must be written and updated every time a new version of the ERP software is released. Over time, if the customization does not perfectly match the organization's needs, then the system can be very difficult to use.
3. *The best-of-breed approach:* This approach combines the benefits of the vanilla and customized systems while avoiding the extensive costs and risks associated with complete customization. Companies that adopt this approach mix and match core ERP modules as well as other extended ERP modules from different software providers to best fit their unique internal processes and value chains. Thus, a company may choose several core ERP modules from an established vendor to take advantage of industry best practices—for example, for financial management and human resource management. At the same time, it may also choose specialized software to support its unique business processes—for example, for manufacturing, warehousing, and distribution. Sometimes companies arrive at the best-of-breed approach the hard way. For example, Dell wasted millions of dollars trying to customize an integrated ERP system from a major vendor to match its unique processes before it realized that a smaller, more flexible system that integrated well with other corporate applications was the answer.

Software-as-a-Service ERP Implementation Companies can acquire ERP systems without having to buy a complete software solution (i.e., on-premise ERP implementation). Many organizations are using software-as-a-service (SaaS) (discussed in Chapter 13 and Technology Guide 3) to acquire cloud-based ERP systems. (We discuss cloud computing in Technology Guide 3.)

In this business model, the company rents the software from an ERP vendor that offers its products over the internet using the SaaS model. The ERP cloud vendor manages software updates and is responsible for the system's security and availability.

Cloud-based ERP systems can be a perfect fit for some companies. For example, companies that cannot afford to make large investments in IT, yet already have relatively structured business processes that need to be tightly integrated, might benefit from cloud computing.

The relationship between the company and the cloud vendor is regulated by contracts and by service level agreements (SLAs). The SLAs define the characteristics and quality of service; for example, a guaranteed uptime, or the percentage of time that the system is available. Cloud vendors that fail to meet these conditions can face penalties.

The decision about whether to use on-premise ERP or SaaS ERP is specific to each organization, and it depends on how the organization evaluates a series of advantages and disadvantages. The following are the three major advantages of using a cloud-based ERP system.

1. The system can be used from any location that has internet access. Consequently, users can work from any location using online shared and centralized resources (data and databases). Users access the ERP system through a secure virtual private network (VPN) connection (discussed in Chapter 4) with the provider.
2. Companies using cloud-based ERP avoid the initial hardware and software expenses that are typical of on-premise implementations. For example, to run SAP on-premise, a company must purchase SAP software and a licence to use SAP. The magnitude of this investment can hinder small to medium-sized enterprises (SMEs) from adopting ERP.
3. Cloud-based ERP solutions are scalable, meaning it is possible to extend ERP support to new business processes and new business partners (e.g., suppliers) by purchasing new ERP modules.

There are also disadvantages to adopting cloud-based ERP systems that a company must carefully evaluate. The following are the three major disadvantages of using a cloud-based ERP system.

1. It is not clear whether cloud-based ERP systems are more secure than on-premise systems. In fact, a survey conducted by North Bridge Venture Partners indicated that security was the primary reason why organizations did not adopt cloud-based ERP.
2. Companies that adopt cloud-based ERP systems sacrifice their control over a strategic IT resource. For this reason, some companies prefer to implement an on-premise ERP system, using a strong in-house IT department that can directly manage the system.
3. The third disadvantage is a direct consequence of the lack of control over IT resources. This disadvantage occurs when the ERP system experiences problems; for example, if some ERP functions are temporarily slow or are not available. In such cases, having an internal IT department that can solve problems immediately rather than dealing with the cloud vendor's system support can speed up the system recovery process.

This situation is particularly important for technology-intensive companies. In such companies, IT is crucial to conduct any kind of business with customers. Examples are e-commerce companies, banks, and government organizations that manage emergencies or situations that might involve individual and national security (e.g., health care organizations, police, Public Safety Canada, antiterrorism units, and others).

Finally, slow or unavailable software from a cloud-based ERP vendor creates business continuity problems for the client. (We discuss business continuity in Chapter 4.) That is, a sudden system problem or failure makes it impossible for the firm to operate. Companies lose money when they lose business continuity because customers cannot be serviced, and employees cannot do their jobs. A loss of business continuity also damages the company's reputation because customers lose trust in the firm.

Enterprise Application Integration

For some organizations, integrated ERP systems are not appropriate. This situation is particularly true for companies that find the process of converting from their existing system too difficult or time consuming.

Such companies, however, may still have isolated information systems that need to be connected with one another. To accomplish this task, these companies can use enterprise application integration. An **enterprise application integration (EAI) system** integrates existing systems by providing software, called *middleware*, that connects multiple applications. In essence, the EAI system allows existing applications to communicate and share data, thereby enabling organizations to use existing applications while eliminating many of the problems caused by isolated information systems. EAI systems also support implementation of best-of-breed ERP solutions by connecting software modules from different vendors.

enterprise application integration (EAI) system

A system that integrates existing systems by providing layers of software that connect applications together.

Before you go on...

1. Define ERP and describe its functions.
2. What are ERP II systems?
3. Differentiate between core ERP modules and extended ERP modules.
4. List some drawbacks of ERP software.
5. Highlight the differences between ERP vanilla configuration, customization, and best-of-breed implementation strategies.

10.4

ERP Support for Business Processes

LEARNING OBJECTIVE

Describe the three main business processes supported by ERP systems.

cross-departmental process

A business process that originates in one department and ends in another department or originates and ends in the same department while involving other departments.

ERP systems effectively support a number of standard business processes. In particular, they manage end-to-end, cross-departmental processes. A **cross-departmental process** is one that (1) originates in one department and ends in a different department or (2) originates and ends in the same department but involves other departments.

The Procurement, Fulfillment, and Production Processes

The following are the three prominent examples of cross-departmental processes:

1. The *procurement process*, which originates in the warehouse department (need to buy) and ends in the accounting department (send payment)
2. The *fulfillment process*, which originates in the sales department (customer request to buy) and ends in the accounting department (receive payment)
3. The *production process*, which originates and ends in the warehouse department (need to produce and reception of finished goods) but involves the production department as well

These three processes are examined in more detail in the following sections, focusing on the steps that are specific to each one.

procurement process A cross-functional business process that originates when a company needs to acquire goods or services from external sources and concludes when the company receives and pays for them.

POM ACCT Procurement Process The **procurement process** originates when a company needs to acquire goods or services from external sources and concludes when the company receives and pays for them. Let's consider a procurement process in which the company needs to acquire physical goods (see **Figure 10.5**). This process involves three main departments—Warehouse, Purchasing, and Accounting—and it consists of the following steps:

1. The process originates in the warehouse department, which generates a purchase requisition to buy the needed products.
2. The warehouse forwards the requisition to the purchasing department, which creates a purchase order (PO) and forwards it to a vendor (aka, supplier). Generally, companies can choose from a number of vendors, and they select the one that best meets their requirements in regard to convenience, speed, reliability, and other characteristics.
3. After the company places the order, it receives the goods in its warehouse department, where someone physically checks the delivery to make certain that it corresponds to what the company ordered. They perform this task by comparing a packing list attached to the shipment against the PO.

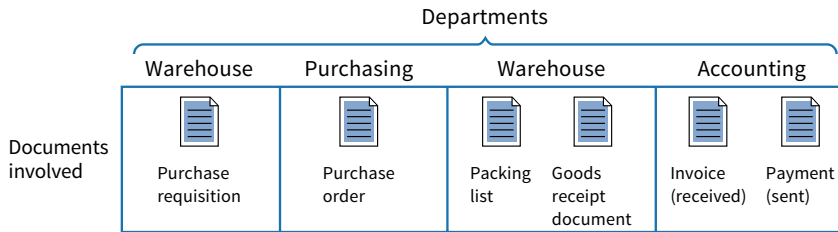


FIGURE 10.5 Departments and documents flow in the procurement process.

4. The warehouse issues a goods receipt document, which states whether the shipment received matches the PO.
5. At the same time or shortly thereafter, the accounting department receives an invoice from the vendor. Accounting then checks that the PO, the goods receipt document, and the invoice match. This process is called the *three-way match*.
6. After Accounting verifies the match, it processes the payment and sends it to the vendor.

The Order Fulfillment Process In contrast to procurement, in which the company purchases goods from a vendor, in the **order fulfillment process**, also known as the *order-to-cash process*, the company sells goods to a customer. Fulfillment originates when the company receives a customer order and concludes when the company receives a payment from the customer.

The fulfillment process can follow two basic strategies: *sell-from-stock* and *configure-to-order*. *Sell-from-stock* involves fulfilling customers' orders directly, using goods that are already in the warehouse (i.e., stock, inventory on hand). These goods are standard, meaning that the company does not customize them for buyers. In contrast, in *configure-to-order*, the company customizes the product in response to a customer request.

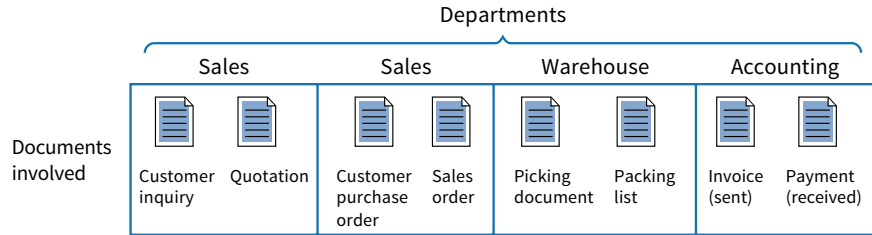
MKT **POM** **ACCT** A fulfillment process involves three main departments: Sales, Warehouse, and Accounting. This process includes the following steps:

1. The sales department receives a customer inquiry, which essentially is a request for information concerning the availability and price of a specific good. (We restrict our discussion here to fulfilling a customer order for physical goods rather than services.)
2. After Sales receives the inquiry, it issues a quotation that indicates availability and price.
3. If the customer finds the price and terms acceptable, it sends a purchase order to the Sales department, which then issues a sales order based on the purchase order received from the customer.
4. Sales forwards the sales order to the warehouse. The sales order is an interdepartmental document that helps the company keep track of the internal processes that are involved in fulfilling a specific customer order. It also provides details on the quantity, price, and other characteristics of the product.
5. The warehouse prepares the shipment and produces two other internal documents: the picking document, which it uses to remove goods from the warehouse, and the packing list, which accompanies the shipment and provides details about the delivery.
6. At the same time, Accounting issues an invoice for the customer.
7. The process concludes when Accounting receives a payment that is consistent with the invoice.

Figure 10.6 shows the fulfillment process. Note that it applies to both *sell-from-stock* and *configure-to-order* because the basic steps are the same for both strategies.

order fulfillment process A cross-functional business process that originates when the company receives a customer order and concludes when it receives a payment from the customer.

FIGURE 10.6 Departments and documents flow in the fulfillment process.



production process A cross-functional business process in which a company produces physical goods.

POM The Production Process The **production process** does not occur in all companies because not all companies produce physical goods. In fact, many businesses limit their activities to buying (procurement) and selling products (e.g., retailers).

The production process can follow two different strategies: make-to-stock and make-to-order. (See the discussion of the pull model and the push model in Chapter 11.) *Make-to-stock* occurs when the company produces goods to create or increase an *inventory*; that is, finished products that are stored in the warehouse and are available for sales. In contrast, *make-to-order* occurs when production is generated by a specific customer order.

Manufacturing companies that produce their own goods manage their interdepartmental production process across the production and warehouse departments. The production process involves the following steps:

1. The warehouse issues a planned order when the company needs to produce a finished product, either because the warehouse has insufficient inventory or because the customer placed a specific order for goods that are not currently in stock.
2. Once the planned order reaches Production, the production controller authorizes the order and issues a production order, which is a written authorization to start the production of a certain amount of a specific product.
3. To assemble a finished product, Production requires a number of materials (or parts). To acquire these materials, Production generates a material withdrawal slip, which lists all of the needed parts, and forwards it to the warehouse.
4. If the parts are available in the warehouse, the warehouse delivers them to Production. If the parts are not available, the company must purchase them through the procurement process.
5. After Production has created the products, it updates the production order specifying that, as planned, a specific number of units of product now can be shipped to the warehouse.
6. As soon as the warehouse receives the finished goods, it issues a goods receipt document that certifies how many units of a product it received are available for sales.

This overview of the production process is a highly simplified one. In reality, the process is very complex and frequently involves additional steps. ERP systems also collect a number of other documents and pieces of information such as the bill of materials (a list of all materials needed to assemble a finished product), the list of work centres (locations where the production takes place), and product routing (production steps). All of these topics require an in-depth analysis of the production process and are therefore beyond the scope of our discussion here. **Figure 10.7** illustrates the production processes.

A number of events can occur that create exceptions or deviations in the procurement, fulfillment, and production processes. Deviations may include the following:

- A delay in the receipt of products
- Issues related to an unsuccessful three-way match regarding a shipment (procurement). Recall that the three-way match is about checking a supplier's invoice against its associated purchase order and goods receipt documents.
- Rejection of a quotation

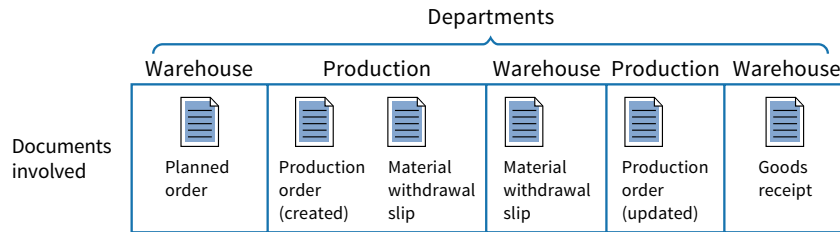


FIGURE 10.7 Departments and documents flow in the production process.

- A delay in a shipment
- A mistake in preparing the shipment or in invoicing the customer (fulfillment)
- Overproduction of a product
- Receipt of parts that cannot be used in the production process (due to poor quality, for example)
- Unavailability of certain parts from a supplier

Companies use ERP systems to manage procurement, fulfillment, and production because these systems track all of the events that occur within each process. Furthermore, the system stores all of the documents created in each step of each process in a centralized database, where they are available as needed in real time. Any exceptions or mistakes made during one or more interdepartmental processes are handled right away by simply querying the ERP system and retrieving a specific document or piece of information that needs to be revised or examined more carefully. Therefore, it is important to follow each step in each process and to register the corresponding document in the ERP system.

Figure 10.8 portrays the three cross-functional business processes we just discussed. It specifically highlights the integration of the three processes, which is made possible by ERP systems.

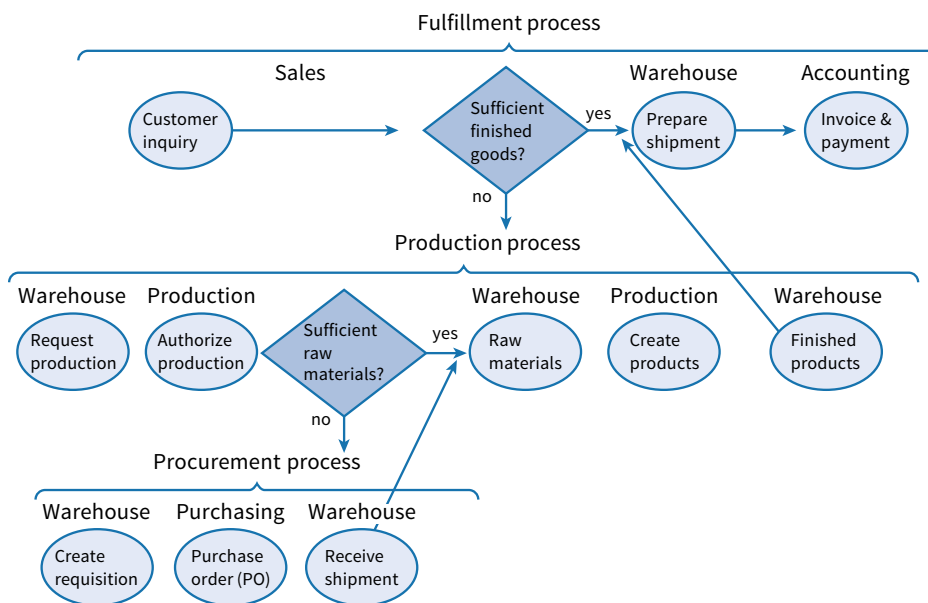


FIGURE 10.8 Integrated processes with ERP systems.

Interorganizational Processes: ERP with SCM and CRM

Although the procurement and fulfillment processes involve suppliers and customers, they are considered (together with the production process) intraorganizational processes because they originate and conclude within the company. However, ERP systems can also manage processes that originate in one company and conclude in another company. These processes are called *interorganizational processes*, and they typically involve supply chain management (SCM) and customer relationship management (CRM) systems. (You can find a more detailed description of CRM and SCM in Chapter 11.) Here, we focus on the integration of these processes within a firm's industry value chain.

SCM and CRM processes help multiple firms in an industry to coordinate activities such as the production-to-sale of goods and services. Let's consider a chain of grocery stores whose supply chain must properly manage perishable goods. On the one hand, store managers need to stock only the amount of perishable products that they are reasonably sure they will sell before the products' expiration dates. On the other hand, they do not want to run out of stock of any products that customers need.

ERP SCM systems have the capability to place automatic requests to buy fresh perishable products from suppliers in real time. That is, as each perishable product is purchased, the system captures data on that purchase, adjusts store inventory levels, and transmits these data to the grocery chain's warehouse as well as the products' vendors. The system executes this process by connecting the point-of-sale bar code scanning system with the warehouse and accounting departments, as well as with the vendors' systems. SCM systems also use historical data to predict when fresh products need to be ordered before the store's supply becomes too low.

ERP CRM systems also benefit businesses by generating forecasting analyses of product consumption based on critical variables such as geographical area, season, day of the week, and type of customer. These analyses help grocery stores coordinate their supply chains to meet customer needs for perishable products. Going further, CRM systems identify particular customer needs and then use this information to suggest specific product campaigns. These campaigns can transform a potential demand into sales opportunities and convert sales opportunities into sales quotations and sales orders. This process is called the *demand-to-order* process.

Before you go on...

1. What are the three main intraorganizational processes that are typically supported by ERP systems?
2. Why is it important that all steps in each process generate a document that is stored in the ERP system?
3. What is the difference between intraorganizational and interorganizational processes?
4. What are the two main ERP II systems that support interorganizational processes?

What's in IT for me?

ACCT For the Accounting Major

Understanding the functions and outputs of TPSs effectively is a major concern of any accountant. It is also necessary to understand the various activities of all functional areas and how they are interconnected. Accounting information systems are a central component in any ERP package. In fact, all large CPA firms actively consult with clients on ERP implementations, using thousands of specially trained accounting majors.

FIN For the Finance Major

IT helps financial analysts and managers perform their tasks better. Analyzing cash flows and securing the financing required for smooth operations are particularly important. Financial applications can also support such activities as risk analysis, investment management, and global transactions involving different currencies and fiscal regulations.

Finance activities and modelling are key components of ERP systems. Flows of funds (payments), at the core of most supply chains,

must be executed efficiently and effectively. Financial arrangements are especially important along global supply chains, where currency conventions and financial regulations must be considered.

MKT For the Marketing Major

Marketing and sales expenses are usually targets in a cost-reduction program. Also, sales force automation improves not only salespeople's productivity (thus reducing costs) but also customer service.

POM For the Production/Operations Management Major

Managing production tasks, materials handling, and inventories in short time intervals, at a low cost, and with high quality is critical for competitiveness. These activities can be achieved only if they are properly supported by IT. IT can also greatly enhance interaction with other functional areas, especially sales. Collaboration in design, manufacturing, and logistics requires knowledge of how modern information systems can be connected.

HRM For the Human Resource Management Major

Human resources managers can increase their efficiency and effectiveness by using IT for some of their routine functions. Human resources personnel need to understand how information flows between the HR department and the other functional areas. Finally, the integration of functional areas through ERP systems has a major impact on skill requirements and scarcity of employees, which are related to the tasks performed by the HRM department.

MIS For the MIS Major

The MIS function is responsible for the most fundamental information systems in organizations: the transaction processing systems. The TPSs provide the data for the databases. In turn, all other information systems use these data. MIS personnel develop applications that support all levels of the organization (from clerical to executive) and all functional areas. The applications also enable the firm to do business with its partners.

Summary

10.1 Explain the purpose of transaction processing systems.

TPSs monitor, store, collect, and process data generated from all business transactions. These data provide the inputs into the organization's database.

10.2 Explain the types of support that information systems can provide for each functional area of the organization.

The major business functional areas are production/operations management, marketing, accounting/finance, and human resources management. **Table 10.1** provides an overview of the many activities in each functional area supported by FAISS.

10.3 Identify advantages and drawbacks to businesses of implementing an enterprise resource planning (ERP) system.

Enterprise resource planning (ERP) systems integrate the planning, management, and use of all of the organization's resources. The major objective of ERP systems is to tightly integrate the functional areas of the organization. This integration enables information to flow seamlessly across the various functional areas.

The following are the major benefits of ERP systems.

- Because ERP systems integrate organizational resources, they make organizations more flexible, agile, and adaptive. The organizations can therefore react quickly to changing business conditions and capitalize on new business opportunities.
- ERP systems provide essential information on business performance across functional areas. This information significantly

improves managers' ability to make better, more timely decisions.

- ERP systems integrate organizational resources, resulting in significant improvements in the quality of customer service, production, and distribution.

The following are the major drawbacks of ERP systems.

- The business processes in ERP software are often predefined by the best practices that the ERP vendor has developed. As a result, companies may need to change existing business processes to fit the software's predefined business processes. For companies with well-established procedures, this requirement can be a huge problem.
- ERP systems can be extremely complex, expensive, and time-consuming to implement. In fact, the costs and risks of failure in implementing a new ERP system are substantial.

10.4 Describe the three main business processes supported by ERP systems.

The *procurement process*, which originates in the warehouse department (need to buy) and ends in the accounting department (send payment).

The *fulfillment process*, which originates in the sales department (customer request to buy) and ends in the accounting department (receive payment).

The *production process*, which originates and ends in the warehouse department (need to produce and reception of finished goods), but involves the production department as well.

We leave the details of the steps in each of these processes up to you.

Key Terms

ad hoc (on-demand) reports 308	enterprise application integration (EAI) system 313	key indicator reports 308
batch processing 298	enterprise resource planning (ERP) systems 308	online transaction processing (OLTP) 298
comparative reports 308	ERP II systems 310	order fulfillment process 315
computer-integrated manufacturing (CIM) 305	exception reports 308	procurement process 314
cross-departmental process 314	functional area information systems (FAISs) 299	production process 316
drill-down reports 308		routine reports 308
		transaction 297
		transaction processing system (TPS) 297

Discussion Questions

1. Why is it logical to organize IT applications by functional areas?
2. Describe the role of a TPS in a service organization.
3. Describe the relationship between TPSs and FAISs.
4. Discuss how IT facilitates the budgeting process.
5. How can the internet support investment decisions?
6. Describe the benefits of integrated accounting software packages.
7. Discuss the role that IT plays in support of auditing.
8. Investigate the role of the Web in human resources management.
9. What is the relationship between information silos and enterprise resource planning?

Problem-Solving Activities

1. Finding a job on the internet is challenging, as there are almost too many places to look. Visit the following sites: www.careerbuilder.ca, www.craigslist.org, www.linkedin.com, www.indeed.ca, and www.monster.ca. What does each of these sites provide you with as a job seeker?
2. Enter www.sas.com/en_ca/software/revenue-optimization-suite.html. Explain how SAS software helps in optimizing prices.
3. Enter www.eleapsoftware.com and review the product that helps with online training (training systems). What are the most attractive features of this product?
4. Examine the capabilities of the following (and similar) financial software packages: Financial Analyzer (from Oracle) and CFO Vision (from SAS Institute). Prepare a report comparing the different packages' capabilities.
5. Surf the Net and find free accounting software. (Try www.cnet.com and www.tucows.com.) Download the software and try it. Compare the ease of use and usefulness of each software package.
6. Examine the capabilities of the following financial software packages: Financial Analyzer (from www.oracle.com/ca-en/) and Financial Management (from www.sas.com/en_ca/). Prepare a report comparing the different packages' capabilities.
7. Find Simply Accounting Basic from Sage Software (<https://www.sage.com/en-ca/products/sage-50cloud/>). Why is this product recommended for small businesses?
8. Enter www.sap.com/canada/index.html. Examine its software products and compare them.
9. Visit www.netsuite.com and read the article titled "15 Benefits of ERP for Businesses in 2022." Summarize the effects ERP has on global businesses.
10. Read one of the latest articles at www.erpfocus.com. Summarize what you learned.

Closing Case

When Gummy Bears Are Late Due to an ERP Project Failure

By some estimates, between 55 percent and 75 percent of ERP implementation attempts fail. "Failure," however, does not necessarily mean that the implementation was not complete or

operational. It could mean that the process cost more money or took more time than was estimated, or it didn't achieve the efficiency level it was supposed to provide.

Consider the following statistics. Sixty percent of customers are unhappy with their new system. Ninety percent feel that the system fails to deliver any measurable return on the investment

(ROI). Fifty-seven percent contend that the implementation took longer than expected. Fifty-four percent of implementations exceeded their project budget, and 40 percent caused unintended operational disruptions. Each of these responses would likely be categorized as an implementation failure, even though the ERP system was functioning properly.

If implementing an ERP system is so problematic, then why do companies take on the task? Put simply, something in the business has changed. Current information systems are not providing the necessary support to operate in today's fast-paced, agile environment. In some cases, business partners update their systems, which requires the companies that work with them to do the same. Or on-premise hardware could be at the end of its life, requiring updates. Regardless of the reason, many companies begin ERP transformation projects, and the majority are unhappy with the results.

Consider the case of Haribo (www.haribo.com), the German producer of gummy bears. In 2018, the company moved its headquarters and the attached production facilities from Bonn to Graftschaff. In addition to the move, Haribo decided to adopt a new SAP-built ERP system to streamline its production, update its old goods management system, and, in short, handle the increased demands of effective supply chain management. However, the adoption of the new system disrupted Haribo's supply chain. When a supply chain that spans from raw materials to consumers of gummy bears is disrupted, it affects not only production and delivery but also sales, cash flow, and profitability. In fact, as a result of Haribo not being able to fulfill its orders on time, the company lost 25 percent in revenue in 2018.

What could have gone wrong? Many companies do not disclose the specifics of their system implementation failures. However, industry experts who study ERP implementations have identified many common problems. Below, we summarize these obstacles to success, and we also present suggestions for successful system implementations.

Lack of alignment with the (evolving) business mode

An ERP adoption project should be in line with the firm's business model. It is especially important for firms who want to commit to a large-scale project like an ERP adoption to make sure that it aligns with their future-state business model. For instance, Haribo intended to expand its international manufacturing and supply chain operation. However, some people think the features built into the SAP S/4HANA platform might not have been able to support that goal in any case.

Failure to effectively manage business processes

Before adopting a new ERP system, it is essential to have a good understanding of the current business processes as well as studying which processes are working well and which ones are not. After a company evaluates existing processes and takes into account the goals that it wants to achieve, it can then define future processes that are in alignment with its own needs and the new software. This process is called business process reengineering (see Chapter 2). In the case of Haribo, the fact that some business processes were broken after the ERP system went live suggests that it might have not paid enough timely attention and devoted enough energy to its business process reengineering and business process management.

Insufficient system testing

It is common for firms to overlook the importance of adequate system testing during their ERP adoption projects. Testing is crucial

in ERP projects because not only could there be bugs and issues that need resolving but also, due to the integrated nature of ERP systems, an error in one area can cause other errors in entirely different areas. For example, a problem in a sales order will impact inventory, production, and accounts receivable. So, when an error is found and resolved in one of these areas, it is important to retest all other areas to make sure that fixing one problem has not created new ones. In the case of Haribo, effective system testing should have uncovered potentially major disruptions. The fact that the company discovered many issues only after going live suggests that there could have been flaws in its ERP system testing approach.

Insufficient or lack of executive leadership and support

In large-scale projects like ERP adoption, it is never good enough for the top management to merely authorize the project. They should be actively involved during the design, development, implementation, and integration stages to make sure that the project is a success. A successful ERP project cannot be accomplished only by the CIO and an IT team. It is, in fact, a team effort that requires the entire business, especially the C-suite (i.e., executive-level managers of the company), to be on board. Only when top management is involved is it possible to push past short-term operational issues. In addition, top management support can increase the alignment between the goals of the ERP project and those of the business. Top management engagement can also help overcome potential resistance from employees. As with any change, there can be resistance from employees regarding adoption of a new ERP system. Such resistance must be addressed from the very beginning of the project.

Finally, perpetual improvement requires continual monitoring and upgrading. Although an organization might implement ERP once, the system must be adaptable and scalable so that it can evolve with the business. After the application is deployed, the project team is responsible for addressing bugs and adding new functionalities as required. Because the goal is to continue utilizing ERP systems for years after they are implemented, it is critical to audit or review them periodically to ensure they are aligned.

Despite the initial hiccups, in February 2019, Haribo announced that the worst was over and that the company's delivery capability was improving continuously, every day.

Haribo could have avoided a huge loss in revenue and profit by having more clearly defined objectives for its ERP project that was in line with its future objectives, by spending more time and energy on reengineering and managing its business processes, by conducting thorough system tests, and by planning for operational disruptions.

Although successful ERP implementations are difficult, they are possible. It is easy to become overwhelmed by a project as large and complex as an ERP implementation. Still, with a thoughtful planning process and steadfast follow-through, you can make yours a success.

Questions

1. What were Haribo's goals when it implemented its new ERP system?
2. What are some of the common challenges of implementing ERP systems?
3. Discuss three ways organizations can better prepare for an ERP upgrade.

Sources: Compiled from G. Toombs, “Why Digital Transformations Fail,” *Codal*, January 8, 2023; J. Schrader, “Why ERP Implementations Fail: How to Avoid the 7 Pitfalls,” <https://www.crestwood.com/2022/04/25/why-erp-implementations-fail/>, April 25, 2022; S. Mishra, “How to Overcome the Challenges in ERP Implementation,” *Enterprise Talk*, May 11, 2022; E. St-Jean, “8 Ways to Avoid Business Disruption from a New ERP System,” *TechTarget*, May 26, 2022; A. B. Eisner, D. Gallo, and H. J. Korn, “Haribo and the Gummi Bear Business: A Sticky Situation,” *Global Journal of Business Pedagogy*, Volume 5, Number 2, 2021; S. Habib, “Lessons Learned From the Haribo SAP ERP Failure,” *DSFM Technologies*, January 13, 2021; B. Baumann, “Lessons Learned from the Haribo ERP Failure,” *Panorama Consulting Group*, January 6,

2021; R. Carlton, “Ten ERP Failure Statistics That Highlight the Importance of Getting It Right First Time Round,” <https://www.erpfocus.com/ten-erp-failure-statistics.html>, August 22, 2019; K. H. Lauri, “Haribo Struggling with Production Problems after ERP Implementation,” *MRPeasy.com*, February 12, 2019, <https://manufacturing-software-blog.mrpeasy.com/haribo-production-sap-implementation>, accessed April 14, 2023; J. O'Donnell, “Haribo Can't Bear SAP S/4HANA Implementation,” *TechTarget*, February 5, 2019; E. Kimberling, “Lessons from the SAP Transformation Problems at Haribo,” *Third Stage Consulting Group*, January 7, 2019; M. S. Harris, “Gumming Up Gummy Bears,” *softwarenegotiation.com*, January 25, 2019, <https://softwarenegotiation.com/gumming-up-gummy-bears/>.

Customer Relationship Management and Supply Chain Management

CHAPTER OUTLINE

LEARNING OBJECTIVES

11.1 Defining Customer Relationship Management	11.1 Identify the primary functions of both customer relationship management (CRM) and collaborative CRM strategies.
11.2 Operational Customer Relationship Management Systems	11.2 Describe how businesses might use applications of each of the two major components of operational CRM systems.
11.3 Other Types of Customer Relationship Management Systems	11.3 Explain the advantages and disadvantages of mobile CRM systems, on-demand CRM systems, open-source CRM systems, social CRM systems, and real-time CRM systems.
11.4 Supply Chains	11.4 Describe the three components and the three flows of a supply chain.
11.5 Supply Chain Management	11.5 Identify popular strategies to solve the multiple challenges of supply chains.
11.6 Information Technology Support for Supply Chain Management	11.6 Explain the utility of each of the three major technologies that support supply chain management.

Opening Case—Robots to the Rescue

Background

Our highly interconnected global supply chain faces serious challenges with no obvious solutions. Many of these challenges can be traced to the outbreak of COVID-19 in 2020. When the world shut down to slow the spread of the pandemic, many people began to work from home or became unemployed. Meanwhile, purchasing patterns shifted to items needed at home. Demand for home office

furniture, toilet paper, and small appliances skyrocketed. Supplies of these items were limited, and manufacturing, warehousing, and delivery workers were at home or working limited shifts.

Furthermore, everyone needed medical supplies such as masks, gowns, and hand sanitizer. Significantly, most of these goods were produced in China. China ramped up production of these items and shipped them out. Unfortunately, this increased production did not resolve the problem. Instead, we came to

realize that we had a global shipping problem. The one thing China needed to ship out the supplies was the one thing it did not have—shipping containers.

Shipping containers were unevenly distributed around the world because thousands of them sat on ships waiting to be unloaded or in ports waiting to be picked up and transported. This trend continued during 2021 and 2022. There were multiple reports of ships in daylong queues waiting to make it to port. Ports were backlogged and almost at full capacity. Further, when products finally made it to the warehouse, there were not enough workers to pick and prepare them for delivery.

The crisis revealed how a shift in the global supply chain can have a cascading effect on global commerce. An October 2022 report revealed that the following goods were in short supply: various food items, automotive backup cameras, carbon dioxide for beer, baby formula, and tampons. Overall, almost every industry has felt the squeeze of supply chain issues.

Significantly, many of these factors are beyond the control of the distribution companies. For example, the global labour shortage is a challenge at every stage of the supply chain. Regarding warehouses, for example, the new generation of the labour force strongly prefers to work in offices. Warehouse work is dirty, tiring, monotonous, and dangerous. To address this worker shortage, many warehouses are turning to robots.

Robotics and automation have long been used in warehousing. Conveyor belts, scanners, and many similar innovations have transformed the industry over time. However, these techniques created a hybrid system where technology augmented human activity. In contrast, in modern hybrid systems, human labour augments the robotic technology.

The ultimate goal of robotic technology is to create an operation where robots are capable of replacing humans. Robots are not subject to fatigue, illness, or injury, and they do not form unions or demand benefits. Training robots is as easy as updating the software that directs them. Some experts, however, estimate that we are years away from implementing fully automated warehousing.

The Technology Response

The robots in use today, known as *autonomous mobile robots* (AMRs), are capable of understanding and moving autonomously within their environment. Previous generations of robots could only perform repetitive tasks such as moving a pallet along a predefined path. In contrast, today's robots can employ artificial intelligence (AI) to travel autonomously and handle goods of various sizes and shapes.

AMRs can quickly and accurately deliver parts and tools to the skilled workers who need them. They can also handle potentially dangerous materials, thereby eliminating the risk for human workers. Furthermore, AMRs can take over time-consuming and redundant tasks to relieve pressure on human workers while also avoiding supply chain congestion by quickly and safely moving goods and clearing backlogged items from warehouses and other storage spaces.

Robots bring multiple advantages to warehousing. For starters, they are highly proficient at performing repetitive operations such as sorting, picking, and putting products where they belong. In addition, the software that powers these robots can enhance inventory management.

Robots can also reduce high labour costs. Robots never get sick, not even during a pandemic. They never stay home to care for their children. Unlike people, robots can easily be moved into and out of production, which means there is no need to hire, train, and then lay off temporary employees,

Another benefit of utilizing robots is improved workplace safety. Monotonous tasks cause both mental and physical fatigue, which reduces productivity and increases the risk of injury. Robots can alleviate mental strain by reducing the chances of errors and enabling human workers to focus on more fruitful tasks such as quality and safety.

For these and other reasons, warehousing companies are pursuing automation and are more than willing to employ robots in place of human workers.

The Results

An October 2022 report by BlueWeave Consulting (www.blueweaveconsulting.com), a consulting firm that focuses on providing data analytics and market intelligence, predicted that the global AMR market will grow steadily, owing to the increasing popularity of e-commerce across the world. The report estimated that the global AMR market, which totalled \$2.37 billion in 2021, will reach nearly \$9.5 billion by 2028. Clearly, AMRs are becoming an essential element of the warehousing industry.

During the COVID-19 pandemic, Loblaw (www.loblaw.ca) the largest grocery and retail pharmacy chain in Canada, was one of the first few grocery chains that offered its customers the option to order online and pick up groceries the same day. As the number of online orders increased to unprecedented levels, Loblaw took several steps to improve its fulfillment process. Fortunately, the company was already in the process of introducing its first Micro Fulfillment Centre with Takeoff Technologies (www.takeoff.com). This centre is basically an automation and fulfillment solution within a space in an existing storefront that uses a robotic racking system along with a cloud (see Technology Guide 3) and AI technology to pick up, store, and fulfill orders.

When an order is received at a Takeoff-powered Loblaw facility, based on the products ordered, it may be split between manual and automated pickup. The automated facility brings the automated portion of the order to a human employee. Once all the items are picked up, the order goes to a staging area, where it is reviewed and stored in a frozen, chilled, or room temperature zone. This automation has helped Loblaw to drastically improve the efficiency of its order fulfillment process.

Hudson's Bay (www.thebay.com), the oldest retailer in North America, sells a large variety of retail apparel and home goods. The company has recently deployed a new robotic fulfillment system at its Scarborough distribution centre in Toronto. When an order is received at the facility, the warehouse management system communicates with the warehouse control system about the items on the order. The warehouse control system's job is to control the automated material handling equipment.

Then, the order fulfillment process at the Hudson's Bay fulfillment facility begins with cartons being erected automatically, while the robotic goods-to-person system assigns robots to deliver the ordered items to operators. By the time the cartons are labelled and arrive at the automated storage and retrieval system (AS/RS) workstations through a conveyor system, the AS/RS robots have already picked and delivered the right products. Human operators then take the product out of the robot's carrier, put it in the carton, and confirm it with a system that uses lights as indicators. When an order is complete, it travels on conveyors to shipping; on its way, it receives documents from a robotic print-and-insert system. As the weight of the box is checked, it is given a shipping label, and finally it is sorted based on the carrier. Using the robotic fulfillment system, it can now take only 15 minutes from the receipt of an order to having the shipment packed for delivery.

Other organizations will soon see benefits of deploying robots in their warehouses for picking and packaging, but there will be even easier ways to start using robots: Robots-as-a-service (RaaS). The benefits of RaaS were emphasized in 2020, when manufacturers, distributors, and warehousing businesses needed to adapt fast to deal with the pandemic.

RaaS allows organizations to support shifts to their supply chains, providing scalability and reliability as conditions change rapidly. Furthermore, there are no capital expenditures with RaaS. Instead, the necessary expenditures are treated as operating expenses. Consequently, there is no need to have capital expenses approved, which can be a lengthy and expensive process. Finally, because RaaS typically utilizes a cloud-based architecture, it can be deployed within weeks. In general, a cloud-based RaaS model can provide companies with the infrastructure for greater operational resilience, a necessity in today's unpredictable industrial landscape.

Conclusions

The modern warehouse runs on robots. The past few decades have seen significant advancements in robotics and logistics, enabling futuristic warehouses to take shape. Within the walls of these facilities, robots automate nearly every function—from shelving and packing to distribution and cleaning. These robots have improved efficiency during a period of ever-rising customer demand, helping businesses not only to meet their goals but to grow and improve.

Questions

1. What are autonomous mobile robots? How do they differ from previous generations of robots?
2. What advantages do robots bring to warehousing?
3. Do you think warehouses will ever be fully automated? Why or why not?

Sources: Compiled from B. Ames, “RILA Show: Old-School Retailer Jumps into Automation with Both Feet,” *Supply Chain Quarterly*, February 21, 2023; G. Mitra, “Powering the Next Generation of Robotic Workers...without Wires,” *Smart Industry*, October 14, 2022; R. Goodman, “How COVID-19 Opened the Door to Robots in the Warehouse [Video],” *Supply Chain Brain*, October 13, 2022; M. Romain, “Robots Could Be Replacing People In Warehouses as Workers Disappear,” *Village Free Press*, October 9, 2022; BlueWeave Consulting, “Global Autonomous Mobile Robots Market Size to Surge Fast [sic] USD 9.4 Billion by 2028 | BlueWeave Consulting,” *GlobeNewsWire*, October 10, 2022; P. Seitz, “Labor Shortage Spurs Drive to Automate Warehouses,” *Investor’s Business Daily*, October 7, 2022; R. Aggarwal, “Disrupt the Disruptions: Industry 4.0-Driven Nearshoring to Bolster Your Supply Chain,” *Forbes*, October 6, 2022; R. Michel, “Robots Edge into Packaging,” *Modern Materials Handling*, October 4, 2022; S. Kumar, “AI-Powered Robots Have Become Nice to Necessity for Warehousing Automation,” *Entrepreneur*, September 29, 2022; DC Velocity Staff, “Warehouse Management: Top Trends to Watch,” *DC Velocity*, September 19, 2022; J. Douglas, “China’s Factories Accelerate Robotics Push as Workforce Shrinks,” *The Wall Street Journal*, September 18, 2022; P. Goodman, “The Supply Chain Broke. Robots Are Supposed to Help Fix It,” *The New York Times*, September 7, 2022; P. Sisson, “Robots Aren’t Done Reshaping Warehouses,” *The New York Times*, July 12, 2022; L. Gamio and P. Goodman, “How the Supply Chain Crisis Unfolded,” *The New York Times*, December 5, 2021; P. Goodman, “‘It’s Not Sustainable’: What America’s Port Crisis Looks Like Up Close,” *The New York Times*, October 14, 2021; C. Tharp, “How Loblaw Turns to Technology to Support Canadians during COVID-19,” *Google Canada Blog*, June 25, 2020; R. Redman, “Loblaw Tests Micro-Fulfillment for Online Grocery,” *Supermarket News*, November 13, 2019; “Hudson’s Bay Uses Advanced Order Fulfillment Technology,” *Modern Materials Handling*, November 20, 2018, https://www.mmh.com/article/hudsons_bay_uses_advanced_order_fulfillment_technology, accessed April 24, 2023.

Introduction

In Chapter 10, you learned about information systems that support activities within the organization. In this chapter, you study information systems that support activities that extend outside the organization to customers and suppliers. The first half of this chapter addresses customer relationship management (CRM) systems and the second half covers supply chain management systems (SCM).

Organizations are emphasizing a customer-centric approach to their business practices because they realize that long-term customer relationships provide sustainable value that extends beyond an individual business transaction. Organizations are also integrating their strategy and operations with supply chain partners because tight integration along the supply chain also leads to sustainable business value. Significantly, customer relationship management and supply chain management are critically important for all enterprises, regardless of size.

The chapter opening case points out how important data are to the customer-centric approach to business. Businesses are now able to discover when customers are having trouble with their websites before the customers even complain. This type of data analysis is crucial to helping organizations understand customer problems and implement timely solutions.

Supply chain management is equally important for organizations to successfully compete in the marketplace. Today, supply chain management is an integral part of all organizations and can improve customer service and reduce operating costs. Let’s look at these two areas in more detail.

- **POM** *Improve the fulfillment process.* Customers expect to receive the correct products as quickly as possible. Therefore, products must be on hand in the correct locations. Furthermore, follow-up support after a sale must be done effectively and efficiently.

- **FIN** *Reduce operating costs.* Retailers depend on their supply chains to quickly distribute expensive products so that they will not have inventory carrying costs for costly, depreciating products.

Delays in production are costly. Supply chains must ensure the reliable delivery of materials to assembly plants to avoid expensive delays in manufacturing.

At this point, you might be asking yourself: Why should I learn about CRM and SCM? The answer, as you will see in this chapter, is that customers and suppliers are supremely important to *all* organizations. Regardless of your job, you will have an impact, directly or indirectly, on managing your firm's customer relationships and its supply chain. When you read the What's in IT for me? section at the end of this chapter, you will learn about opportunities to make immediate contributions on your first job. Therefore, it is essential that you acquire a working knowledge of CRM, CRM systems, supply chains, SCM, and SCM systems.

11.1 Defining Customer Relationship Management

LEARNING OBJECTIVE

Identify the primary functions of both customer relationship management (CRM) and collaborative CRM strategies.

Before the supermarket, the mall, and the automobile, people purchased goods at their neighbourhood store. The owners and employees recognized customers by name and knew their preferences and wants. For their part, customers remained loyal to the store and made repeated purchases. Over time, however, this personal customer relationship became impersonal as people moved from farms and small towns to cities, consumers became mobile, and supermarkets and department stores achieved economies of scale through mass marketing. Although prices were lower and products were more uniform in quality, the relationship with customers became nameless and impersonal.

The customer relationship has become even more impersonal with the rapid growth of the internet and the World Wide Web. In today's hypercompetitive marketplace, customers are increasingly powerful; if they are dissatisfied with a product or a service from one organization, a competitor is often just one mouse click away. Furthermore, as more and more customers shop on the Web, an enterprise does not even have the opportunity to make a good first impression *in person*.

Customer relationship management returns to personal marketing. That is, rather than market to a mass of people or companies, businesses market to each customer individually. By employing this approach, businesses can use information about each customer—for example, previous purchases, needs, and wants—to create highly individualized offers that customers are more likely to accept. The CRM approach is designed to achieve *customer intimacy*.

Customer relationship management is a customer-focused and customer-driven organizational strategy. That is, organizations concentrate on assessing customers' requirements for products and services and then provide a high-quality, responsive customer experience. CRM is not a process or a technology per se; rather, it is a customer-centric way of thinking and acting. The focus of modern organizations has shifted from conducting business transactions to managing customer relationships. In general, organizations recognize that customers are the core of a successful enterprise, and the success of the enterprise depends on effectively managing relationships with them.

The CRM approach is enabled by information technology in the form of various systems and applications. However, CRM is not only about the software. Sometimes the problem with managing relationships is simply a lack of time or information. Old systems may contain the needed information, but this information may take too long to access and may not be usable

customer relationship management (CRM)

A customer-focused and customer-driven organizational strategy that concentrates on addressing customers' requirements for products and services, and then providing high-quality, responsive services.

across a variety of applications or devices. The result is that companies have less time to spend with their customers.

In contrast, modern CRM strategies and systems build sustainable long-term customer relationships that create value for the company as well as for the customer. That is, CRM helps companies acquire new customers and retain and expand their relationships with profitable existing customers. Retaining customers is particularly important because repeat customers are the largest generator of revenue for an enterprise. Moreover, organizations have long understood that winning back a customer who has switched to a competitor is vastly more expensive than keeping that customer satisfied in the first place.

Figure 11.1 depicts the CRM process. The process begins with marketing efforts, through which the organization solicits prospects from a target population of potential customers. A certain number of these prospects will make a purchase and thus become customers. A certain number of these customers will become repeat customers. The organization then segments its repeat customers into low- and high-value repeat customers. An organization's overall goal is to maximize the *lifetime value* of a customer, which is that customer's potential revenue stream over a number of years.

Over time, all organizations inevitably lose a certain percentage of customers, a process called *customer churn*. The optimal result of the organization's CRM efforts is to maximize the number of high-value repeat customers while minimizing customer churn.

CRM is a fundamentally simple concept: treat different customers differently because their needs differ and their value to the company may also differ. A successful CRM strategy not only improves customer satisfaction but also makes the company's sales and service employees more productive, which in turn generates increased profits. Researchers at the United States National Quality Research Center at the University of Michigan discovered that a 1-percent increase in customer satisfaction can lead to as much as a 300-percent increase in a company's *market capitalization*, defined as the number of shares of the company's stock outstanding multiplied by the price per share of the stock. Put simply, a minor increase in customer satisfaction can generate a major increase in a company's overall value.

Up to this point, you have been looking at an organization's CRM strategy. It is important to distinguish between a CRM *strategy* and CRM *systems*. Basically, CRM systems are

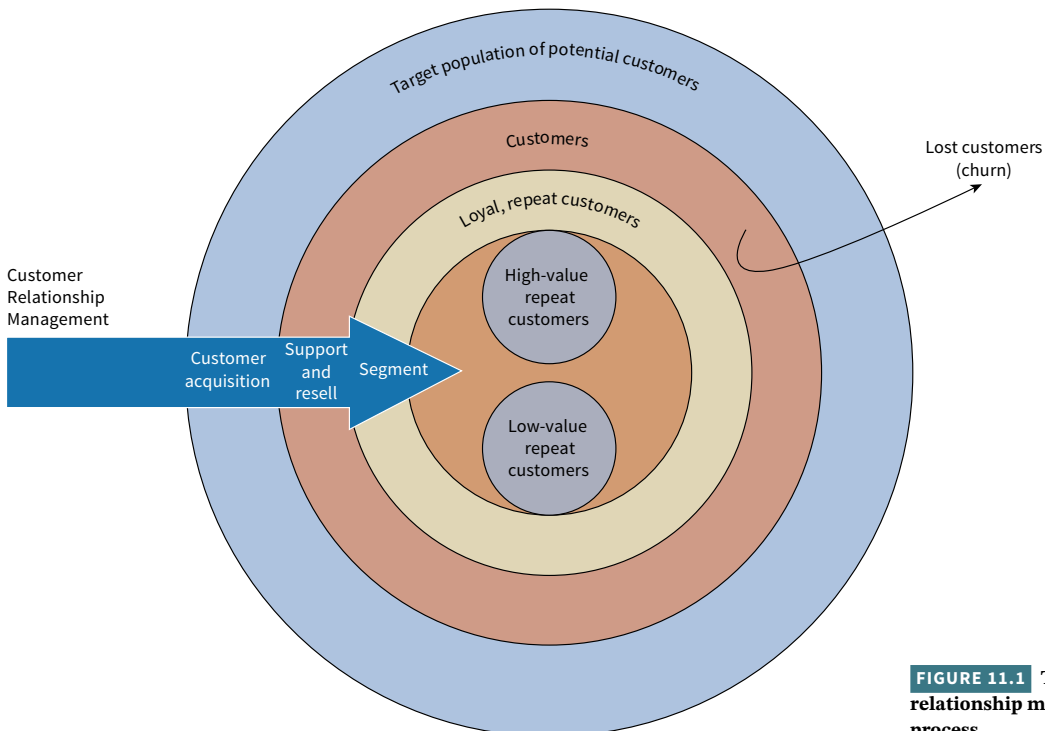


FIGURE 11.1 The customer relationship management process.

information systems designed to support an organization's CRM strategy. For organizations to pursue excellent relationships with their customers, they need to employ CRM systems that provide the infrastructure needed to support those relationships. Because customer service and support are essential to a successful business, organizations must place a great deal of emphasis on both their CRM strategy and their CRM systems.

Broadly speaking, CRM systems lie along a continuum, from *low-end CRM systems*—designed for enterprises with many small customers—to *high-end CRM systems*—for enterprises with a few large customers. An example of a low-end system is Amazon, which uses its CRM system to recommend products to returning customers. An example of a high-end system is Bentley Motors, which uses its CRM system to increase lead generation and enhance the brand experience for customers. As you study the cases and examples in this chapter, consider where on the continuum a particular CRM system would fall.

Although CRM varies according to circumstances, all successful CRM policies share two basic elements: (1) the company must identify the many types of customer touch points, and (2) it needs to consolidate data about each customer. Let's examine these two elements in more detail.

Customer Touch Points

customer touch point Any interaction between a customer and an organization.

Organizations must recognize the numerous and diverse interactions they have with their customers. These interactions are referred to as **customer touch points**. Traditional customer touch points include telephone contact, direct mailings, and actual physical interactions with customers during their visits to a store. Organizational CRM systems, however, must manage many additional customer touch points that occur through the use of popular personal technologies. These touch points include email, websites, and communications through smartphones (see Figure 11.2).

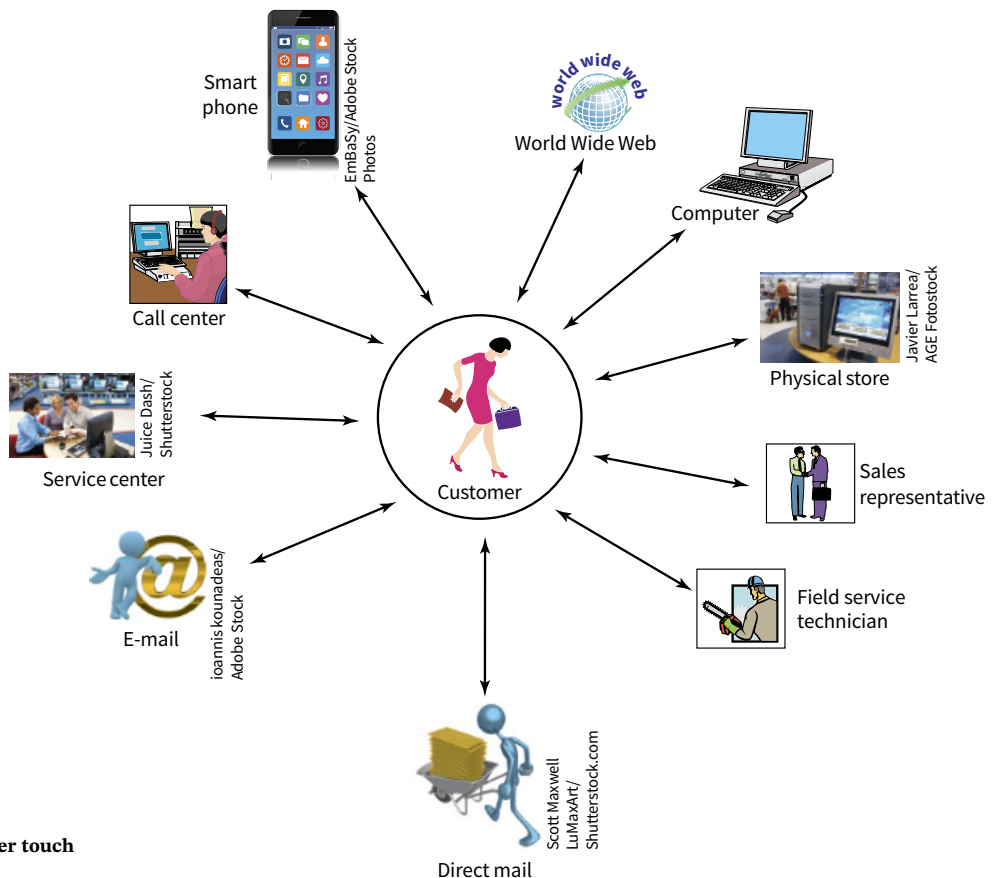


FIGURE 11.2 Customer touch points.

The business–customer relationship is constantly evolving. As personal technology usage changes, so too must the methods that businesses use to interface with their customers. It is now possible to physically locate customers through their smartphones. As a result, location information can now provide another customer touch point. IT’s About Business 11.1 discusses the changing expectations of customers and how modern CRMs must adapt to changing business needs.

Businesses recognize this, but they have not moved all of their touch points in sync, and this has led to several channel conflicts. For example, have you ever placed an online order for in-store pickup only to get to the store and find out that it never received your order? Or you have to wait because the store didn’t prepare it when it was promised by the online system? What about when you try to return something you purchased online only to find out that you have to ship it back rather than dropping it off at the local brick-and-mortar version of the same store?

Today, effective marketing makes use of all of these channels (touch points) in sync with one another. We call this omnichannel marketing (*omni* meaning “all”). Omnichannel marketing refers to an approach to customers that creates a seamless experience regardless of the channel (or device) used to “touch” the business. Many businesses are creating omnichannel strategies to drive this cohesive experience for their customers. To accomplish this goal, businesses must utilize information systems (specifically CRM) because the need for data consistency across channels is more apparent now than ever.

IT’s About Business 11.1

Customizable CRM Brings Speed and Agility

Business Problem

Customer relationship management is at the heart of every business. Businesses need loyal customers who return and who encourage new customers, which enables the business to expand its customer base and business network.

In the fifth edition of its *State of the Connected Customer* report, Salesforce (www.salesforce.com) stated that 71 percent of customers switched brands at least once during 2021. Almost 50 percent of those customers were looking for better customer service. Additionally, 83 percent of customers expect to interact with someone immediately when they contact a company, and 78 percent use multiple communication channels.

Furthermore, 56 percent stated they are more likely to buy from a brand that offers a loyalty program. Customers want to feel emotionally connected to brands. They also want to be treated personally at every step in the purchasing process. In addition, 75 percent of customers think businesses should understand their individual needs and expectations, while 66 percent want companies to foresee their future needs as well.

These are some of the reasons why managing customers is complicated. Customer relationships are not numbers, conversions, metrics, data, or cost centres. Rather, they are human, and they are based on personal experiences. Customers want businesses to become more personal. If they don’t, then customers are willing to walk away.

The challenge is that organizations are *not* human. They are numbers, metrics, and cost centres. To maintain loyal customers, however, businesses must empower their humans—their employees—to behave toward other humans—their customers—in ways that feel relational. Meeting this challenge involves more than becoming customer-focused. It also involves the necessary operations, data, processes, and people to anticipate and deliver the experiences customers want and the engagement that builds

relationships in real time. To address this need, companies implement customer relationship management tools.

The Technology Solution

Monday.com (www.monday.com) is a customizable workflow management system, which had more than 150,000 customers at the end of 2021. It is primarily designed to implement custom-built workflows within an organization. Monday.com is a platform that enables users to drag, drop, and build tools to help organizations show their employees how to interact with their customers.

Moreover, Monday.com, is programmed to engage in some automatic interactions with customers on behalf of a user organization. For example, several tasks happen automatically when a customer’s payment status changes from “pending” to “cleared.” First, a personalized email informs the customer that the payment has cleared, and the supply room receives information for product packaging, with a customized thank-you note to add to the shipping box. Accounting records are updated, and the sales team receives congratulations from management. These and other automatic tasks—is programmed to behave in the way the organization has defined when interacting with a customer.

Initially, Monday.com was designed to enable automated communication within organizations. Employees used the platform to organize workflow, communicate, share files, update teams, track progress, view dashboards, and more. It is no surprise that Monday.com’s users began building workflows that would automate the customer relationship activities that are vital to organizational success. Monday.com recognized this and decided to add its own CRM functionality to its platform to better serve its customers.

Monday.com’s CRM product enables users to automate tedious tasks, customize the program to suit the company’s work processes, and close deals more efficiently. Organizations can sync Gmail/Outlook to send and receive emails or automatically keep a log of their sent emails, all within Monday.com. Additionally,

the platform automatically notifies businesses when a lead opens up or replies to an email so they can follow up immediately. And when sales are completed, Monday.com will help manage after-sale activities.

In addition to providing the necessary tools for sales leads and deals, Monday.com's CRM platform offers a comprehensive, flexible database covering the entire customer journey. The platform automates the process of adding new clients to the system, providing representatives with all the data related to a specific account. This shared workflow enables a company to transition seamlessly from prospects to confirmed customers regardless of which representatives interact on its behalf. Automations enable customer data to sync across departments, ensuring that organizations manage every account efficiently and effectively.

Results

Monday.com enables organizations to automate different processes throughout their dealings with customers. It enables managers and salespeople to manage all aspects of their sales process and customer data in a single centralized location. Sales representatives used to manage this process themselves. Calling in to check on customers and maintaining relationships was a purely human activity that was not supported by organizations' information systems. Further, the best sales representatives built strong relationships that often followed them when they changed organizations. Customers were typically loyal primarily to the representative. CRM platforms such as Monday.com are designed to shift this relationship to the organization.

As an example, consider Ray White, Australia's most prominent real estate franchise. The company operates more than 880 offices worldwide, generating more than AU \$6.6 billion annually in sales. The company decided to use Monday.com to manage its customer relationships. It customized its CRM from Monday.com with almost 1,300 automations and integrations. The ability to customize software platforms enables organizations to make the software their own and to align it perfectly with their customer

journey. The automation and integration at Ray White enabled it to set up its workflow in advance for the next two to three years in terms of automated emails, notifications, and follow-up prompts.

With Monday.com, Ray White now plans customer contact points for tax time, holidays, scheduled inspections, and other important events. These regular contact points give the impression that the company is personally keeping up with a relationship that has already been established when an agent was personally in touch with the customer. The ability to automatically execute these tasks for more than 2,000 clients has helped Ray White increase its efficiency in performing administrative tasks by 70 percent.

Questions

1. What are some advantages of an easily customizable CRM?
2. How does a CRM establish a customer relationship with an organization rather than a particular sales representative?
3. How does Monday.com's platform support the customer journey that an organization wants to create for its customers?

Sources: Compiled from B. Solis, "Reinforcing the 'R' in CRM," *Destination CRM*, October 3, 2022; S. Jajoo, "Customer Relationship Management: It's More Than Just Conversions," *Entrepreneur*, September 22, 2022; A. Rudder, K. Main, "Pipedrive vs Monday.com (2022 Comparison)," *Forbes Advisor*, September 5, 2022; A. Drapkin, "Monday.com Rolls Out Brand New CRM for Sales Teams," *tech.co*, August 8, 2022; D. Taylor, "7 CRM Features of Monday.com That Can Help You Build Your Business," *The Ascent*, August 5, 2022; D. MacRae, "Monday.com Launches Monday Sales CRM," *Marketing Tech*, August 3, 2022; C. Trueman, "Monday.com Launches New CRM Tool," *ComputerWorld*, August 3, 2022; N. Reckman, "Monday.com CRM Review and Pricing," *Business.com*, <https://www.business.com/reviews/monday-crm/>, accessed October 17, 2022; K. Dorman, "Ray White Powered by Monday.com," <https://www.youtube.com/watch?v=TX4kk4OIQfY&t=38s>, accessed October 18, 2022.

Data Consolidation

MIS Data consolidation is also critical to an organization's CRM efforts. The organization's CRM systems must manage customer data effectively. In the past, customer data were stored in isolated systems (or silos) located in different functional areas across the business—for example, in separate databases in the finance, sales, logistics, and marketing departments. Consequently, data for individual customers were difficult to share across the various functional areas.

As you saw in Chapter 5, modern interconnected systems built around a data warehouse now make all customer-related data available to every unit of the business. This complete data set on each customer is called a *360° view* of that customer. By accessing this view, a company can enhance its relationship with its customers and ultimately make more productive and profitable decisions.

Data consolidation and the 360° view of the customer enable the organization's functional areas to readily share information about customers. This information sharing leads to collaborative CRM. **Collaborative CRM systems** provide effective, efficient interactive communication with the customer throughout the entire organization. That is, they integrate communications between the organization and its customers in all aspects of marketing, sales, and customer support. Collaborative CRM systems also enable customers to provide direct feedback to the organization. As you read in Chapter 9, social media applications such as social networks, blogs, microblogs, and wikis are very important to companies that

collaborative CRM system

A CRM system in which communications between the organization and its customers are integrated across all aspects of marketing, sales, and customer support processes.

value customer input into their product and service offerings, as well as into new product development.

The most recent push for consolidated data is called **customer identity management**. Large businesses with several divisions and brands need to understand who their customers are across the business and how their relationship has changed over time. Much the way databases and data warehouses centralize data within a division (meaning all functional areas share data), a customer identity management platform within a CRM will help a company create the 360° view across an entire organization and not just within a division.

An organization's CRM system contains two major components: operational CRM systems and analytical CRM systems. You will learn about operational CRM systems in the next section. We provide a brief overview of analytical CRM systems at the end of Section 11.2, and discuss these systems in more detail in Chapter 12.

customer identity management A marketing technology intended to complete a 360° view of a customer across an organization.

Before you go on...

1. What is the definition of customer relationship management?
2. Why is CRM so important to an organization?
3. Define and provide examples of customer touch points.

11.2

Operational Customer Relationship Management Systems

LEARNING OBJECTIVE

Describe how businesses might use applications of each of the two major components of operational CRM systems.

Operational CRM systems support front-office business processes. **Front-office processes** are those that directly interact with customers; that is, sales, marketing, and service. The two major components of operational CRM systems are customer-facing applications and customer-touching applications (discussed further on). Operational CRM systems provide the following benefits:

- Efficient, personalized marketing, sales, and service
- A 360° view of each customer
- The ability for sales and service employees to access a complete history of a customer's interaction with the organization, regardless of the touch point

CRM tools are often used to accomplish the following objectives:

- Improve sales and account management by optimizing the information shared by multiple employees and by streamlining existing processes (e.g., taking orders using mobile devices)
- Form individualized relationships with customers, with the aim of improving customer satisfaction and maximizing profits
- Identify the most profitable customers and give them the highest level of service
- Provide employees with the information and processes necessary to know their customers
- Understand and identify customer needs, and effectively build relationships among the company, its customer base, and its distribution partners

operational CRM systems The component of CRM that supports the front-office business processes that directly interact with customers (i.e., sales, marketing, and service).

front-office processes Those processes that directly interact with customers; that is, sales, marketing, and service.

customer-facing CRM applications

Areas in which customers directly interact with the organization, including customer service and support, sales force automation, marketing, and campaign management.

customer interaction centre (CIC)

A CRM operation in which organizational representatives use multiple communication channels to interact with customers in functions such as inbound teleservice and outbound telesales.

sales force automation (SFA)

The component of an operational CRM system that automatically records all the aspects of a sales transaction process.

Customer-Facing Applications

In **customer-facing CRM applications**, an organization's sales, field service, and customer interaction centre representatives interact directly with customers. These applications include customer service and support, sales force automation, marketing, and campaign management.

MKT Customer Service and Support

Customer service and support refers to systems that automate service requests, complaints, product returns, and requests for information. Today, organizations have implemented **customer interaction centres (CIC)**, in which organizational representatives use multiple channels such as the Web, telephone, fax, and face-to-face interactions to communicate with customers.

One of the best-known customer interaction centres is the *call centre*, a centralized office set up to receive and transmit a large volume of requests by telephone. Call centres enable companies to respond to a large variety of questions, including requests for product support and complaints.

MIS Sales Force Automation

Sales force automation (SFA) is the component of an operational CRM system that automatically records all of the components in a sales transaction process. SFA systems include a *contact management system*, which tracks all communications between the company and the customer, the purpose of each communication, and any necessary follow-up. This system eliminates duplicated contacts and redundancy, which in turn reduces the risk of irritating customers. SFA also includes a *sales lead tracking system*, which lists potential customers or customers who have purchased related products; that is, products similar to those that the salesperson is trying to sell to the customer.

Other elements of an SFA system can include a *sales forecasting system*, which is a mathematical technique for estimating future sales, and a *product knowledge system*, which is a comprehensive source of information regarding products and services. More developed SFA systems also have online product-building features, called *configurators*, that enable customers to model a product to meet their specific needs. For example, you can customize your own running shoe at Nike By You (www.nike.com/ca/nike-by-you). Finally, many current SFA systems enable salespeople in the field to connect remotely with customers and the home office through Web-based interfaces on their smartphones.

MKT Marketing

Thus far, you have focused primarily on how sales and customer service personnel can benefit from CRM systems. However, CRM systems have many important applications for an organization's marketing department as well. For example, they enable marketers to identify and target their best customers, to manage marketing campaigns, and to generate quality leads for sales teams. CRM marketing applications can also sift through volumes of customer data—a process known as *data mining* (discussed in Chapter 12)—to develop a *purchasing profile*; that is, a snapshot of a consumer's buying habits that may lead to additional sales through cross-selling, upselling, and bundling.

Cross-selling is the marketing of additional related products to customers based on a previous purchase. This sales approach has been used very successfully by banks. For example, if you have a chequing and a savings account at your bank, then a bank officer will recommend other products for you, such as guaranteed investment certificates (GICs) or other types of investments.

Upselling is a strategy in which the salesperson provides customers with the opportunity to purchase related products or services of greater value in place of, or along with, the consumer's initial product or service selection. For example, if a customer goes into an electronics store to buy a new television, a salesperson may show him a pricey 1080i HD LED television placed next to a less expensive LCD television in the hope of selling the more expensive set (assuming that the customer is willing to pay more for a sharper picture). Other common examples of upselling are warranties on electronics merchandise and the purchase of a car wash after buying gas at a gas station.

Finally, *bundling* is a form of cross-selling in which a business sells a group of products or services together at a lower price than their combined individual prices. For example, your cable company might bundle cable TV, broadband internet access, and telephone service at a lower price than you would pay for each service separately.

MKT Campaign Management

Campaign management applications help organizations plan campaigns that send the right messages to the right people through the right

channels. Organizations manage their campaigns very carefully to avoid targeting people who have opted out of receiving marketing communications. Furthermore, companies use these applications to personalize individual messages for each particular customer.

Customer-Touching Applications

Corporations have used manual CRM systems for many years. In the mid-1990s, for example, organizations began to use the internet, the Web, and other electronic touch points (e.g., email, point-of-sale terminals) to manage customer relationships. In contrast with customer-facing applications, through which customers deal with a company representative, customers who use these technologies interact directly with the applications themselves. For this reason, these applications are called **customer-touching CRM applications** or **electronic CRM (e-CRM)** applications. Customers typically can use these applications to help themselves. There are many types of e-CRM applications. Let's examine some of the major ones.

Search and Comparison Capabilities It is often difficult for customers to find what they want from the vast array of products and services available on the Web. To assist customers, many online stores and malls offer search and comparison capabilities, as do independent comparison websites (see www.shopbot.ca).

Technical and Other Information and Services Many organizations offer personalized experiences to induce customers to make purchases or to remain loyal. For example, websites often allow customers to download product manuals. One example is General Electric's website (www.ge.com), which provides detailed technical and maintenance information and sells replacement parts to customers who need to repair outdated home appliances. Another example is Goodyear's website (www.goodyear.ca), which provides information about tires and their use.

Customized Products and Services Another customer-touching service that many online vendors use is mass customization, a process through which customers can configure their own products. For example, Dell (www.dell.com/en-ca) allows customers to configure their own computer systems. Several clothing brands such as Melanie Lyne (www.melanielyne.com) enable customers to "mix and match" an entire wardrobe. Other brands such as Indochino (www.indochino.com) enables customers to fully customize clothing items.

Customers can now also view account balances or check the shipping status of orders at any time from their computers or smartphones. If you order books from Amazon, for example, you can look up the anticipated arrival date. Many other companies, including Canada Post (www.canadapost.ca) and Hudson's Bay (www.thebay.com/), provide similar services.

Personalized Web Pages Many organizations permit their customers to create personalized web pages. Customers use these pages to record purchases and preferences, as well as problems and requests. For example, American Airlines generates personalized web pages for each of its registered travel-planning customers.

FAQs Frequently asked questions (FAQs) are a simple tool for answering repetitive customer queries. Customers may find the information they need by using this tool, thereby eliminating the need to communicate with an actual person.

Email and Automated Response The most popular tool for customer service is email. Companies use email, which is inexpensive and fast, not only to answer customer inquiries but also to disseminate information, send alerts and product information, and conduct correspondence on any topic.

Loyalty Programs **Loyalty programs** recognize customers who repeatedly use a vendor's products or services.

Although loyalty programs are frequently referred to as "rewards programs," their actual purpose is not to reward *past* behaviour, but rather to influence *future* behaviour. Significantly, the most profitable customers are not necessarily those whose behaviour can be most easily influenced. As one example, WestJet provides some "elite" benefits to anyone who spends \$8,000 or more with it over the course of a year. However, such customers do not always

customer-touching CRM applications Applications and technologies with which customers interact and typically help themselves.

electronic CRM (e-CRM) Applications and technologies with which customers interact and typically help themselves.

loyalty programs Programs that offer rewards to customers to influence future behaviour.

take advantage of these benefits. Why is this true? One reason is that elite customers are less influenced by loyalty programs than discount flyers. Therefore, airlines award more benefits to discount flyers than to elite flyers (relative to their spending).

The airlines' frequent flyer programs are probably the best-known loyalty programs. Other popular loyalty programs are casino players' clubs, which reward frequent players, and supermarkets' points programs, which reward frequent shoppers. Loyalty programs use a database or data warehouse to maintain a record of the points (or miles) a customer has accrued and the rewards to which they are entitled. The programs then use analytical tools to mine the data and learn about customer behaviour.

Analytical CRM Systems

analytical CRM system CRM system that analyzes customer behaviour and perceptions in order to provide actionable business intelligence.

Analytical CRM systems provide business intelligence by analyzing customer behaviour and perceptions. (We discuss analytics in detail in Chapter 12.) For example, analytical CRM systems typically provide information concerning customer requests and transactions, as well as customer responses to the organization's marketing, sales, and service initiatives. These systems also create statistical models of customer behaviour and the value of customer relationships over time, as well as forecasts about acquiring, retaining, and losing customers.

Important technologies in analytical CRM systems include data warehouses, data mining, decision support, and other business intelligence technologies. After these systems have completed their various analyses, they supply information to the organization in the form of reports and digital dashboards. We discuss these technologies in more detail in Chapter 12.

Analytical CRM systems analyze customer data for a variety of purposes, including:

- Designing and executing targeted marketing campaigns
- Increasing customer acquisition, cross-selling, and upselling
- Providing input into decisions relating to products and services (e.g., pricing and product development)
- Providing financial forecasting and customer profitability analysis

Figure 11.3 illustrates the relationship between operational CRM systems and analytical CRM systems.

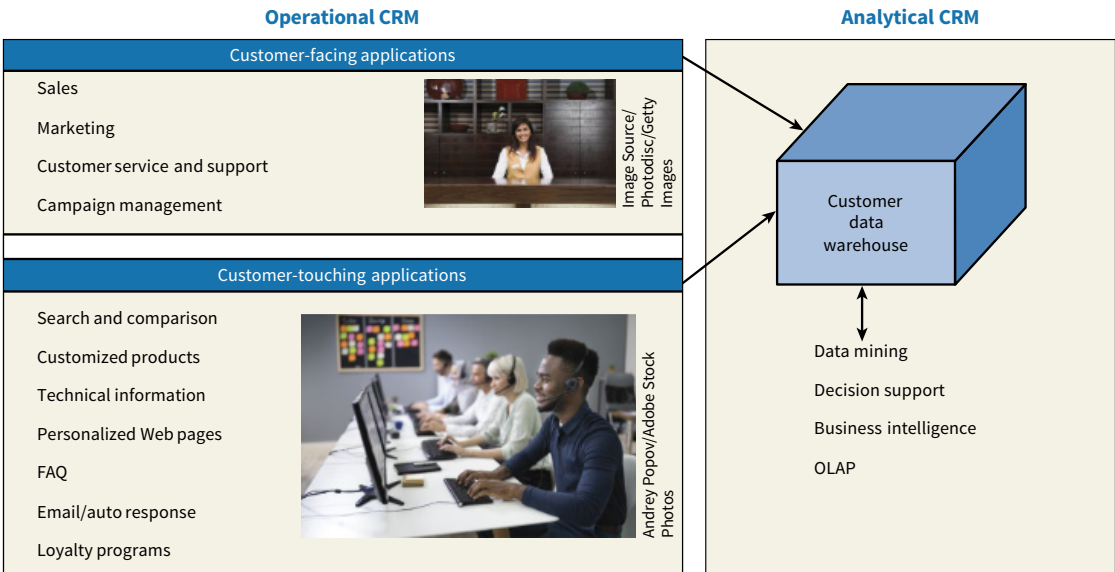


FIGURE 11.3 The relationship between operational CRM and analytical CRM.

Before you go...

1. Differentiate between customer-facing applications and customer-touching applications.
2. Provide examples of cross-selling, upselling, and bundling (other than the examples presented in the text).

11.3 Other Types of Customer Relationship Management Systems

LEARNING OBJECTIVE

Explain the advantages and disadvantages of mobile CRM systems, on-demand CRM systems, open-source CRM systems, social CRM systems, and real-time CRM systems.

Now that you have examined operational and analytical CRM systems, let's shift our focus to other types of CRM systems. Five exciting developments in this area are on-demand CRM systems, mobile CRM systems, open-source CRM systems, social CRM, and real-time CRM.

On-Demand CRM Systems

Customer relationship management systems may be implemented as either *on-premise* or *on-demand*. Traditionally, organizations used on-premise CRM systems, meaning that they purchased the systems from a vendor and then installed them on site. This arrangement was expensive, time-consuming, and inflexible. Some organizations, particularly smaller ones, could not justify the costs of these systems.

On-demand CRM systems became a solution for the drawbacks of on-premise CRM systems. An **on-demand CRM system** is one that is hosted by an external vendor in the vendor's data centre. This arrangement spares the organization the costs associated with purchasing the system. Because the vendor creates and maintains the system, the organization's employees also need to know how to access it and use it. The concept of on-demand is also known as *utility computing* or *software-as-a-service* (SaaS) (see Technology Guide 3).

Salesforce (www.salesforce.com) is the best-known on-demand CRM vendor. The company's goal is to provide a new business model that allows firms to rent the CRM software instead of buying it. The secret to its success is that CRM has common requirements applicable to many customers. Consequently, Salesforce's product meets its customers' demands without a great deal of customization.

One Salesforce customer is Canadian telecom TELUS (www.telus.com/en). TELUS aims to give customers the best possible experience. To do this, it decided to use Salesforce to sign up prospective customers. With Salesforce, door-to-door sales teams can complete key parts of the sales process while they are still on the road. For example, customers no longer need to wait while a paper contract is prepared and sent to them; instead, they can just digitally sign an electronic contract on the salesperson's tablet and it is emailed to them immediately.

POM **MKT** With the Salesforce platform, TELUS customers can be signed up very quickly. In addition, sales agents can immediately access customer contact information, check if a household has already subscribed to certain services, and follow up in a more targeted way. This system makes it easy to deliver valuable information to sales agents at the right time and place.

MKT Durabuilt Windows & Doors (www.durabuiltwindows.com) is an Alberta-based manufacturer of doors and windows for customers across Western Canada. Striving to be a relationship-first business, Durabuilt needs to make sure that all its conversations with customers are consistent, efficient, and seamless. Salesforce CRM enables the company to

on-demand CRM system
A CRM system that is hosted by an external vendor in the vendor's data centre.

achieve that by helping sales and service teams to access shared customer data that provides a 360° view of their profiles, history, and orders. The CRM system empowers the sales team and improves its accountability by providing timely key performance indicators including meeting volumes, close ratios, and budgets. Additionally, the service team can instantly respond to customers' enquiries and schedule and track service crews efficiently. As a result, the service team's productivity has increased to 70 percent.

Despite their benefits, on-demand CRM systems have potential problems. First, the vendor could prove to be unreliable, in which case the client company would have no CRM functionality at all. Second, hosted software is difficult or impossible to modify, and only the vendor can upgrade it. Third, vendor-hosted CRM software may be difficult to integrate with the organization's existing software. Finally, giving strategic customer data to vendors always carries security and privacy risks.

Mobile CRM Systems

mobile CRM system

An interactive CRM system in which communications related to sales, marketing, and customer service activities are conducted through a mobile medium for the purpose of building and maintaining customer relationships between an organization and its customers.

A **mobile CRM system** is an interactive system that enables an organization to conduct communications related to sales, marketing, and customer service activities through a mobile medium for the purpose of building and maintaining relationships with its customers. Mobile CRM systems involve interacting directly with consumers through portable devices such as smartphones. Mobile CRM systems help to create personalized customer relationships that may be accessed anywhere and at any time. In fact, the opportunities offered by mobile marketing are so rich that many companies are employing mobile CRM systems in their marketing activities.

Open-Source CRM Systems

open-source CRM system

CRM software whose source code is available to developers and users.

As explained in Technology Guide 2, the source code for open-source software is available at no cost. **Open-source CRM systems**, therefore, are CRM systems whose source code is available to developers and users.

Open-source CRM systems provide the same features or functions as other CRM software, and they may be implemented either on-premise or on-demand. Leading open-source CRM vendors include SuiteCRM (www.suitecrm.com), SugarCRM (www.sugarcrm.com), and Vtiger (www.vtiger.com). Let's look at an example.

MKT Larsen Jewellery (www.larsenjewellery.com.au), founded by Lars Larsen, is an Australian jeweller. Larsen has created a niche in custom-made fine jewellery, focusing on special experiences, lifetime customer relationships, and personal service.

Interestingly, Larsen operates as a face-to-face retailer without a traditional store. He has established studio workshops where customers work with jewellers to participate in the creation of their own unique pieces of jewellery.

Traditionally, Larsen recorded and managed his customer information entirely on paper, including customer inquiries, payments, production, and servicing. This process worked when the firm had a low volume of high-value sales. However, Larsen wanted to expand his locations, which meant that manual processes would no longer be feasible.

Because all customer details were maintained manually, capturing, finding, and using these data took time. Larsen needed to keep all customer information such as contact details, purchases, and design sketches in an easily accessible central repository.

Larsen also could not effectively analyze manual data. He wanted to know how many of the people who visited his studios actually became customers. He also wanted to understand the products and experiences that people were interested in so he could shape his strategy and marketing efforts accordingly.

In addition to transitioning away from manual processes, Larsen had to contend with pressure from online jewellers. These firms operate high-volume, low-margin businesses, which impact customer attitudes and lower their price expectations. While Larsen does offer value for the money, his brand is not the cheapest. Larsen's value is based on personal service with customers helping to create their own jewellery and then returning regularly to have their jewellery cleaned and maintained.

Larsen had three problems. First, brands that focus on value rather than price must set themselves apart through service and customer experience. Second, the firm had to automate its business processes. Third, with plans to open branches around Australia, Larsen needed to ensure that the business had efficient, repeatable processes. As a result, Larsen needed a CRM package that would help him solve these problems.

Larsen chose SugarCRM (www.sugarcrm.com). The CRM software, enhanced with Flexidocs, lets staff easily capture information and use it to enhance the customer experience. Customer details are all in one place, along with their jewellery certificates, payment histories, and service records. Flexidocs (www.flexidocs.co) allows users to generate documents with a single click using data from CRM systems. Firms can then email the documents to customers, ready for electronic signing.

Larsen implemented SugarCRM over a six-month period. The jeweller first deployed the package in his Sydney branch so problems could be worked out before extending it to Melbourne.

The benefits became clear very quickly. SugarCRM provided Larsen with checks, balances, and automated prompts to ensure that the company's processes became more efficient and human errors were minimized. The package also provided a central repository for all customer information that makes it easy for users to access data for analysis.

The benefits of open-source CRM systems include favourable pricing and a wide variety of applications. These systems are also easy to customize. This is an attractive feature for organizations that need CRM software that is designed for their specific needs. Finally, updates and bug (software error) fixes for open-source CRM systems are rapidly distributed, and extensive support information is available free of charge.

Like all software, however, open-source CRM systems have certain risks. The most serious risk involves quality control. Because open-source CRM systems are created by a large community of unpaid developers, there is sometimes no central authority responsible for overseeing the quality of the product. (We discuss open-source software in Technology Guide 2). Furthermore, for best results, companies must have the same IT platform in place as the one on which the open-source CRM system was developed.

Social CRM

Social CRM is the use of social media technology and services to enable organizations to engage their customers in a collaborative conversation in order to provide mutually beneficial value in a trusted and transparent manner. Social CRM is a company's response to its customers' ownership of this two-way conversation. In social CRM, organizations monitor services such as Facebook, Twitter, and LinkedIn (among many others) for relevant mentions of their products, services, and brand, and respond accordingly.

MKT *Example.* General Motors (www.gm.com) launched Fastlane, one of the first blogs personally written by senior executives. Customer feedback through the blog saves the company US\$180,000 per year compared with traditional focus group research. The blog also generated enormous goodwill because company executives respond directly to consumers.

MKT *Example.* Tim Hortons (www.timhortons.ca) has an active social media marketing strategy. Tim Hortons engages in both small and large-scale initiatives, from asking customers about their go-to song for good coffee sipping vibes on Twitter to promoting the company's collaboration with Canadian pop superstar Justin Bieber on its social media accounts. This collaboration was a huge success, leading to increased brand awareness, visits from younger customers, and as a result, sales. One of the reasons for this success was attributed to Justin Bieber being a long-time fan of Tim Hortons and posting about the brand on his social media channels many times. Using its digital and social media engagement strategies, celebrity partnerships, and other strategic moves, Tim Hortons managed to increase its sales in 2022 to the highest since 2015.

Social media are also providing methods that customers can use to obtain faster, better customer service. Morton's Steakhouse certainly put social media to good use in surprising a customer.

MKT A corporate manager was in meetings all day and had to take a later flight home that caused him to miss his dinner. So, he jokingly tweeted Morton's Steakhouse (www.mortons.com) and requested that the restaurant show up with a steak when he landed.

social CRM The use of social media technology and services to enable organizations to engage their customers in a collaborative conversation in order to provide mutually beneficial value in a trusted and transparent manner.

Morton's saw the Tweet, discovered that the tweeter was a frequent customer (and frequent tweeter—he had 100,000 Twitter followers), pulled data on what he typically ordered, identified the flight he was on, and then sent a delivery person to Newark Airport (New Jersey) to serve him his dinner. When he got to the reception lobby at the airport, he noticed a man in a tuxedo holding a card with his name. The man was also carrying a bag that contained a Porterhouse steak, shrimp, potatoes, bread, two napkins, and silverware.

The nearest Morton's restaurant was 38 kilometers from the airport, and the manager's flight took only two hours. This scenario says a lot about both Morton's customer service and the speed of social media. Admittedly, the entire scenario was a publicity stunt that went explosively viral over the internet. This is not the point, however. The questions that businesses should be asking themselves are: Would your company even consider doing something like this? If not, why not?

Real-Time CRM

Organizations are implementing real-time customer relationship management to provide a superior level of customer satisfaction for today's always-on, always-connected, more knowledgeable, and less loyal customers. **Real-time CRM systems** help organizations to respond to customer product searches, requests, complaints, comments, ratings, reviews, and recommendations in near real-time, 24/7/365. Southwest Airlines provides an excellent example of real-time CRM.

POM **MKT** A passenger was in her seat on a Southwest Airlines flight about to take off when the plane turned back to the gate. A flight attendant asked her to get off the plane. When she checked with the Southwest agent at the desk inside the terminal, he told her that her son was in a coma after suffering a head injury and to call her husband.

Even before she had disembarked, Southwest had rebooked her on the next nonstop flight to her son's city—free of charge. The airline offered her a private waiting area, rerouted her luggage, allowed her to board first, and packed a lunch for her. Moreover, the airline delivered her luggage to where she was going to stay and called her to ask about her son. The woman said that her son was recovering and that she could not be more grateful for the way she was treated.

Southwest Airlines went above and beyond its responsibilities after it learned of the son's accident. Details were not available about how the airline learned of the son's accident, but it is clear that Southwest brought customer relationship management to a new level.

real-time CRM system

A CRM system enabling organizations to respond to customer product searches, requests, complaints, comments, ratings, reviews, and recommendations in near real time, 24/7/365.

Before you go on...

1. Describe on-demand CRM.
2. Describe mobile CRM.
3. Describe open-source CRM.
4. Describe social CRM.
5. Describe real-time CRM.

11.4

Supply Chains

LEARNING OBJECTIVE

Describe the three components and the three flows of a supply chain.

Modern organizations are increasingly concentrating on their core competencies and on becoming more flexible and agile. To accomplish these objectives, they rely on other companies rather than on companies they own to supply the goods and services they need. Organizations recognize that these suppliers can perform these activities more efficiently and

effectively than they can. This trend toward relying on an increasing number of suppliers has led to the concept of supply chains. A **supply chain** is the flow of materials (and services), information, and money from raw material suppliers, through factories and warehouses, to the end customers. A supply chain also includes the *organizations* and *processes* that create and deliver products, information, and services to the end customers.

Supply chains enhance trust and collaboration among supply chain partners, thus improving supply chain visibility and inventory velocity. **Supply chain visibility** refers to the ability of all organizations within a supply chain to access or view relevant data on purchased materials as these materials move through their suppliers' production processes and transportation networks to their receiving docks. Organizations can also access or view relevant data on out-bound goods as they are manufactured, assembled, or stored in inventory and then shipped through their transportation networks to their customers' receiving docks. The faster a company can deliver products and services after receiving the materials required to make them—that is, the higher the *inventory velocity*—the more satisfied the company's customers will be. In addition, supply chain visibility promotes quick responses to problems or changes along the supply chain by enabling companies to shift products to where they are needed.

Supply chain information has historically been obtained by manual, labour-based tracking, and monitoring, but is now increasingly being generated by sensors, RFID tags, meters, GPS, and other devices and systems. How does this transformation affect supply chain managers? For one thing, they now have real-time information on all products moving through their supply chains. Supply chains will therefore rely less on labour-based tracking and monitoring, because the new technology will allow shipping containers, trucks, products, and parts to report on their own status. The overall result is a vast improvement in supply chain visibility.

Supply chains are a vital component of the overall strategies of many modern organizations. To use supply chains efficiently, a business must be tightly integrated with its suppliers, business partners, distributors, and customers. A critical component of this integration is the use of information systems to facilitate the exchange of information among the participants in the supply chain.

supply chain The coordinated movement of *resources* from organizations through *conversion* to the end consumer.

supply chain visibility The ability of all organizations in a supply chain to access or view relevant data on purchased materials as these materials move through their suppliers' production processes.

The Structure and Components of Supply Chains

POM The term *supply chain* comes from a picture of how the partnering organizations are linked. **Figure 11.4** illustrates a typical supply chain. (Recall that Figure 1.5 also illustrated a supply chain, in a slightly different way.) Note that the supply chain involves three segments:

1. *Upstream*, where sourcing or procurement from external suppliers occurs.

In this segment, supply chain managers select suppliers to deliver the goods and services the company needs to produce its product or service. Furthermore, supply chain managers develop the pricing, delivery, and payment processes between a company and its suppliers. Included here are processes for managing inventory, receiving and verifying shipments, transferring goods to manufacturing facilities, and authorizing payments to suppliers.

2. *Internal*, where packaging, assembly, or manufacturing takes place.

Supply chain managers schedule the activities necessary for production, testing, packaging, and preparing goods for delivery. They also monitor quality levels, production output, and worker productivity.

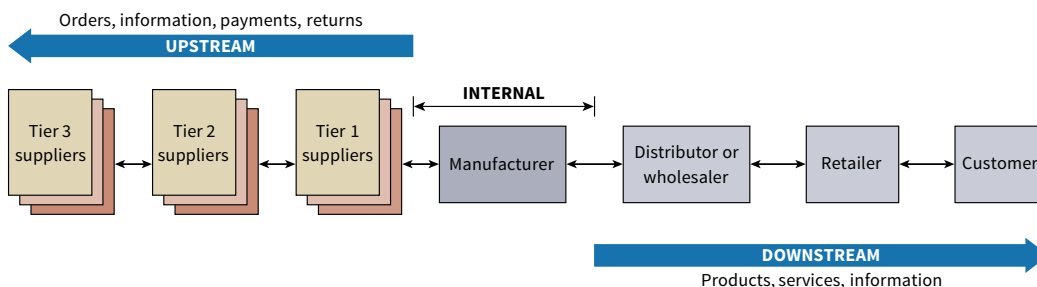


FIGURE 11.4 Generic supply chain.

3. *Downstream*, where distribution takes place, frequently by external distributors.

In this segment, supply chain managers coordinate the receipt of orders from customers, develop a network of warehouses, select carriers to deliver products to customers, and implement invoicing systems to receive payments from customers.

The flow of information and goods can be bidirectional. For example, damaged or unwanted products can be returned, a process known as *reverse flows* or *reverse logistics*. In the retail clothing industry, for example, reverse logistics involves clothing that customers return, either because the item had defects or because the customer did not like it.

Tiers of Suppliers Figure 11.4 shows several tiers of suppliers. As the diagram indicates, a supplier may have one or more subsuppliers, a subsupplier may have its own subsupplier(s), and so on. For an automobile manufacturer, for example, Tier 3 suppliers produce basic products such as glass, plastic, and rubber; Tier 2 suppliers use these inputs to make windshields, tires, and plastic mouldings; and Tier 1 suppliers produce integrated components such as dashboards and seat assemblies.

The Flows in the Supply Chain There are typically three flows in the supply chain: material, information, and financial. *Material flows* are the physical products, raw materials, supplies, and so forth that flow along the chain. Material flows also include the reverse flows discussed earlier. A supply chain thus involves a *product life cycle* approach, from “dirt to dust.”

Information flows consist of data related to demand, shipments, orders, returns, and schedules, as well as changes in any of these data. Finally, *financial flows* involve money transfers, payments, credit card information and authorization, payment schedules, e-payments, and credit-related data.

Significantly, different supply chains have different numbers and types of flows. In service industries, for instance, there may be no physical flow of materials, but there is frequently a flow of information, often in the form of documents (physical or electronic copies). For example, the digitization of software, music, and other content can create a supply chain without any physical flow. Notice, however, that in such a case there are two types of information flows: one that replaces materials flow (digitized software), and another that provides the supporting information (orders, billing, and so on). To manage the supply chain, an organization must coordinate all three flows among all of the parties involved in the chain, a topic we turn to next.

Before you go on...

1. What is a supply chain?
2. Describe the three segments of a supply chain.
3. Describe the flows in a supply chain.

11.5

Supply Chain Management

LEARNING OBJECTIVE

Identify popular strategies to solve the multiple challenges of supply chains.

supply chain management (SCM) An activity in which the leadership of an organization provides extensive oversight for the partnerships and processes that compose the supply chain and leverages these relationships to provide an operational advantage.

The function of **supply chain management (SCM)** is to improve the processes a company uses to acquire the raw materials it needs to produce a product or service and then deliver that product or service to its customers. That is, supply chain management is the process of

planning, organizing, and optimizing the various activities performed along the supply chain. There are five basic components of SCM:

1. **Plan:** Planning is the strategic component of SCM. Organizations must have a strategy for managing all the resources that are involved in meeting customer demand for their product or service. Planning involves developing a set of metrics (measurable deliverables) to monitor the organization's supply chain to ensure that it is efficient and delivers high quality and value to customers for the lowest cost.
2. **Source:** In the sourcing component, organizations choose suppliers to deliver the goods and services they need to create their product or service. Supply chain managers develop pricing, delivery, and payment processes with suppliers, and they create metrics to monitor and improve their relationships with their suppliers. They also develop processes for managing their goods and services inventory, including receiving and verifying shipments, transferring the shipped materials to manufacturing facilities, and authorizing supplier payments.
3. **Make:** This is the manufacturing component. Supply chain managers schedule the activities necessary for production, testing, packaging, and preparation for delivery. This component is the most metric-intensive part of the supply chain, in which organizations measure quality levels, production output, and worker productivity.
4. **Deliver:** This component, often referred to as logistics, is the one in which organizations coordinate the receipt of customer orders, develop a network of warehouses, select carriers to transport their products to their customers, and create an invoicing system to receive payments.
5. **Return:** Supply chain managers must create a responsive, flexible network for receiving defective, returned, or excess products back from their customers, as well as for supporting customers who have problems with delivered products.

Like other functional areas, SCM uses information systems. The goal of SCM systems is to reduce the problems, or friction, along the supply chain. Friction can increase time, costs, and inventories and decrease customer satisfaction. SCM systems, therefore, reduce uncertainty and risks by decreasing inventory levels and cycle time while improving business processes and customer service. These benefits make the organization more profitable and competitive.

Various circumstances can cause problems with global supply chains, including hurricanes, tornados, and other weather events. However, the COVID-19 pandemic has had a far greater impact than these other phenomena. The pandemic was totally unforeseen, it had global impacts, and it did not give supply chain planners much time to react.

POM Supply chains also lead to increased sales and profits. Consider Adidas (www.adidas.com), the leading sports shoe brand in Russia, with more than 1,200 stores in that country. As part of its strategy to optimize the customer experience, Adidas built the supply chain infrastructure needed to enable initiatives such as RFID chips (see Chapter 8), ship from store, click and collect, and endless aisle.

- **Ship from store:** Goods ordered online are delivered from a physical store.
- **Click and collect:** Customers buy products online and collect the products at a physical store or warehouse. By October 2018, some 70 percent of Adidas's online sales were through click and collect.
- **Endless aisle:** Using in-store kiosks, customers can order products not in stock in their local store but available in another one. Products are then delivered using the ship from store or click and collect process.

Russia is, physically, the largest country in the world. Shipping goods from one end of Russia to the other can take up to 15 days using traditional delivery systems. With its three supply chain initiatives, Adidas reduced delivery times and costs while increasing sales and profits. Here is the reason why. Consumers typically return 50 percent of the products they buy online if delivery is made within 24 hours. However, if delivery takes 3 days, consumers may return 70 percent of products. Therefore, because these three processes increase the speed of delivery, customers return fewer goods, which leads to higher completed sales and increased profits.

interorganizational information system (IOS) An information system that supports information flow among two or more organizations.

Significantly, SCM systems are a type of interorganizational information system. In an **interorganizational information system (IOS)**, information flows among two or more organizations. By connecting business partners' ISs, IOSs enable the partners to perform a number of tasks.

- Reduce the costs of routine business transactions
- Improve the quality of the information flow by reducing or eliminating errors
- Compress the cycle time involved in fulfilling business transactions
- Eliminate paper processing and its associated inefficiencies and costs
- Make the transfer and processing of information easier for users

push model A business model in which the production process begins with a forecast, which predicts the products that customers will want as well as the quantity of each product. The company then produces the amount of products in the forecast, typically by using mass production, and sells, or “pushes,” those products to consumers.

The Push Model Versus the Pull Model

Many SCM systems employ the **push model**. In this model, also known as *make-to-stock*, the production process begins with a forecast, which is simply an educated guess as to customer demand. The forecast must predict which products customers will want and in what quantities. The company then produces the amount of products in the forecast, typically by using mass production, and sells, or “pushes,” those products to consumers.

Unfortunately, these forecasts are often incorrect. Consider, for example, an automobile manufacturer that wants to produce a new car. Marketing managers conduct extensive research, including customer surveys and analyses of competitors' cars, and then provide the results to forecasters. If the forecasters' predictions are too high—that is, if they predict that customers will purchase a certain number of these new cars, but actual demand falls below this amount—then the automaker has excess cars in inventory and will incur large carrying costs (the costs of storing unsold inventory). Furthermore, the company will probably have to sell the excess cars at a discount.

From the opposite perspective, if the forecasters' predictions are too low—that is, actual customer demand exceeds expectations—then the automaker will probably have to run extra shifts to meet the demand, thereby incurring substantial overtime costs. Furthermore, the company risks losing business to its competitors if the cars that customers want are not available. Thus, using the push model in supply chain management can cause problems, as you will see in the next section.

To avoid the uncertainties associated with the push model, many companies now employ the pull model of supply chain management, using Web-enabled information flows. In the **pull model**, also known as *make-to-order*, the production process begins with a customer order. Therefore, companies make only what customers want, a process closely aligned with mass customization (discussed in Chapter 2).

pull model A business model in which the production process begins with a customer order and companies make only what customers want, a process closely aligned with mass customization.

POM A prominent example of a company that uses the pull model is Dell Computer. Dell's production process begins with a customer order. This order not only specifies the type of computer the customer wants but also alerts each Dell supplier as to the parts of the order for which that supplier is responsible. That way, Dell's suppliers ship only the parts that Dell needs to produce the computer.

Not all companies can use the pull model. Automobiles, for example, are far more complicated and more expensive to manufacture than computers, so automobile companies require longer lead times to produce new models. Some automobile companies do use the pull model, but only for specific automobiles that certain customers order (e.g., Rolls-Royce, Bentley, and other extremely expensive cars).

Problems Along the Supply Chain

As you saw earlier, friction can develop within a supply chain. One major consequence of friction is poor customer service. In some cases, supply chains do not deliver products or services when and where customers—either individuals or businesses—need them. In other cases, the supply chain provides poor-quality products. Other problems associated with supply chain friction are high inventory costs and revenue loss.



FIGURE 11.5 The bullwhip effect.

The problems along the supply chain arise primarily from two sources: (1) uncertainties; and (2) the need to coordinate multiple activities, internal units, and business partners. A major source of supply chain uncertainties is the *demand forecast*. Demand for a product can be influenced by numerous factors such as competition, price, weather conditions, technological developments, overall economic conditions, and customers' general confidence. Another uncertainty is delivery times, which can be affected by numerous factors ranging from production machine failures to road construction and traffic jams. Quality problems in materials and parts can create production delays, which also generate supply chain problems.

One major challenge that managers face in setting accurate inventory levels throughout the supply chain is known as the bullwhip effect. The **bullwhip effect** refers to erratic shifts in orders up and down the supply chain (see Figure 11.5). Basically, the variables that affect customer demand can become magnified when they are viewed through the eyes of managers at each link in the supply chain. If each separate entity that makes ordering and inventory decisions places its own interests above those of the chain, then stockpiling can occur at as many as seven or eight locations along the chain. Research has revealed that, in some cases, this type of hoarding has led to as much as a 100-day supply of inventory that is waiting "just in case," versus the 10- to 20-day supply manufacturers normally keep on hand.

bullwhip effect Erratic shifts in orders up and down the supply chain.

Solutions to Supply Chain Problems

Supply chain problems can be very costly. Therefore, organizations are motivated to find innovative solutions. During the oil crises of the 1970s, for example, Ryder Systems, a large trucking company, purchased a refinery to control the upstream part of the supply chain and ensure it had sufficient gasoline for its trucks. Ryder's decision to purchase a refinery is an example of vertical integration. **Vertical integration** is a business strategy in which a company purchases its upstream suppliers to ensure that its essential supplies are available as soon as it needs them. Ryder later sold the refinery because it could not manage a business it did not understand and because oil became more plentiful.

Ryder's decision to vertically integrate was not the best method for managing its supply chain. In the remainder of this section, you will look at some other possible solutions to supply chain problems, many of which are supported by IT.

vertical integration Strategy of integrating the upstream part of the supply chain with the internal part, typically by purchasing upstream suppliers, so as to ensure timely availability of supplies.

Using Inventories to Solve Supply Chain Problems Undoubtedly, the most common solution to supply chain problems is *building inventories* as insurance against supply chain uncertainties. As you have learned, holding either too much or too little inventory can be very costly. Thus, companies make major attempts to optimize and control inventories.

One widely used strategy to minimize inventories is the **just-in-time (JIT)** inventory system. Essentially, JIT systems deliver the precise number of parts, called *work-in-process* inventory, to be assembled into a finished product at precisely the right time.

Although JIT offers many benefits, it has certain drawbacks as well. To begin with, suppliers are expected to respond instantaneously to requests. As a result, they have to carry more

just-in-time (JIT) An inventory system in which a supplier delivers the precise number of parts to be assembled into a finished product at precisely the right time.

inventory than they otherwise would. In this sense, JIT does not *eliminate* excess inventory; rather, it simply *shifts* it from the customer to the supplier. This process can still reduce the overall inventory size if the supplier can spread the increased inventory over several customers. However, that is not always possible.

JIT also replaces a few large supply shipments with a large number of smaller ones. In terms of transportation, then, the process is less efficient.

Information Sharing Another common approach to solving supply chain problems, and especially to improving demand forecasts, is *sharing information* along the supply chain. Information sharing can be facilitated by electronic data interchange and extranets, topics you will learn about in the next section.

One notable example of information sharing occurs between large manufacturers and retailers. For example, Walmart provides Procter & Gamble (P&G) with access to daily sales information from every store for every item that P&G makes for Walmart. This access enables P&G to manage the *inventory replenishment* for Walmart’s stores. By monitoring inventory levels, P&G knows when inventories fall below the threshold for each product at any Walmart store. These data trigger an immediate shipment.

Information sharing between Walmart and P&G is executed automatically. It is part of a vendor-managed inventory strategy. **Vendor-managed inventory (VMI)** occurs when the supplier, rather than the retailer, manages the entire inventory process for a particular product or group of products. Significantly, P&G has similar agreements with other major retailers. The benefit for P&G is accurate and timely information on consumer demand for its products. Thus, P&G can plan production more accurately, minimizing the bullwhip effect.

A problem that has been exacerbated by the pandemic is the increasing numbers of products that customers are returning. IT’s About Business 11.2 presents an overview of shoppers’ changing attitudes and expectations regarding product returns.

vendor-managed inventory (VMI) An inventory strategy where the supplier monitors a vendor’s inventory for a product or group of products and replenishes products when needed.

IT’s About Business 11.2

Return Problems

Customers love free returns. They make shopping less risky and allow customers to “bracket” their purchases. *Bracketing* refers to the practice in which customers buy multiple sizes or colours of the same item and then return the items they don’t want. According to a recent KPMG study, two-thirds of Canadians have increased their online shopping habits significantly during and after the COVID-19 pandemic. On average, at least 30 percent of all products purchased online are returned. This rate is different across different industries, with fashion holding the highest percentage. In the United States, in 2020, shoppers sent back roughly US \$100 billion worth of merchandise. In 2021, that amount more than doubled to US \$218 billion. Some analysts believe that this trend of returning merchandise is not sustainable.

Ironically, although customers are returning far more items than ever before, many shoppers consider this process to be too complicated. According to Shopify, 58 percent of shoppers state they are “not satisfied” with the ease of making returns. Customers further claim they are willing to abandon brands if those brands do not offer easy return policies. Moreover, 72 percent of shoppers are willing to spend more money and order more frequently from online stores that offer a customer-friendly return process. In sum, customers are increasingly making their purchasing decisions based on how simple it is to “undo” a decision.

Return policies became even more important following the COVID-19 outbreak. The world was taken off guard by the pandemic. Retailers were not prepared for the surge in online shopping. They were even less prepared for the huge volumes of returns. Before the pandemic, many retailers considered returns as a standard cost of doing business. In contrast, today the return process has become a vital component of the customer experience.

Free and easy returns have become the expectation. However, this practice has reinforced consumers’ treatment of purchases more as risk-free discoveries for size and style than as end-of-shopping journeys. Retailers report this reality to be especially true for select categories such as women’s shoes and dresses.

Although shoppers appreciate free shipping and free returns, it is not free for retailers to take those items back. One analysis found that processing a return costs a company up to 66 percent of the product’s sales price. The costs to the retailer include ground shipping and the labour required to process, sort, and prepare those goods to be resold. On average, these added processing costs are causing retailers to lose millions of dollars annually.

For many retailers, 2022 was a challenging year financially. In response, some companies are adjusting their return policies in an attempt to decrease the loss associated with returns. Managing returns, however, has been a relatively neglected problem. Any lag time in returns in a fashion-based business (or any business where

trends and seasons impact pricing) can lead to significant mark-downs for reselling the merchandise. Brands that sell returns at wholesale prices face an added challenge. It is not uncommon for retail returns to all come back at the end of a selling season, making the resell market more difficult because of their short shelf life relative to the season. Marking down prices too much can also lead to value erosion compared with competing retailers. For example, if customers become accustomed to a particular brand cutting prices by 50 percent, they may begin to see the true value as 50 percent of the manufacturer's suggested retail price. Finally, there is the environmental impact: an estimated 10 percent of all returns end up in a landfill.

One relatively unpopular approach to this problem is to charge customers for returns. In theory, this practice would force customers to make better, more final purchasing decisions to avoid paying the return fee. For example, Naturalizer shoes added a fee of \$8 for returns and Hudson's Bay added a fee of \$10 for returning online merchandise using a courier (e.g., Canada Post). Other companies are offering free returns only to their most loyal shoppers, while some others provide only a merchandise credit (and not a refund of the original method of payment).

A different strategy to reduce the number of returns is to provide more information to help customers make better purchasing decisions. In the apparel industry, retailers need to help shoppers understand how clothes will fit them before they make a purchase. In the past, retailers employed supermodels to promote their products. Today, they use a variety of people with different skin tones, heights, and weights to help shoppers better understand what they are buying. Furthermore, many brands such as lululemon (<https://shop.lululemon.com>) provide customers with the option to text or even book video chat sessions to inform them about different product details as well as fit and sizing.

Other retailers provide in-depth customer feedback on their competitors' brands as well as their own products. This feedback helps customers to decide between brands rather than bracket their order with multiple brands with the intention of returning unwanted items.

Looking toward the future, some companies are investing in augmented reality technology to support customers in their buying process. For instance, Nike launched a high-tech store in China that provides an innovative foot-scanning technology. It is not alone in this; several shoe stores have scanning tools to help customers make more informed decisions about the shoes they will purchase. This tool helps customers to determine which size fits them best for various shoe styles. Similarly, Sephora's Virtual Artist enables customers to "try on" makeup products through the app or in-store screens. Warby Parker allows customers to virtually "try on" hundreds of pairs of glasses.

Moving beyond apparel and makeup, Amazon employs augmented reality to enable customers to "see" items in their own space. For example, customers can see how a painting will look in their room or how a different-sized TV will fit on the wall. Similarly, using augmented reality, Ikea helps its customers plan their decorating and design projects. Ikea's app called Ikea Place lets customers virtually place furnishings such as sofas, lamps, rugs, and tables in their space. The products on Ikea Place are 3D and true to size so customers can better see if a piece of furniture is the right size and design for them.

Despite these efforts, however, customers will continue to return items. Knowing this to be the case, businesses can deploy strategies to help reduce the cost of returns. One strategy is to

simplify the process by encouraging customers to return items directly to a store. For example, to streamline the return process, in January 2023, Hudson's Bay announced a partnership with ReturnBear (www.returnbear.com/), Canada's first end-to-end online returns service provider. As a result, many items purchased on the Hudson's Bay website (www.thebay.com), including purchases from Marketplace sellers, can be more easily returned. Hudson's Bay customers can now more easily "initiate a return" in their order history, indicate what product(s) they want to return, and generate a QR code. They will then have the QR code scanned in store to drop off their return. Not only does this process eliminate the need to print labels and repack items—making it simple and convenient—but customers do not have to explain to a sales associate why they do not want an item.

Some retailers have established stores known as *return consolidation centres* that are dedicated entirely to returns. These centres operate based on clear guidelines as to how to manage returns. Data inform employees about whether an item should be discarded or retained and resold. Decisions are based on profit margin from the initial sale, seasonality, item condition, packaging condition, and other product-specific considerations.

Another strategy to make returns more convenient is to outsource the process to a third party that specializes in this area. Companies like Happy Return and Narvar operate thousands of drop-off locations nationwide. Retailers can outsource this service and receive cleaned, prepped, and sorted returns without having to manage the reverse logistics.

The timely return of resaleable inventory is crucial in categories that are season-sensitive. For example, a customer purchases summer apparel near the end of the season and returns it within the 45-day window. That item might not have a place on the shelves after the store has switched to fall products. There might not be anything physically wrong with the product or the packaging. However, the window of time to sell the product at the full price has closed. Third-party companies that quickly process returns before they go out of season help reduce this loss.

Finally, some retailers such as Amazon use return cost analytics to determine whether the cost of the return is higher than the liquidation/resale value. If this is the case, then they would consider letting the customer keep the item. These "refund and keep" decisions are driven by analysis and awareness of the growing return problem.

Regardless of the strategies they use, companies must deal with the issue of returns.

Questions

1. How has online shopping increased the volume of returns?
2. Discuss how technology can be used to lessen the number of returns by helping customers make informed decisions.
3. How can businesses utilize technology to better manage returns?

Sources: Compiled from The Bay, "The Bay and ReturnBear Partner to Make Returns Easier," *Canada New Wire*, January 17, 2023; A. Hartmans, "The Era of Free Returns May Be Coming to an End. Here's Why Retailers Have Started Charging Return Fees—And How You Can Avoid Them," *Business Insider*, October 14, 2022; G. Petro, "Desperation in the Air" as the Great Retail Destocking Picks Up

Steam,” *Forbes*, October 14, 2022; M. Corkery, “Retail’s ‘Dark Side’: As Inventory Piles Up, Liquidation Warehouses Are Busy,” *The New York Times*, July 30, 2022; K. Saleh, “E-Commerce Product Return Rate—Statistics and Trends,” *Invesp*, May 16, 2022; M. Repko, “A More Than \$761 Billion Dilemma: Retailers’ Returns Jump as Online Sales Grow,” *CNBC*, January 25, 2022; M. Simoncic and A. Lozano, “Returns Are the New Growth Strategy,” *Retail Dive*, December 23, 2021; E. Dopson, “The Plague of Ecommerce Return Rates and How to Maintain Profitability,” *shopify.com*, August 25, 2021; G. Jezerc, “Returning to Normal: How Retail Can Beat the Returns Challenge,”

First Insight, August 13, 2021; J. Mitchell, “How Online Returns Will Impact the Post-Covid Customer Experience,” *Supply Chain Brain*, July 15, 2021; J. Ader, P. Adhi, J. Chai, M. Singer, S. Touse, and H. Yankelevich, “Returning to Order: Improving Returns Management for Apparel Companies,” *McKinsey & Company*, May 25, 2021; National Retail Foundation, “\$428 Billion in Merchandise Returned in 2020,” [Press Release], January 11, 2021; KPMG LLP, “Black Friday / Cyber Monday Will Test How Well Canadian Retailers Pivoted to the New COVID-19 Reality: KPMG in Canada Report,” *Canada New Wire*, November 27, 2020.

Before you go on...

1. Differentiate between the push model and the pull model.
2. Describe various problems that can occur along the supply chain.
3. Discuss possible solutions to problems along the supply chain.

11.6 Information Technology Support for Supply Chain Management

LEARNING OBJECTIVE

Explain the utility of each of the three major technologies that support supply chain management.

Clearly, SCM systems are essential to the successful operation of many businesses. As you have seen, these systems—and IOSs in general—rely on various forms of IT to resolve problems. Three technologies, in particular, provide support for IOSs and SCM systems: electronic data interchange, extranets, and Web services. You will learn about Web services in Technology Guide 3. In this section, you examine the other two technologies.

Electronic Data Interchange (EDI)

electronic data interchange (EDI) A communication standard that enables business partners to transfer routine documents electronically.

Electronic data interchange (EDI) is a communication standard that enables business partners to exchange routine documents, such as purchasing orders, electronically. EDI formats these documents according to agreed-upon standards (e.g., data formats). It then transmits messages over the internet using a converter, called a *translator*.

EDI provides many benefits that are not available with a manual delivery system. To begin with, it minimizes data entry errors, because each entry is checked by the computer. The length of the message can also be shorter, and the messages are secured. EDI also reduces cycle time, increases productivity, enhances customer service, and minimizes paper usage and storage. **Figure 11.6** contrasts the process of fulfilling a purchase order with and without EDI.

EDI does have some disadvantages. Business processes must sometimes be restructured to fit EDI requirements. Also, there are many EDI standards in use today, so one company might have to use several standards to communicate with multiple business partners.

In today’s world, in which every business has a broadband connection to the internet and where multi-megabyte design files, product photographs, and PDF sales brochures are routinely emailed, the value of reducing a structured e-commerce message from a few thousand XML bytes to a few hundred EDI bytes is negligible. As a result, EDI is being replaced by XML-based Web services. (You will learn about XML in Technology Guide 3.)

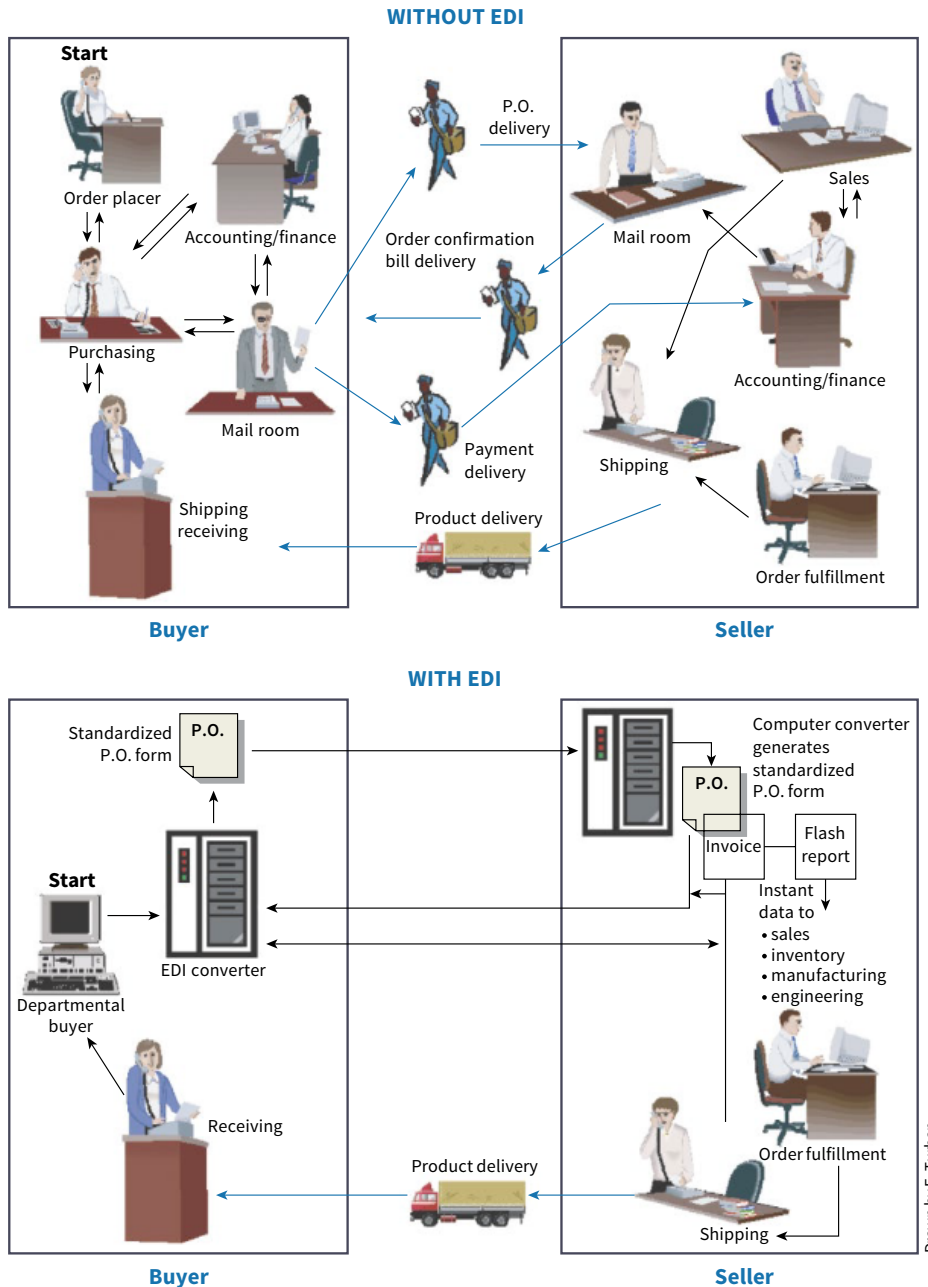
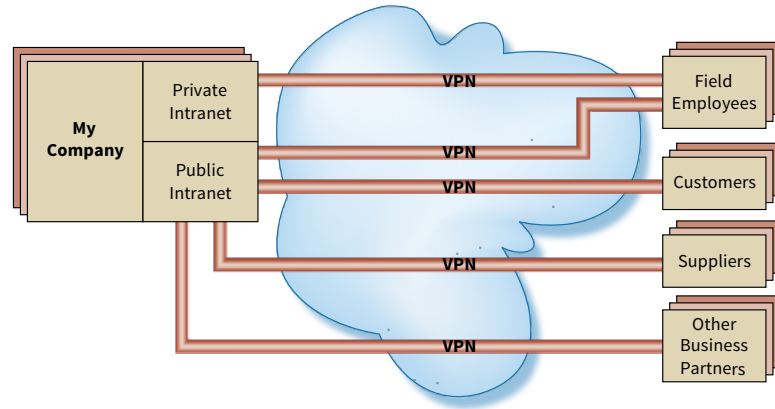


FIGURE 11.6 Comparing purchase order (PO) fulfillment with and without EDI.

Extranets

To implement IOSs and SCM systems, a company must connect the intranets of its various business partners to create extranets. Extranets link business partners over the internet by giving them access to certain areas of each other's corporate intranets (see [Figure 11.7](#)).

FIGURE 11.7 The structure of an extranet.

The primary goal of extranets is to foster collaboration between and among business partners. A business provides extranet access to selected B2B suppliers, customers, and other partners. These individuals access the extranet through the internet. Extranets enable people located outside a company to collaborate with the company's internal employees. They also allow external business partners to enter the corporate intranet, through the internet, to access data, place orders, check the status of those orders, communicate, and collaborate. Finally, they make it possible for partners to perform self-service activities such as checking inventory levels.

Extranets use virtual private network (VPN) technology to make communication over the internet more secure. The major benefits of extranets are faster processes and information flow, improved order entry and customer service, lower costs (e.g., for communications, travel, and administrative overhead), and overall improved business effectiveness.

There are three major types of extranets. The type that a company chooses depends on the business partners involved and the purpose of the supply chain. We present each type next, along with its major business applications.

A Company and Its Dealers, Customers, or Suppliers This type of extranet centres on a single company. An example is the FedEx extranet, which allows customers to track the status of a delivery. Customers use the internet to access a database on the FedEx intranet. Enabling customers to monitor deliveries saves FedEx the cost of hiring human operators to perform that task over the phone.

An Industry's Extranet Just as a single company can set up an extranet, the major players in an industry can team up to create an extranet that will benefit all of them. For example, OpenText (www.opentext.com) enables companies to collaborate effectively through a network that provides a secure global medium for B2B information exchange. This network is used for mission-critical business transactions by leading international organizations in aerospace, automotive, chemical, electronics, financial services, health care, logistics, manufacturing, transportation, and related industries. It offers customers a reliable extranet as well as VPN services.

Joint Ventures and Other Business Partnerships In this type of extranet, the partners in a joint venture use the extranet as a vehicle for communication and collaboration. An example is Bank of America's extranet for commercial loans. The partners involved in making these loans include a lender, a loan broker, an escrow company, and a title company. The extranet connects lenders, loan applicants, and the loan organizer, Bank of America. A similar case is Lending Tree (www.lendingtree.com), a company that provides mortgage quotes for homeowners and also sells mortgages online. Lending Tree uses an extranet for its business partners (e.g., the lenders).

Portals and Exchanges

As you saw in Chapter 6, corporate portals offer a single point of access through a Web browser to critical business information in an organization. In the context of B2B supply chain management, these portals enable companies and their suppliers to collaborate very closely.

There are two basic types of corporate portals: procurement (sourcing) portals for a company's suppliers (upstream in the supply chain), and distribution portals for a company's customers (downstream in the supply chain). **Procurement portals** automate the business processes involved in purchasing or procuring products between a single buyer and multiple suppliers. For example, Celestica has deployed a procurement portal called Supplier Portal through which it conducts business with its suppliers. **Distribution portals** automate the business processes involved in selling or distributing products from a single supplier to multiple buyers. For example, Dell services its business customers through its distribution portal at www.premier.dell.com.

procurement portals

Corporate portals that automate the business processes involved in purchasing or procuring products between a single buyer and multiple suppliers.

distribution portals

Corporate portals that automate the business processes involved in selling or distributing products from a single supplier to multiple buyers.

Emerging Technologies

Logistics experts predict that several technologies will significantly impact supply chains by 2025. The opening case presented several of these technologies and the impact they will have on the supply chain.

Before you go on...

1. Define EDI, and list its major benefits and limitations.
2. Define extranet, and explain its infrastructure.
3. List and briefly define the major types of extranets.
4. Differentiate between procurement portals and distribution portals.

What's in IT for me?

ACCT For the Accounting Major

Customer Relationship Management

CRM systems can help companies establish controls for financial reporting related to interactions with customers in order to support compliance with legislation.

CRM systems can track document flow from a sales opportunity to a sales order, to an invoice, to an accounting document, thus enabling finance and accounting managers to monitor the entire flow. CRM systems that track sales quotes and orders can be used to incorporate process controls that identify questionable sales transactions. CRM systems can provide exception-alert capabilities to identify instances outside defined parameters that put companies at risk.

Supply Chain Management

The cost accountant will play an important role in developing and monitoring the financial accounting information associated with inventory and cost of goods sold. In a supply chain, much of the data for these accounting requirements will flow into the organization from various partners within the chain. It is up to the chief

accountant, the comptroller or CFO, to prepare and review these data.

Going further, accounting rules and regulations and the cross-border transfer of data are critical for global trade. IOSs can facilitate such trade. Other issues that are important for accountants are taxation and government reports. Creating information systems that rely on EDI also requires the attention of accountants. Finally, detecting fraud in global settings (e.g., transfers of funds) can be facilitated by appropriate controls and auditing.

FIN For the Finance Major

Customer Relationship Management

CRM systems allow companies to track marketing expenses, collecting appropriate costs for each individual marketing campaign. These costs can then be matched to corporate initiatives and financial objectives, demonstrating the financial impact of the marketing campaign.

Pricing is another key area that impacts financial reporting. For example, what discounts are available? When can a price be overridden? Who approves discounts? CRM systems can put controls into place for these issues.

Supply Chain Management

In a supply chain, the finance major will be responsible for analyzing the data created and shared among supply chain partners. In many instances, the financial analyst will recommend actions to improve supply chain efficiencies and cash flow. This may benefit all of the partners in the chain. These recommendations will be based on financial models that incorporate key assumptions such as supply chain partner agreements for pricing. Through the use of extensive financial modeling, the financial analyst helps to manage liquidity in the supply chain.

Many finance-related issues exist in implementing IOSs. For one thing, establishing EDI and extranet relationships involves structuring payment agreements. Global supply chains may involve complex financial arrangements, which can have legal implications.

MKT For the Marketing Major

Customer Relationship Management

CRM systems are an integral part of every marketing professional's work activities. CRM systems contain the consolidated customer data that provide the foundation for making informed marketing decisions. Using these data, marketers develop well-timed and targeted sales campaigns with customized product mixes and established price points that enhance potential sales opportunities and therefore increase revenue. CRM systems also support the development of forecasting models for future sales to existing clients through the use of historical data captured from previous transactions.

Supply Chain Management

A tremendous amount of useful sales information can be derived from supply chain partners through the supporting information systems. For example, many of the customer support activities take place in the downstream portion of the supply chain. For the marketing manager, an understanding of how the supply chain's downstream activities relate to prior chain operations is critical.

Furthermore, tremendous amounts of data are fed from the supply chain supporting information systems into the CRM systems that are used by marketers. The information and a complete understanding of its genesis are vital for mixed-model marketing programs.

POM For the Production/Operations Management Major

Customer Relationship Management

Production is heavily involved in the acquisition of raw materials, conversion, and distribution of finished goods. However, all of these activities are driven by sales. Increases or decreases in the demand for goods will increase or decrease a company's need for raw materials. Integral to a company's demand is forecasting future sales, an important feature of CRM systems. Sales forecasts are created from the historical data stored in CRM systems.

This information is critical to a production manager who is placing orders for manufacturing processes. Without an accurate future sales forecast, production managers can face inventory problems (discussed in detail in this chapter). The use of CRM systems for production and operational support is critical to efficiently managing the company's resources.

Supply Chain Management

The production/operations management major plays an important role in the supply chain development process. In many organizations, the production/operations management staff may even lead the supply chain integration process because of their extensive knowledge

of the organization's manufacturing components. Because the production/operations staff are in charge of procurement, production, materials control, and logistical handling, they must possess a comprehensive understanding of SCM techniques.

The downstream segment of supply chains is where marketing, distribution channels, and customer service are conducted. An understanding of how downstream activities are related to the other segments is critical. Supply chain problems can reduce customer satisfaction and negate marketing efforts. It is essential, then, that marketing professionals understand the nature of such problems and their solutions. Also, learning about CRM, its options, and its implementation is important for designing effective customer services and advertising.

As competition intensifies globally, finding new global markets becomes critical. IOSs provide an opportunity to improve marketing and sales. Understanding the capabilities of these technologies as well as their implementation issues will enable the marketing department to excel.

HRM For the Human Resources Major

Customer Relationship Management

Companies trying to enhance their customer relationships must recognize that employees who interact with customers are critical to the success of CRM strategies. Essentially, the success of CRM is based on the employees' desire and ability to promote the company and its CRM initiatives. In fact, research analysts have found that customer loyalty is based largely on employees' capabilities and their commitment to the company.

As a result, human resources managers know that a company that desires valued customer relationships needs valued relationships with its employees. Therefore, HR managers are implementing programs to increase employee satisfaction and are training employees to execute CRM strategies.

Supply Chain Management

Supply chains require the employees of partners in the chain to interact effectively. These interactions are the responsibility of the human resources manager, who must be able to address supply chain issues that relate to staffing, job descriptions, job rotations, and accountability. All of these areas are complex within a supply chain, and they require the HR function to understand the relationships among partners as well as the movement of resources.

Preparing and training employees to work with business partners (frequently in foreign countries) requires knowledge about how IOSs operate. Sensitivity to cultural differences and extensive communication and collaboration can be facilitated with IT.

MIS For the MIS Major

Customer Relationship Management

The IT function in the enterprise is responsible for the corporate databases and data warehouse, as well as the correctness and completeness of the data stored in them. That is, the IT department provides the data used in a 360° view of the customer. Furthermore, IT personnel provide the technologies underlying the customer interaction centre.

Supply Chain Management

The MIS staff will be instrumental in the design and support of information systems—both internal organizational and interorganizational—that will underpin the business processes that are part of the supply chain. In this capacity, the MIS staff must have a concise knowledge of the business, the systems, and the points of intersection between the two.

Summary

11.1 Identify the primary functions of both customer relationship management (CRM) and collaborative CRM strategies.

Customer relationship management (CRM) is an organizational strategy that is customer-focused and customer-driven. That is, organizations concentrate on assessing customers' requirements for products and services and then on providing high-quality, responsive services. CRM functions include acquiring new customers, retaining existing customers, and growing relationships with existing customers.

Collaborative CRM is an organizational CRM strategy in which data consolidation and the 360° view of the customer enable the organization's functional areas to readily share information about customers. The functions of collaborative CRM include integrating communications between the organization and its customers in all aspects of marketing, sales, and customer support processes, and enabling customers to provide direct feedback to the organization.

11.2 Describe how businesses might use applications of each of the two major components of operational CRM systems.

Operational CRM systems support the front-office business processes that interact directly with customers (i.e., sales, marketing, and service). The two major components of operational CRM systems are customer-facing applications and customer-touching applications.

Customer-facing CRM applications include customer service and support, sales force automation, marketing, and campaign management. *Customer-touching applications* include search and comparison capabilities, technical and other information and services, customized products and services, personalized web pages, FAQs, email and automated response, and loyalty programs.

11.3 Explain the advantages and disadvantages of mobile CRM systems, on-demand CRM systems, open-source CRM systems, social CRM systems, and real-time CRM systems.

Mobile CRM systems are interactive systems through which communications related to sales, marketing, and customer service activities are conducted through a mobile medium for the purpose of building and maintaining customer relationships between an organization and its customers. Advantages of mobile CRM systems include convenience for customers and the chance to build a truly personal relationship with customers. A drawback could be difficulty in maintaining customer expectations; that is, the company must be extremely responsive to customer needs in a mobile, near-real-time environment.

On-demand CRM systems are hosted by an external vendor in the vendor's data centre. Advantages of on-demand CRM systems include lower costs and a need for employees to know only how to access and use the software. Drawbacks include possibly unreliable vendors, difficulty in modifying the software, and difficulty in integrating vendor-hosted CRM software with the organization's existing software.

Open-source CRM systems are those whose source code is available to developers and users. The benefits of open-source CRM systems include favourable pricing, a wide variety of applications, easy customization, rapid updates and bug (software error) fixes, and extensive free support information. The major drawback of open-source CRM systems is quality control.

Social CRM is the use of social media technology and services to enable organizations to engage their customers in a collaborative conversation to provide mutually beneficial value in a trusted and transparent manner.

Real-time CRM means that organizations are able to respond to customer product searches, requests, complaints, comments, ratings, reviews, and recommendations in near real time, 24/7/365.

11.4 Describe the three components and the three flows of a supply chain.

A *supply chain* is the flow of materials (and services), information, and money from raw material suppliers, through factories and warehouses, to the end customers. A supply chain involves three segments: upstream, where sourcing or procurement from external suppliers occurs; internal, where packaging, assembly, or manufacturing takes place; and downstream, where distribution takes place, frequently by external distributors.

There are three flows in the supply chain: *material flows*, which are the physical products, raw materials, supplies, and so forth; *information flows*, which consist of data related to demand, shipments, orders, returns, and schedules, as well as changes in any of these data; and *financial flows*, which involve money transfers, payments, credit card information and authorization, payment schedules, e-payments, and credit-related data.

11.5 Identify popular strategies to solve the multiple challenges of supply chains.

Two major challenges in setting accurate inventory levels throughout a supply chain are the *demand forecast* and the *bullwhip effect*. Demand for a product can be influenced by numerous factors such as competition, prices, weather conditions, technological developments, economic conditions, and customers' general confidence. The *bullwhip effect* refers to erratic shifts in orders up and down the supply chain.

The most common solution to supply chain problems is *building inventories* as insurance against uncertainties. Another solution is the *just-in-time (JIT)* inventory system, which delivers the precise number of parts, called *work-in-process inventory*, to be assembled into a finished product at precisely the right time. A third possible solution is *vendor-managed inventory (VMI)*, which occurs when the vendor, rather than the retailer, manages the entire inventory process for a particular product or group of products.

11.6 Explain the utility of each of the three major technologies that support supply chain management.

Electronic data interchange (EDI) is a communication standard that enables the electronic transfer of routine documents, such as purchasing orders, between business partners.

Extranets are networks that link business partners over the internet by giving them access to certain areas of each other's corporate intranets. The main goal of extranets is to foster collaboration among business partners.

Corporate portals offer a single point of access through a Web browser to critical business information in an organization. In the context of business-to-business supply chain management, these portals enable companies and their suppliers to collaborate very closely.

Key Terms

analytical CRM system 334	electronic CRM (e-CRM) 333	procurement portals 349
bullwhip effect 343	electronic data interchange (EDI) 346	pull model 342
collaborative CRM system 330	front-office processes 331	push model 342
customer identity management 331	interorganizational information system (IOS) 342	real-time CRM system 338
customer interaction centre (CIC) 332	just-in-time (JIT) 343	sales force automation (SFA) 332
customer relationship management (CRM) 326	loyalty programs 333	social CRM 337
customer touch point 328	mobile CRM system 336	supply chain 339
customer-facing CRM applications 332	on-demand CRM system 335	supply chain management (SCM) 340
customer-touching CRM applications 333	open-source CRM system 336	supply chain visibility 339
distribution portals 349	operational CRM systems 331	vendor-managed inventory (VMI) 344
		vertical integration 343

Discussion Questions

1. How do customer relationship management systems help organizations achieve customer intimacy?
2. What is the relationship between data consolidation and CRM systems?
3. Discuss the relationship between CRM and customer privacy.
4. Distinguish between operational CRM systems and analytical CRM systems.
5. Differentiate between customer-facing CRM applications and customer-touching CRM applications.
6. Explain why Web-based customer interaction centres are critical for successful CRM systems.
7. Why are companies so interested in e-CRM applications?
8. Discuss why it is difficult to justify CRM applications.
9. You are the CIO of a small company with a rapidly growing customer base. Which CRM system would you use: an on-premise CRM system, an on-demand CRM system, or an open-source CRM system? Remember that open-source CRM systems may be implemented either on-premise or on-demand. Discuss the pros and cons of each type of CRM system for your business.
10. List and explain the important components of a supply chain.
11. Explain how a supply chain approach may be part of a company's overall strategy.
12. Explain the important role that information systems play in supporting a supply chain strategy.
13. Would Rolls-Royce Motorcars (www.rolls-roycemotorcars.com) use a push model or a pull model in its supply chain? Support your answer.
14. Why is planning so important in supply chain management?

Problem-Solving Activities

1. Access www.amazon.ca and www.thebay.com. Examine some of the IT-supported customer services and tools provided by the two companies. Compare and contrast the customer support provided on the two companies' websites.
2. Enter www.anntaylor.com, www.hermes.com/ca, and www.gucci.com/ca. Compare and contrast the customer service activities offered by these companies on their websites. Do you see marked similarities? Differences?
3. Access your university's website. Investigate how your university provides for customer relationship management. (*Hint: First decide who your university's customers are.*)
4. Access www.salesforce.com/form/signup/testdrive, and take the guided tour. Prepare a report on Salesforce's functionality to the class.
5. Enter www.ascm.org, www.cio.com, www.findarticles.com, and www.google.ca, search for recent information, and find the top five trends in supply chain management. Surf the Web to find a procurement (sourcing) portal, a distribution portal, and an exchange (other than the examples presented in this chapter). List the features they have in common and those features that are unique.
6. Visit www.crmside.com/apple-crm-case-study/. List three things you learned about Apple's success with CRM.
7. Describe the current career opportunities available in supply chain management after visiting www.ascm.org.

Closing Case

IT Helps Laura Canada to Come Back

Laura Canada (www.lauracanada.ca) was founded by Laura Wolstein in 1930. The company grew into a Canada-wide chain in the 1990s. Laura Canada is still a family-owned women's fashion company carrying two brands: Laura and Melanie Lyne. Despite being popular with Canadians, the company has gone through ups and downs with customers. Specifically, Laura Canada experienced large losses in 2012 and 2013. Having liabilities of more than \$20 million, the company filed for protection from creditors in 2015. At the time, it announced that it expected to reorganize the business, maybe close some underperforming stores, but keep doing business as usual while restructuring and reorganizing. And that is what it did, mainly by redesigning its stores and investing in technology to improve the customer experience. Let's review some of Laura Canada's technology-related initiatives.

Salesforce is one of Laura Canada's software provider partners. Salesforce enabled the company to achieve various important goals. First, to diminish duplication of effort and provide customers with a more consistent experience, the company decided to move to a single platform for its two brands. The resulting websites feature gorgeous product photography, enhanced product description and details, and improved navigation. By upgrading its website, Laura Canada managed to elevate customers' perception of the brand.

Salesforce solutions enabled the company's marketing and sales team to send automated emails to welcome new customers, alert customers about price drops for certain products, and remind them about abandoned shopping carts.

With Salesforce products, all customer interactions (through live chat, email, and phone) with the company's service agents are logged into one system. This not only reduced manual data entry but also provided a single view of the customer, improved the company's customer service agents' efficiency, and improved customer satisfaction.

By employing Salesforce Einstein, an artificial intelligence-based system that uses customer data to find patterns, make predictions about customers' future behaviours, and other useful functions, Laura Canada was able to make personalized recommendations to customers on its websites. Thus, customers can now see a personalized home page based on their previous purchasing and browsing history. Laura Canada also introduced an app that empowers in-store advisers to make similar personalized recommendations to customers.

The company also made use of Yottaa's (www.yottaa.com) Web optimization services to improve its website. Since Laura Canada's websites contain many high-resolution images as well as integration with third-party e-commerce technology, it decided to employ Yottaa's solution to improve the speed of the website content delivery to online visitors. Such improvements can enhance customer experiences and satisfaction as well as increased conversions, a term that refers to visitors completing a purchase on the website.

Laura Canada tends to have low-depth inventory, meaning that a store or distribution centre does not carry many different variations (e.g., different styles and sizes) of each product line. In addition, the company wanted an omnichannel operation

to boost customers' experience both online and off-line. Therefore, it decided to partner with Kibo Commerce (www.kibocommerce.com) and adopt Kibo's order management system. Doing so enabled Laura Canada to configure its shipping and fulfillment options so that it better supports customers both online and in-store by getting them the right item quickly. Specifically, the company started a ship-from-store operation. Store associates were trained on using the Kibo system to ship goods in a timely fashion. Store managers receive a report on a pending order if it is not fulfilled in 48 hours.

Results

By upgrading its IT components, Laura Canada not only managed to improve its situation after filing for creditor protection but also witnessed significant improvements in the business. For instance, after it upgraded its e-commerce platforms and technologies, the company saw a massive 400-percent increase in online sales in three years. By improving its supply chain through unlocking store inventory and shipping from its stores across the country, Laura Canada increased its revenue by 25 percent. And by improving its customer relationship management system, the company tripled the number of customer service cases handled daily. Last but certainly not least, sending messages via the new CRM system prompts 30 percent of the company's online sales.

Questions

1. Describe the IT solutions that Laura Canada employed to improve customer experience?
2. Can you think of other customer relationship management approaches that could benefit Laura Canada?
3. Can you think of other supply chain management approaches that could benefit Laura Canada?

Source: Compiled from "Laura Canada Embraces the Omnichannel With New Order Management System," *Supply Chain Brain*, August 4, 2021, www.supplychainbrain.com/articles/33510-laura-canada-embraces-the-omnichannel-with-new-order-management-system, Accessed April 27, 2023; "Personalizing Experiences With Customer 360," *OSF Digital*, May 24, 2021, www.osf.digital/library/media/osf/digital/modules/pdfs/laura-canada_case-study.pdf, Accessed April 27, 2023; "Kibo's Flexible Order Management Empowered Laura Canada," *Kibocommerce.com*, February 26, 2021, www.kibocommerce.com/success-stories/laura-canada, accessed April 27, 2023; "Laura Canada fashions a great customer experience with richer personalization," *Salesforce.com*, September 15, 2019, www.salesforce.com/ca/customer-success-stories/laura-canada, accessed April 25, 2023; M. Harman, "Laura Canada Revamps Stores, Expands Chains," *Retail Insider*, June 21, 2019; "Laura Canada Deploys Yottaa and Improves Website Performance by 35%," *Business Wire*, February 12, 2019, <https://www.businesswire.com/news/home/20190212005156/en/Laura-Canada-Deploys-Yottaa-and-Improves-Website-Performance-by-35>, accessed April 27, 2023; F. Kopun, "165-store retailer Laura files for creditor protection," *Toronto Star*, August 4, 2015; "Laura clothing chain files for creditor protection," *CBC News*, August 4, 2015, www.cbc.ca/news/business/laura-clothing-chain-files-for-creditor-protection-1.3179305, accessed April 23, 2023.

Business Analytics

CHAPTER OUTLINE

LEARNING OBJECTIVES

12.1 Managers and Decision Making

12.1 Use a decision-support framework to demonstrate how technology supports managerial decision making at each phase of the decision-making process.

12.2 The Business Analytics Process

12.2 Describe each phase of the business analytics process.

12.3 Descriptive Analytics

12.3 Provide a definition and a use case example for descriptive analytics.

12.4 Predictive Analytics

12.4 Provide a definition and a use case example for predictive analytics.

12.5 Prescriptive Analytics

12.5 Provide a definition and a use case example for prescriptive analytics.

12.6 Presentation Tools

12.6 Identify and discuss two examples of presentation tools.

Opening Case

MIS North York General Hospital Uses IBM Analytics Solutions

In 2017, North York General Hospital (NYGH; www.nygh.on.ca) in Toronto and IBM (www.ibm.com/ca-en) completed a joint initiative to improve patient care as well as the hospital's operational efficiency using IBM data analytics software solutions.

The storage of data in disparate formats has been a key problem for health care organizations—one that IBM enables NYGH to handle. Specifically, by using IBM solutions, NYGH can consolidate data from more than 50 collection points, dispersed across the hospital's three sites, into a standardized format in a central data warehouse. Then, advanced analytics is employed to produce simple, easy-to-read reports and charts on the hospital's clinical, administrative, and financial performance, displayed to decision makers on Web-based dashboards.

Before using IBM solutions, NYGH had assessed some of these aspects, but the measurements were at the corporate level as it was difficult to collect and analyze data at the unit level.

However, IBM enables NYGH to view all of the data for a single patient (e.g., how long they waited in the emergency room) as well as operational performance indicators for cost, quality, and safety in real time and at different levels of the hospital. As a result, decision makers are empowered to make changes in practices, services, and programs (e.g., in terms of staffing) to improve the services provided to patients and, overall, the hospital's health care system.

Over time, NYGH expanded its use of IBM analytics solutions. For instance, as a community hospital, NYGH receives the majority of its funding from the Ontario Ministry of Health and Long-Term Care, which requires hospitals to demonstrate that they provide health care services that meet or exceed provincial standards. One key piece of evidence is a measurement of Quality-Based Procedures (QBPs), which relate to the number and type of patients that the hospital treats. For several years, NYGH has used IBM analytics solutions to measure and report its QBPs, such as cost per patient, length of stay, and so on. IBM helped NYGH to create a dashboard to replace more than 100 individual reports on different QBPs. This dashboard not only provides insights into all

the QBPs but also enables users to examine details, including drilling down to the patient level.

NYGH also uses IBM analytics solutions for diagnostic and predictive purposes. For instance, through these systems, the hospital discovered that imaging was the main reason for the return visits to the emergency department, which significantly impacted the overall patient flow in that department. The hospital then ensured that imaging resources were available at various times during a patient's first visit and therefore managed to eliminate some of the return visits to the emergency department, which in turn improved overall patient wait times. In another example, the hospital regularly runs a predictive model to give the emergency department an estimation of the number of patients that it should be expecting in different time frames. Thus, the models help it plan its resources, create awareness and preparedness, and make sure that the emergency department feels supported.

By tackling the issues that the hospital was facing, such as bottlenecks, NYGH significantly improved its efficiency and key performance indicators. This improvement led the government to provide an additional \$3 million in funding per year.

When the COVID-19 pandemic arrived on NYGH's doorstep in 2020, the hospital again turned to IBM analytics. Thanks to the infrastructure that was already well developed, NYGH managed to launch its COVID-19 portal in less than two weeks. A major part of the portal was its real-time dashboard that tracked active COVID-19 cases, COVID-19 admissions in acute care, the number of patients being ventilated, and the number of tests done at the hospital's COVID-19 Assessment Centre. In addition, the hospital could measure the pandemic's impact on its services, such as the capacity of the critical care unit, the emergency department, the intensive care unit, and finally its various resources, including even the use of personal protective equipment.

The entire hospital staff was able to see its command centre dashboard. Specifically, about 5,000 staff members had access to the dashboard to track the up-to-date metrics and stay informed.

In addition, at the start of the pandemic, many surgeries and major medical procedures were cancelled or postponed to accommodate the influx of COVID-19 patients. Over time, the hospital used its analytical and modelling tools in a service recovery initiative to avoid surgery backlogs even as it planned for possible increases in COVID-19 capacity.

Overall, with the help of IBM analytics solutions, North York General Hospital has managed to create a smarter, more agile, and more connected health care system, which is capable of delivering better patient care, more efficiently and with fewer mistakes. These analytics systems empower clinicians, nurses, and other staff to make better decisions by consolidating, sharing, and

analyzing data, and presenting meaningful, timely information seamlessly and efficiently.

Questions

1. Describe NYGH's business problem and need(s). Keep in mind that there may be more than one.
2. Can you identify the various sources and types of data that NYGH utilizes in its analytics endeavours?
3. Describe the descriptive analytics applications that NYGH employs.
4. Describe the predictive analytics applications that NYGH employs (or could employ).
5. In the case, NYGH used IBM analytics solutions for various purposes related to handling COVID-19. Can you identify them? Where in the Business Analytics Process (see Figure 12.3) does each of these purposes fit?

Sources: Compiled from A. Palamarchuk, "Province Provides More Funding for North York General Hospital Projects," *Toronto.com*, March 25, 2023; Sectra, "Canadian North York General Hospital Chooses Enterprise Imaging Solution from Sectra to Improve Radiology Workflows," *Cision PR Newswire*, April 13, 2022, <https://www.prnewswire.com/news-releases/canadian-north-york-general-hospital-chooses-enterprise-imaging-solution-from-sectra-to-improve-radiology-workflows-301524602.html>, accessed May 2, 2023; V. B. Peddi, "Analytics Help Toronto-Area Hospital Manage COVID-19 Impacts," *IBM Blog*, March 30, 2021; M. Cloutier "Meeting COVID-19 Head-On with Data-Driven Insights: Toronto-Area Hospital Leans on Analytics to Improve Care," *IBM.com*, March 5, 2021; IBM, "North York General Hospital: Improving Patient Care with IBM Analytics," *IBM MediaCenter*, January 28, 2020, https://mediacenter.ibm.com/media/North+York+General+HospitalA+Improving+patient+care+with+IBM+Analytics/1_0dg0b46d, accessed May 3, 2023; IBM, "IBM Cognos Analytics Helps North York General Hospital Understand Community Needs," *IBM MediaCenter*, January 15, 2020, https://mediacenter.ibm.com/media/IBM+Cognos+Analytics+helps+North+York+General+Hospital+understand+community+needs/0_xi88hftg/145341492, accessed May 3, 2023; IBM, "North York General Hospital Improves Patient Care with IBM Cognos Analytics," *IBM MediaCenter*, December 11, 2019, https://mediacenter.ibm.com/media/North+York+General+Hospital+improves+patient+care+with+IBM+Cognos+Analytics/0_4zja7mmz, accessed May 2, 2023; B. T. Horowitz, "IBM, North York General Hospital Collaborate on Health Care Data Aggregation, Dashboarding," *eWeek*, January 25, 2011; IBM, "North York General Hospital Selects IBM Business Analytics to Improve Quality of Patient Care," *Longwoods*, January 20, 2011, <https://www.longwoods.com/newsdetail/1732>, accessed May 2, 2023.

Introduction

business analytics (BA) The process of developing actionable decisions or recommendations for actions based on insights generated from historical data.

The chapter's opening case illustrates the importance and far-reaching nature of business analytics applications. **Business analytics (BA)** is the process of developing actionable decisions or recommendations for actions based on insights generated from historical data. Business analytics examines data with a variety of tools; it formulates descriptive, predictive, and prescriptive analytics models; and it communicates these results to organizational decision

makers. This definition distinguishes between business analytics and statistics. Essentially, the business analytics process uses statistical procedures to accomplish its goals.

Business analytics can answer questions such as: What happened? How many? How often? Where is the problem? What actions are needed? Why is this happening? What will happen if these trends continue? What will happen next? What is the best (or worst) that can happen? And what actions should the organization take to achieve various successful business outcomes?

There is some confusion between the terms *business analytics* and *business intelligence*.

Business intelligence (BI) has been defined as a broad category of applications, technologies, and processes for gathering, storing, accessing, and analyzing data to help business users make better decisions. Many experts argue that the terms should be used interchangeably. We agree and, for simplicity, we use the term *business analytics (BA)* throughout this chapter.

This chapter describes information systems (ISs) that support *decision making*. Essentially *all* organizational information systems support decision making (refer to Figure 1.4). Fundamental organizational ISs such as transaction processing systems, functional area information systems, and enterprise resource planning systems provide a variety of reports that help decision makers. This chapter focuses on business analytics systems, which provide critical support to the vast majority of organizational decision makers.

The chapter begins by reviewing the manager's job and the nature of modern managerial decisions. This discussion will help you to understand why managers need computerized support. The chapter then introduces the business analytics process and addresses each step in that process in turn.

It is impossible to overstate the importance of business analytics within modern organizations. Recall from Chapter 1 that the essential goal of information systems is to provide the right information to the right person, in the right amount, at the right time, in the right format. In essence, BA achieves this goal. Business analytics systems provide actionable business results that decision makers can act on in a timely fashion.

It is also impossible to overstate the importance of your input into the BA process within an organization, for several reasons. First, you will use your organization's BA applications, probably from your first day on the job, *regardless of your major field of study*. You will decide how you want to analyze the data by using analytics models and statistical tools. We refer to this process as *user-driven analysis*. You will use BA presentation applications such as dashboards to present your findings succinctly and understandably. You will work closely with your MIS department to ensure that these applications meet your needs.

In general, there are three types of analytics users: business users, business analysts, and data scientists. *Business users* access analytics applications to perform their jobs. *Business analysts* typically manage, clean, abstract, and aggregate data and conduct a range of analytical and statistical procedures on those data. *Data scientists* build upon the core competencies of the business analyst with additional mathematical, modelling, algorithmic, programming, and machine-learning skills.

As we proceed from business users to business analysts to data scientists, the technical skill requirements increase. For example, business users would typically come from any major (often other than business analytics majors) who take introductory courses in analytics in business schools. Business analysts typically major in business analytics in business schools and data scientists typically major in mathematics, statistics, or computer science.

Note that much of this chapter is concerned with large-scale BA applications. You should keep in mind, however, that smaller organizations, and even individual users, can implement small-scale BA applications as well.

After you finish this chapter, you will have a basic understanding of decision making, the BA process, and the incredibly broad range of BA applications that are employed in modern organizations. This knowledge will enable you to immediately and confidently provide input into your organization's BA processes and applications. Furthermore, this chapter will help you use your organization's BA applications to effectively analyze data and thus make better decisions. We hope that this chapter will help you "ask the next question." Enjoy!

business intelligence (BI)

A broad category of applications, technologies, and processes for gathering, storing, accessing, and analyzing data to help business users make more informed decisions.

12.1

Managers and Decision Making

LEARNING OBJECTIVE

Use a decision-support framework to demonstrate how technology supports managerial decision making at each phase of the decision-making process.

management A process by which organizational goals are achieved through the use of resources.

productivity The ratio between the inputs to a process and the outputs from that process.

Management is a process by which an organization achieves its goals through the use of resources (people, money, materials, and information). These resources are considered to be *inputs*. Achieving the organization's goals is the *output* of the process. Managers oversee this process in an attempt to optimize it. A manager's success is often measured by the ratio between the inputs and outputs for which they are responsible. This ratio is an indication of the organization's **productivity**.

The Manager's Job and Decision Making

To appreciate how information systems support managers, you must first understand the manager's job. Managers do many things, depending on their position within the organization, the type and size of the organization, the organization's policies and culture, and the personalities of the managers themselves. Despite these variations, however, Henry Mintzberg, a well-respected professor of management at McGill University suggests that all managers perform three basic roles:¹

1. *Interpersonal roles*: figurehead, leader, liaison
2. *Informational roles*: monitor, disseminator, spokesperson, analyzer
3. *Decisional roles*: entrepreneur, disturbance handler, resource allocator, negotiator

Early information systems primarily supported the informational roles. In recent years, however, information systems have been developed that support all three roles. In this chapter, you will focus on the support that IT can provide for decisional roles.

A **decision** refers to a choice among two or more alternatives that individuals and groups make. Decisions are diverse and are made continuously. Decision making is a systematic process. Economist Herbert Simon² described decision making as composed of three major phases: intelligence, design, and choice. Once the choice is made, the decision is implemented. **Figure 12.1** illustrates this process, highlighting the tasks that make up each phase. Note that there is a continuous flow of information from intelligence to design to choice (bold lines). At any phase, however, there may be a return to a previous phase (broken lines).

This model of decision making is quite general. Undoubtedly, you have made decisions in which you did not construct a model of the situation, validate your model with test data, or conduct a sensitivity analysis. The model we present here is intended to encompass *all* of the conditions that might occur when making a decision. For some decisions, some steps or phases may be minimal, implicit (understood), or completely absent.

The decision-making process starts with the *intelligence phase*, in which managers examine a situation and then identify and define the problem or opportunity. In the *design phase*, decision makers construct a model for addressing the situation. They perform this task by making assumptions that simplify reality and by expressing the relationships among all of the relevant variables. Managers then validate the model by using test data. Finally, decision makers set criteria for evaluating all of the potential solutions that are proposed. The *choice phase* involves selecting a solution or course of action that seems best suited to resolve the problem. This solution (the decision) is then implemented. Implementation is successful if the proposed solution solves the problem or seizes the opportunity. If the solution fails, then the process returns to the previous phases. Computer-based decision support assists managers in the decision-making process.

decision A choice that individuals and groups make among two or more alternatives.

¹Mintzberg, H. (1973) *The Nature of Managerial Work*, Harper & Row, New York.

²Simon, H.A. (1977) *The New Science of Management Decision*, Prentice-Hall, Englewood Cliffs, New Jersey.

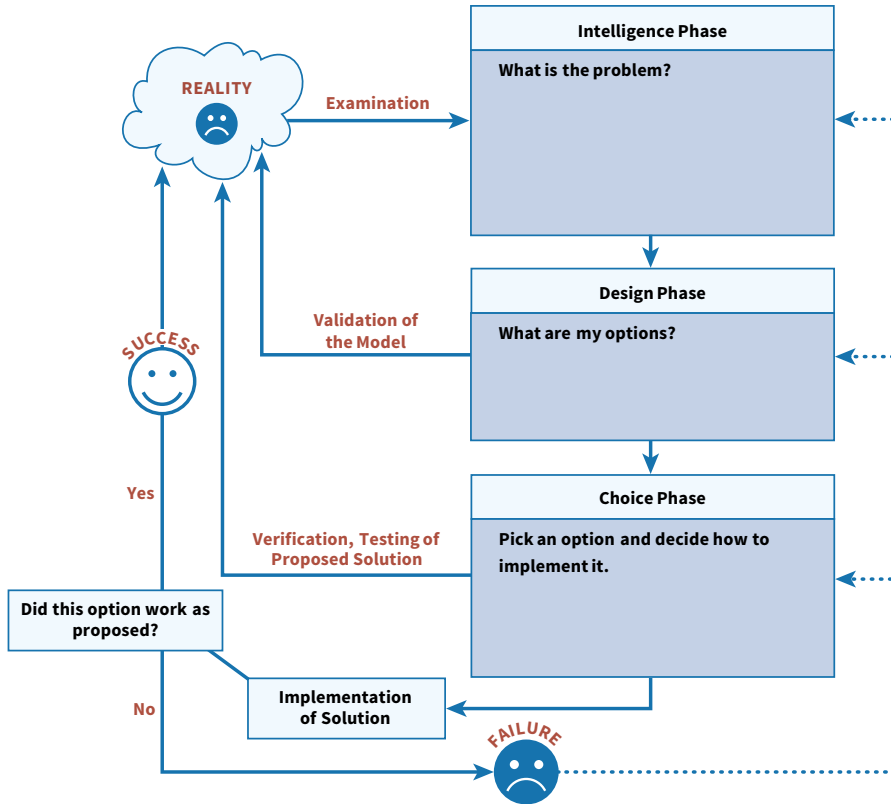


FIGURE 12.1 The process and phases in decision making.

Why Managers Need IT Support

Making good decisions is very difficult without solid information. Information is vital for each phase and activity in the decision-making process. Even when information is available, however, decision making is difficult because of the following trends:

- The *number of alternatives* is constantly *increasing* because of innovations in technology, improved communications, the development of global markets, and the use of the internet and e-business. A key to good decision making is to explore and compare many relevant alternatives. The greater the number of alternatives, the more a decision maker needs computer-assisted searches and comparisons.
- Most decisions must be made *under time pressure*. It is often not possible to manually process information fast enough to be effective.
- Because of increased uncertainty in the decision environment, decisions are becoming more complex. It is usually necessary to *conduct a sophisticated analysis* to make a good decision.
- It is often necessary to rapidly access remote information, consult with experts, or conduct a group decision-making session, all without incurring major expenses. Decision makers, and the information they need to access, can be situated in different locations. Bringing everything together quickly and inexpensively represents a serious challenge.

These trends create major difficulties for decision makers. Fortunately, as you will see throughout this chapter, computerized decision support can be of enormous help. Next you will learn about two aspects of decision making that place our discussion of BA in context: problem structure and the nature of the decisions.

	Operational Control	Management Control	Strategic Planning	IS Support
Structured	Accounts receivable, order entry 1	Budget analysis, short-term forecasting, personnel reports, make-or-buy analysis 2	3	MIS, statistical models (management science, financial, etc.)
Semi-structured	Production scheduling, inventory control 4	Credit evaluation, budget preparation, plant layout, project scheduling, reward systems design 5	Building a new plant, mergers and acquisitions, planning (product, quality assurance, compensation, etc.) 6	Decision support systems, business intelligence
Unstructured	7	Negotiating, recruiting an executive, buying hardware, lobbying 8	New technology development, product R&D, social responsibility planning 9	Decision support systems, expert systems, enterprise resource planning, neural networks, business intelligence, Big Data

FIGURE 12.2 Decision-support framework.

A Framework for Computerized Decision Analysis

To better understand business analytics, note that various types of decisions can be placed along two major dimensions, according to Gorry and Scott Morton (1971): problem structure and the nature of the decision.³ **Figure 12.2** provides an overview of decision making along these two dimensions.

Problem Structure The first dimension is *problem structure*, in which decision-making processes fall along a continuum ranging from highly structured to highly unstructured (see the left column in **Figure 12.2**). *Structured decisions* deal with routine and repetitive problems for which standard solutions exist, such as inventory control. In a structured decision, the first three phases of the decision process—intelligence, design, and choice—are laid out in a particular sequence, and the procedures for obtaining the best (or at least a good enough) solution are known. These types of decisions are candidates for decision automation.

At the other extreme of complexity are *unstructured decisions*. These decisions are intended to deal with “fuzzy,” complex problems for which there are no cut-and-dried solutions. An unstructured decision is one in which there is no standardized procedure for carrying out any of the three phases. In making such a decision, human intuition and judgement often play an important role. Typical unstructured decisions include planning new service offerings, hiring an executive, and choosing a set of research and development (R&D) projects for the coming year. Although BA cannot make unstructured decisions, it can provide information that assists decision makers.

Located between structured and unstructured decisions are *semi-structured* decisions, in which only some of the decision-process phases are structured. Semi-structured decisions require a combination of standard solution procedures and individual judgement. Examples of semi-structured decisions are evaluating employees, setting marketing budgets for consumer products, performing capital acquisition analysis, and trading bonds.

The Nature of Decisions The second dimension of decision support deals with the *nature of decisions*. All managerial decisions fall into one of three broad categories:

1. *Operational control*: Executing specific tasks efficiently and effectively
2. *Management control*: Acquiring and using resources efficiently in accomplishing organizational goals
3. *Strategic planning*: The long-range goals and policies for growth and resource allocation

These categories are displayed along the top row of **Figure 12.2**.

³Gorry, G.A., and Scott Morton, M. (1971) “A Framework for Management Information Systems,” *Sloan Management Review*, Fall, 21–36.

The Decision Matrix The three primary classes of problem structure and the three broad categories of the nature of decisions can be combined in a decision-support matrix that consists of nine cells, as diagrammed in Figure 12.2. Lower-level managers usually perform the tasks in cells 1, 2, and 4. The tasks in cells 3, 5, and 7 are usually the responsibility of middle managers and professional staff. Finally, the tasks in cells 6, 8, and 9 are generally carried out by senior executives.

Today, it is difficult to state that certain organizational information systems support certain cells in the decision matrix. The fact is that the increasing sophistication of ISs means that essentially any information system can be useful to any decision maker, regardless of their level or function in the organization. As you study this chapter, you will see that business analytics is applicable across all cells of the decision matrix.

Before you go...

1. Describe the decision-making process proposed by Simon.
2. You are registering for classes next semester. Apply the decision-making process to your decision about how many and which courses to take. Is your decision structured, semi-structured, or unstructured? Support your answer.
3. Consider your decision-making process when registering for classes next semester. Explain how information technology supports (or does not support) each phase of this process.

12.2

The Business Analytics Process

LEARNING OBJECTIVE

Describe each phase of the business analytics process.

As previously defined, *business analytics* is the process of developing actionable decisions or recommendations for actions based on insights generated from historical data. Business analytics encompasses not only applications, but also technologies and processes. It includes both “getting data in” (to a data mart or warehouse) and “getting data out” (through BA applications).

The use of BA in organizations varies considerably. In smaller organizations, BA may be limited to Excel spreadsheets. In larger ones, BA is enterprise-wide and includes a wide variety of applications. The importance of BA to organizations continues to grow, to the point where it is now a requirement for competing in the marketplace. That is, BA is a competitive necessity for organizations.

Although BA has become a common practice across organizations, not all organizations use BA in the same way. For example, some organizations employ only one or a few applications, whereas others use enterprise-wide BA. In general, there are three specific analytics targets that represent different levels of change. These targets differ in regard to their focus; scope; level of sponsorship, commitment, and required resources; technical architecture; impact on personnel and business processes; and benefits.

- *The development of one or a few related analytics applications.* This target is often a point solution for a departmental need, such as campaign management in marketing. Sponsorship, approval, funding, impacts, and benefits typically occur at the departmental level. For this target, organizations usually create a data mart to store the necessary data. Organizations must be careful that the data mart—an “independent” application—does not become a “data silo” that stores data that are inconsistent with, and cannot be integrated with, data used elsewhere in the organization.

- *The development of infrastructure to support enterprise-wide analytics.* This target supports both current and future analytics needs. A crucial component of analytics at this level is an enterprise data warehouse. Because it is an enterprise-wide initiative, senior management often provides sponsorship, approval, and funding. The impacts and benefits are also felt throughout the organization.

MKT MIS An example of this target is 3M Corporation (www.3m.com).

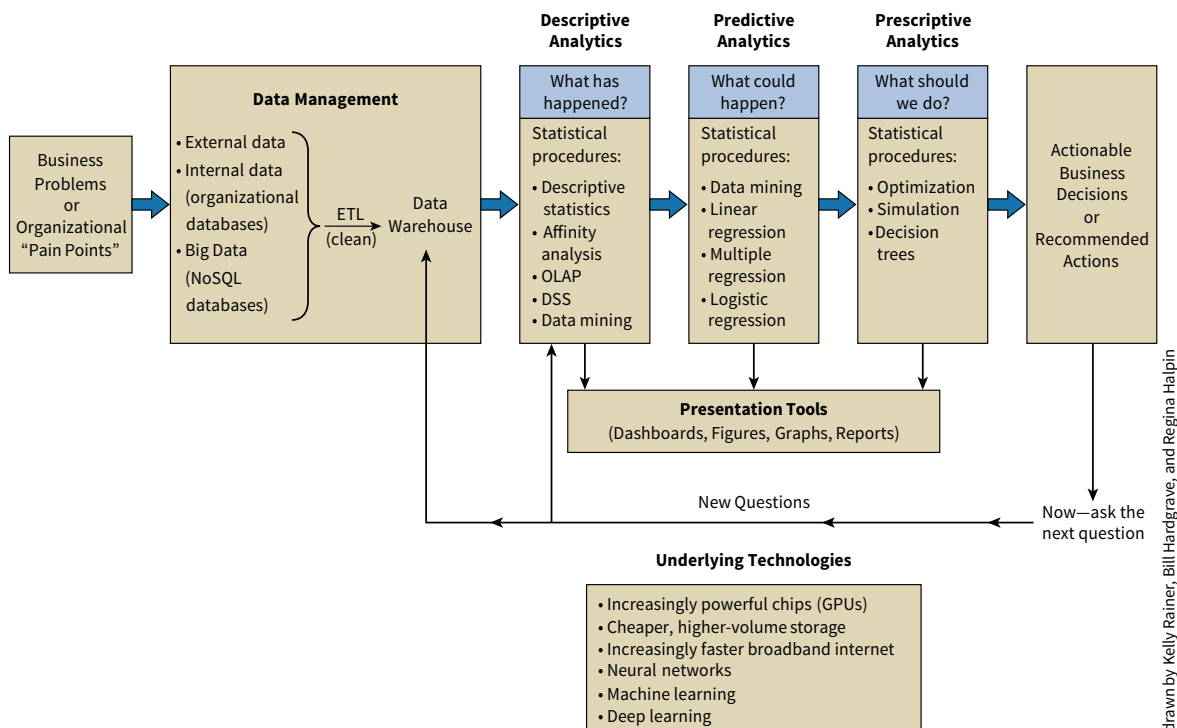
Historically, 3M's various divisions had operated independently, using separate decision-support platforms. Not only was this arrangement costly, it prevented 3M from integrating the data and presenting a "single face" to its customers. For example, sales representatives did not know whether or how business customers were interacting with other 3M divisions. The solution was to develop an enterprise data warehouse that enabled 3M to operate as an integrated company. As an added benefit, the costs of implementing this system were offset by savings resulting from the consolidation of the various platforms.

- *Support for organizational transformation.* With this target, a company uses business analytics to fundamentally transform the ways it competes in the marketplace. Business analytics supports a new business model and enables the business strategy. Because of the scope and importance of these changes, critical elements such as sponsorship, approval, and funding originate at the highest organizational levels. The impact on personnel and processes can be significant, and the benefits accrue across the organization.

MKT Harrah's Entertainment (a brand of Caesars Entertainment; www.caesars.com)

provides a good example of this analytics target. Harrah's developed a customer loyalty program known as Total Rewards. To implement the program, Harrah's created a data warehouse that integrated data from casino, hotel, and special event systems—for example, wine-tasting weekends—across all of the various customer touch points, such as slot machines, table games, and the internet. Harrah's used these data to reward loyal customers and to reach out to them in personal and appealing ways, such as through promotional offers. These efforts helped the company to become a leader in the gaming industry.

Regardless of the scope of BA, all organizations employ a BA process, which **Figure 12.3** depicts. Let's look at each step of Figure 12.3 in turn, from left to right.



drawn by Kelly Rainer, Bill Hardgrave, and Regina Halpin

FIGURE 12.3 The business analytics process.

The Business Analytics Process

The entire BA process begins with a business problem, often called *pain points* by practising managers. When organizations face business problems, they often turn to business analytics, through the process illustrated in Figure 12.3, to help solve those problems. Before we begin our discussion of the BA process, let's emphasize the importance of the technologies that underlie the entire process (see Figure 12.3). These technologies are all improving very rapidly.

MIS Microprocessors (or chips) are becoming increasingly powerful (see Technology Guide 1). In particular, graphics processing units (GPUs) are essential to neural networks, another underlying technology of the BA process. (We discuss neural networks in Chapter 14.)

Advances in digital storage capacity and access speed are driving the cost of storage down, meaning that organizations are able to store and analyze huge amounts of data. Transmission speed (bandwidth; see Chapter 6) in computer networks, particularly the internet, is also rapidly increasing. As a result, decision makers are able to collaborate on difficult, time-sensitive decisions regardless of their locations. Other underlying technologies include machine learning and deep learning, which we discuss in Chapter 14.

Now let's examine the BA process in detail. To illustrate each step in the BA process, we look at Fandango as an example. The BA process begins with defining the business problem.

Define the Business Problem The first, and arguably most important, issue that you will face in the BA process is to define the business problem that you want to address or the business opportunity you want to seize. Defining the business problem or opportunity is not always easy, but these questions can give you some guidance:

- What is the organization trying to accomplish?
- What are the organization's goals?
- What business process is the organization trying to improve? Recall that a *business process* is an ongoing collection of related activities that create a product or service of value to the organization, its business partners, and its customers (see Chapter 2).
- How would improving this business process contribute to making the organization more successful?
- Other, more specific, questions include:
 - Why have profits decreased?
 - Which customers are moving to our competitors and why?
 - Why has demand for a particular product decreased and why?

Recall that we are using Fandango to illustrate each step in the BA process. Here we discuss the company's business problem. Fandango (www.fandango.com) is the leading online (web-site and mobile) ticket seller for movie theatres in the United States. It sells millions of tickets to approximately 20,000 movie theatres across the United States. Customers can print their tickets at home with bar codes scanned at the theatre or they can have their tickets printed out upon arrival at the theatre. Fandango charges a premium over the ticket price to use its services but it does enable people to procure tickets to popular movies without having to stand in long lines.

Because Fandango receives a premium for each movie ticket sold, the company's business problem is how to best target the movies that its customers are most likely to want to see, advertise those movies on its website, and offer promotions to those movies. In that way, customers will buy more tickets, increasing Fandango's revenue.

MIS Data Management After defining the business problem, we consider the data that we have for analysis. As we have noted, organizations are now able to analyze rapidly increasing amounts of data. As you learned in Chapter 5, these data can come from data streams. These streams include but are not limited to:

- *Point-of-sale (POS) data.* Organizations capture data from each customer purchase with their POS systems.
- *Clickstream data.* Clickstream data are those data that visitors and customers produce when they visit a website and click on hyperlinks (described in Chapter 6).

- **Social media data.** Social media data (also called social data) are the data collected from individuals' activity on social media websites. These data include shares, likes and dislikes, ratings, reviews, recommendations, comments, and many other examples.
- **Sensor data.** The Internet of Things (IoT; see Chapter 8) is a system in which any object, natural or manmade, contains internal or external wireless sensor(s) that communicate with each other without human interaction. Each sensor monitors and reports data on physical and environmental conditions around it, such as temperature, sound, pressure, vibration, and movement.

As noted in Chapter 5, these four data streams, together with data in organizational databases, comprise Big Data. We defined Big Data as diverse, high-volume, high-velocity information assets that require new forms of processing in order to enhance decision making, lead to insights, and optimize business processes. Essentially, Big Data is the heart of the analytics process.

At this point, organizations integrate and “clean” these data into data marts and data warehouses (see Chapter 5) through a process called *extract, transform, and load (ETL)*. The data in the data warehouse are now available to be analyzed by business users, business analysts, and data scientists.

MIS Fandango Recall that we are using Fandango to illustrate each step in the BA process. Here we discuss the company's data management. Fandango captures data about customers, movie theatres, ticket sales, and show times. For each customer, it collects data on the movies they see, how often they go to movie theatres, their favourite movie genre, the day of the week they go to theatres, and many other variables. It collects Big Data from its website (clickstream data), social media sites (social data), promotions, and other sources.

Descriptive Analytics, Predictive Analytics, and Prescriptive Analytics Organizations perform three types of analytics applications: descriptive analytics, predictive analytics, and prescriptive analytics. We discuss these analytics applications in Sections 12.3, 12.4, and 12.5 respectively.

At the end of Section 12.4, we present an example (with summarized data) that illustrates how a decision maker proceeds through the BA process. In our example, we address only descriptive analytics and predictive analytics. We do not include prescriptive analytics in this example because this type of analytics is not yet widespread in industry.

Presentation Tools All three types of analytics produce results, which must be communicated to decision makers in the organization. In general, data scientists perform these analyses. Many organizations have employees who “translate” the results of these analyses into business terms for the decision makers. These employees often use presentation tools in the form of dashboards to communicate the message visually. We discuss dashboards and other presentation tools in Section 12.6.

Ask the Next Question What is critically important about the analytics process is that, once the results are obtained and presented, decision makers must be ready to “ask the next question.” Everyone involved in the BA process must use their creativity and intuition at this point. In addition, the results of the BA process will almost always lead to new, unanswered questions.

Business Analytics Tools

A variety of BA tools are available to analyze data. They include Excel, multidimensional analysis (also called online analytical processing, or OLAP), data mining, and decision-support systems. BA also employs numerous statistical procedures, which include descriptive statistics; affinity analysis; linear, multiple, and logistic regression; as well as many others.

Other than Excel, we discuss BA tools and statistical procedures in the context of the analytics application for which they are most appropriate. We discuss Excel here because it is the

most popular and commonly used BA tool. Furthermore, Excel incorporates the functionality of many of the other BA tools and statistical procedures. For example, analysts can use Excel to provide descriptive statistics and to perform regression analyses.

BA vendors typically design their software so that it interfaces with Excel. How does this process work? Essentially, users download plug-ins that add functionality—for example, the ability to list the top 10 percent of customers, based on purchases—to Excel. Excel then connects to the vendor’s application server, which provides additional data analysis capabilities, which in turn connects to a back-end database, a data mart, or a data warehouse. This arrangement gives Excel users the functionality and access to data that are typical of sophisticated BA products while allowing them to work with a familiar tool.

In the next three sections, we address descriptive analytics, predictive analytics, and prescriptive analytics, respectively. Each section begins by defining the type of analytics, continues with a discussion of the BA tools and statistical procedures that are appropriate to that type of analytics, and closes with examples of that type of analytics.

Before you go on...

1. Describe the three business analytics targets.
2. Describe the business analytics process.

12.3 Descriptive Analytics

LEARNING OBJECTIVE

Provide a definition and a use case example for descriptive analytics.

Organizations must analyze huge amounts of raw data to make sense of them. This overall process is known as *data reduction*. Data reduction is the conversion of raw data into a smaller amount of more useful information. Descriptive, predictive, and prescriptive analytics are essentially steps in data reduction.

Descriptive analytics is the first step in data reduction. **Descriptive analytics** summarizes what has happened in the past and enables decision makers to learn from past behaviours. Organizations employ descriptive analytics to generate information such as total stock in inventory, average dollars spent per customer, and year-over-year change in sales. Common examples of descriptive analytics are reports that provide historical insights regarding an organization’s production, financials, operations, sales, finance, inventory, and customers.

descriptive analytics A type of business analytics that summarizes what has happened in the past and allows decision makers to learn from past behaviours.

BA Tools in Descriptive Analytics

BA tools in descriptive analytics applications include online analytical processing, data mining, decision-support systems, and a variety of statistical procedures. Examples of such statistical procedures are descriptive statistics, affinity analysis, and many others (see Figure 12.3). We take a closer look at these tools here.

Online Analytical Processing Some BA applications include **online analytical processing (OLAP)**, also referred to as **multidimensional analysis** capabilities. OLAP involves “slicing and dicing” the data that are stored in a dimensional format, “drilling down” in the data to greater detail, and “rolling up” the data to greater summarization (less detail).

Consider our example from Chapter 5. Recall Figure 5.6, which illustrates the data cube. The product is on the x-axis, geography is on the y-axis, and time is on the z-axis. Now, suppose

online analytical processing (OLAP) (or multidimensional data analysis) A set of capabilities for “slicing and dicing” data using dimensions and measures associated with the data.

multidimensional data analysis See **online analytical processing (OLAP)**.

you want to know how many nuts the company sold in the West region in 2019. You would slice and dice the cube, using *nuts* as the specific measure for product, *West* as the measure for geography, and *2019* as the measure for time. The value or values that remain in the cell(s) after our slicing and dicing is(are) the answer to our question. As an example of drilling down, you might also want to know how many nuts were sold in January 2019. Alternatively, you might want to know how many nuts were sold from 2019 through 2021, which is an example of aggregation, also called “roll-up.”

data mining The process of searching for valuable business information in a large database, data warehouse, or data mart.

Data Mining **Data mining** refers to the process of searching for valuable business information in a large database, data warehouse, or data mart. Data mining can perform two basic operations: (1) identifying previously unknown patterns and (2) predicting trends and behaviours. The first operation is a descriptive analytics application, and the second is a predictive analytics application.

In descriptive analytics, data mining can identify previously hidden patterns in an organization's data. For example, a descriptive analytics application can analyze retail sales data to discover seemingly unrelated products that people often purchase together. A classic example is beer and diapers (even though it is an urban legend). Data mining found that young men tend to buy beer and diapers at the same time when shopping at convenience stores. This type of analysis is called affinity analysis or market basket analysis.

POM **MKT** **Affinity analysis** is a data mining application that discovers co-occurrence relationships among activities performed by specific individuals or groups. In retail, affinity analysis is used to perform *market basket analysis*, in which retailers seek to understand customers' purchase behaviour. Retailers use this information for the purposes of cross-selling, upselling, sales promotions, loyalty programs, store design (physical location of products), and discount offers. An example of cross-selling with market basket analysis is Amazon's use of “customers who bought book A might also like to buy book B.”

In another example, market basket analysis could inform a retailer that customers often purchase shampoo and conditioner together. Therefore, putting both items on promotion at the same time would not create an increase in revenue, whereas a promotion involving just one of the items would likely drive sales of the other.

decision-support systems (DSSs) Business intelligence systems that combine models and data in an attempt to solve semi-structured and some unstructured problems with extensive user involvement.

Decision-Support Systems **Decision-support systems (DSSs)** combine models and data to analyze semi-structured problems and some unstructured problems that involve extensive user involvement. *Models* are simplified representations, or abstractions, of reality. Decision-support systems enable business managers and analysts to access data interactively, to manipulate these data, and to conduct appropriate analyses.

DSSs can enhance learning, and they can contribute to all levels of decision making. They also employ mathematical models. Finally, they have the related capabilities of sensitivity analysis, what-if analysis, and goal-seeking analysis, which you will learn about next. Keep in mind that these three types of analysis are useful for any type of decision-support application. Excel, for example, supports all three.

Sensitivity Analysis Sensitivity analysis examines how sensitive an output is to any change in one input while keeping other inputs constant. Sensitivity analysis is valuable because it enables the system to adapt to changing conditions and to the varying requirements of different decision-making situations. For instance, how much will the monthly mortgage payment change if the mortgage rate is increased by 0.2, 0.3, 0.4, or 0.5 percent?

What-If Analysis A model builder must make predictions and assumptions regarding the input data, many of which are based on the assessment of uncertain futures. The results depend on the accuracy of these assumptions, which can be highly subjective. *What-if analysis* attempts to predict the impact of changes in the assumptions—that is, the input data—on the proposed solution. For example, what will happen to the total inventory cost if the originally assumed cost of carrying inventories is 12 percent rather than 10 percent and the demand is 10 percent less than predicted? In a well-designed BI system, managers themselves can interactively ask the computer these types of questions as often as they need to.

Goal-Seeking Analysis *Goal-seeking analysis* represents a “backward” solution approach. Goal seeking attempts to calculate the value of the inputs necessary to achieve a desired level

of output. For example, let's say that an initial BI analysis predicted a profit of \$2 million. Management might want to know what sales volume would be necessary to generate a profit of \$3 million. To find out, they would perform a goal-seeking analysis.

Examples of Descriptive Analytics Applications

We present several examples of descriptive analytics in this section. Keep in mind that descriptive analytics applications often immediately suggest predictive analytics applications. Let's look at Fandango and OptumRx.

MKT Fandango Recall that we are using Fandango to illustrate each step in the BA process. Here we discuss examples of Fandango's descriptive analytics applications. Fandango analyzes the historical movie preferences of its customers and historical data from movie titles. Using these data, Fandango analysts investigate the total sales for different genres of movies; for example, comedy, drama, action, and others. Using a sample of moviegoers, the company calculates the average ticket sales for a week for each movie and each genre, the most popular movie, the distribution of customers among the movie genres and specific titles, the busiest hours of the day and most popular day of the week for each movie theatre, and many other analyses. These descriptive analyses help Fandango set ticket prices; offer discounts for certain movies, certain show times, and certain days of the week; set budgets for promotions and advertising; and many other possible actions.

FIN HRM OptumRx Pharmacy care service company OptumRx (www.optumrx.com) was analyzing a client company's prescription drug claims, when it noticed that the client's spending on acne medicine seemed high compared with other clients' spending on the medication. Analyzing the data, OptumRx found that employees had been prescribed newer brand-name acne drugs that were largely combinations of older generic medicines. It informed the client, a 60,000-employee company, which then began to require patients to begin treatment with the cheaper medicines and to use the more expensive medicines only if the others did not work. Within six months, the company had saved more than US \$70,000.

POM HRM In another case, OptumRx noted that, at one of its client companies, drugs for attention deficit hyperactivity disorder (ADHD) were being overprescribed to adults. Some of the employees were using the drug to improve their performance at work. The firm's benefit manager formulated stricter rules concerning reimbursement for ADHD prescriptions and saved the 19,000-worker company US \$110,000.

HRM OptumRx also uses descriptive analytics to improve patient health. For instance, the company can analyze how frequently asthma sufferers are refilling their prescriptions to discover whether they are taking too many puffs on their inhalers. This could indicate that these employees require a different drug. Switching patients to more effective medicines is worthwhile even if these drugs are more expensive, because they can help reduce costly hospitalizations and visits to emergency rooms.

The emergence of technology for capturing, storing, and using real-time data (e.g., the Internet of Things, see Chapter 8) has enabled BA users to employ analytics to analyze data in real time. Real-time BA also helps organizations to make decisions and interact with customers in new, innovative ways. Real-time BA is closely related to descriptive analytics, where the focus of decisions is real time rather than some point in the future. Google Analytics is an excellent example of real-time BA of clickstream data.

Google Analytics is one of the most popular Web analytics services. The service is free, and it is an application under the Google Marketing Platform. *Web analytics* is the collection and analysis of clickstream data to measure Web traffic, assess and improve a website's performance, and conduct market research. Google Analytics offers many benefits to organizations including:

- Automatic data collection: A company sets up its Google Analytics account and places computer code on its website. This code enables Google Analytics to immediately begin collecting data.
- Users can choose from many reports that Google has created or build their own customized reports using the drag-and-drop interface.

- Users can link their Google Ads account seamlessly with Google Analytics. *Google Ads* is an online advertising platform that is triggered every time a user does a keyword search. Through auctions, advertisers bid to show users their advertisements and videos and present their products and services.
- Users can track internal website searches to reveal what goods and services potential customers are looking for after they arrive on a website. Users can also track the number of unique visitors to a website, the pages they view, the number of views per page, the length of time viewers spend on each page, and many other variables. With these insights, users can make necessary changes or additions to their website navigation and their product and service offerings.
- Users can determine how visitors reached their websites. That is, which keywords did visitors use to find their website?
- *Bounce rate* describes the percentage of visitors who leave a website after visiting only one page. Google Analytics provides detailed reports on any pages on users' websites that experience a high bounce rate. These data enable users to identify the reasons for this problem and fix them.
- The Audience section of Google Analytics provides data about visitors to websites, including their age, gender, interests, devices, language used, and location (country and city).
- Users can see how much traffic to their websites is driven by social media platforms. Google Analytics also indicates the conversion rate of website visitors from each social platform. *Conversion rate* is the percentage of visitors who take a desired action, such as making a purchase. This information enables users to allocate their advertising budget efficiently across various social media platforms.
- Users can perform A/B testing without having to write any code. A/B testing is a user experience research method that compares two versions of, for instance, a website. The method compares user responses to each version to determine which version is more effective. For example, on version A of its website, a company places the buy button at the top right of a page. On version B, the company places the buy button at the bottom right of that page. Other than the placement of the buy button, the pages are identical. The company analyzes the data from Web visitors to determine which version leads to the most purchases.

Let's look at how several companies use Google Analytics.

- General Electric (www.ge.com) tracks the country of origin for visitors to its website. This information provides GE with insights into market demand as well as strategies to improve its website to manage multiple languages and cultures.
- The Weather Network (www.theweathernetwork.ca) conducts marketing analytics to obtain a complete picture of how effective its online and off-line marketing campaign is. In addition, the company uses Google Analytics to identify returning users to its site.
- Nissan (www.nissan-global.com) uses Google Analytics to gain a better understanding of its target audience's product preferences.
- Barnes and Noble (www.barnesandnoble.com) learns how different author layouts, chapter snippets, and reviews impact the ways that visitors navigate content on the site. The bookseller also receives valuable data on the most viewed titles and the characteristics of visitors who purchased certain titles.
- The Four Seasons (www.fourseasons.com) gains insights into the travel patterns and habits of its guests and potential guests. Integrating these data into its strategy helps the hotelier to market to customers and to decide which other sites to partner with for advertising.

Before you go on...

1. Describe the purpose of descriptive analytics.
2. Discuss the BA tools that are commonly used in descriptive analytics.

12.4

Predictive Analytics

LEARNING OBJECTIVE

Provide a definition and a use case example for predictive analytics.

Predictive analytics examines recent and historical data to detect patterns and predict future outcomes and trends. Predictive analytics provides estimates about the likelihood of a future outcome.

The purpose of predictive analytics is *not* to tell decision makers what will happen in the future. Predictive analytics can only forecast what *might* happen in the future, based on probabilities. Predictive analytics applications forecast customer behaviour and purchasing patterns, identify trends in sales activities, and forecast demand for inputs from suppliers.

predictive analytics A type of business analytics that examines recent and historical data to detect patterns and predict future outcomes and trends.

BA Tools in Predictive Analytics

Organizations use a variety of BA tools and statistical procedures in performing predictive analytics. The tools include data mining, and the statistical procedures include linear regression, multiple regression, and logistic regression. Recall that data mining can perform two basic operations: (1) identifying previously unknown patterns and (2) predicting trends and behaviours. The first operation is a descriptive analytics application, and the second is a predictive analytics application. There are many other tools and statistical procedures that are used in predictive analytics.

Examples of Predictive Analytics Applications

In this section, we present numerous examples of predictive analytics. Keep in mind that descriptive analytics applications often immediately suggest predictive analytics applications. Let's continue with the example of Fandango.

MKT Fandango Recall that we are using Fandango to illustrate each step in the BA process. Here we discuss examples of Fandango's predictive analytics applications. How does the ticket seller know when to send emails to its members with discount offers for a specific movie on a specific day? Consider John Jones. Predictive analytics tools analyze terabytes of data to determine that, although John likes science fiction movies, he has not seen the latest science fiction film, which has been in theatres since the previous Friday. Consequently, Fandango could send him a discount offer for this movie.

MKT Marketing Examples

- Using predictive analytics, organizations can employ targeted marketing, where firms classify customer demographics to predict which customers will respond to a mailing or buy a particular product. Furthermore, firms can use data from past promotional mailings to identify which prospects are most likely to respond favourably to future mailings.
- Predictive analytics drives the coupons you receive at the grocery cash register. United Kingdom grocery giant Tesco (www.tesco.com) predicts which discounts customers will redeem so it can better target more than 100 million personalized coupons annually at cash registers in 13 countries. This process increased coupon redemption rates by 360 percent over previous methods.
- Websites predict which ads you will click so they can instantly choose which ad to show you, a process that drives millions of dollars in new revenue.
- Wireless carriers predict how likely you are to cancel and defect to a competitor—a process called *churn*—possibly before you have even decided to do so. These predictions are

based on factors such as dropped calls, your phone usage, your billing information, and whether your contacts have already defected.

- Leading online dating companies Match (www.match.com), OkCupid (www.okcupid.com), and eHarmony (www.eharmony.ca) predict which prospect on your screen will be the most compatible with you.

POM Production and Operations Management Examples

- Predictive analytics can enable organizations to determine correct inventory levels and distribution schedules among outlets.
- The difference between *preventive maintenance* and *predictive maintenance* is that preventive maintenance is scheduled at regular intervals, while predictive maintenance occurs as needed based on conditions of the asset. Because predictive maintenance is done only when needed, it reduces labour and material costs.

In 2015, ThyssenKrupp (www.thyssenkrupp.com) launched a predictive maintenance service based on data from sensors that measure a variety of operating conditions on the firm's 120,000 elevators around the world. Based on predictive analytics of the sensor data, if a condition falls outside normal limits, the company dispatches an engineer. The goal is to get an engineer to the site before the elevator breaks down. Often when the engineer arrives, the system has already done much of the diagnostic work.

- Carmaker BMW (www.bmw.com) is using predictive analytics to address vulnerabilities early in its production cycle. The manufacturer analyzes data from its global warranty, diagnostics, and repair units to optimize the design and production of new vehicles. By analyzing multiple data sources, BMW can find patterns that will help it to pinpoint potential design flaws.

FIN Finance Examples

- Banks use predictive analytics to forecast levels of bad loans, predict credit card spending by new customers, determine which kinds of customers will best respond to (and qualify for) new loan offers, and forecast bankruptcy and other forms of default.

Banks also use predictive analytics to detect fraudulent credit card transactions. Over time, a pattern emerges of the typical ways that customers use their credit cards, the amounts they spend, and so on. If a thief steals a card and uses it fraudulently, then that usage typically varies noticeably from the cardholder's established pattern and the charges are denied.

- Financial services firms employ predictive analytics to produce credit scores. They use these scores to determine the probability that customers will make future credit payments on time.
- Companies use Business Integrity Screening from SAP (www.sap.com/canada/products/financial-management/fraud-management.html) to combat fraud. This system scans large volumes of data in real time looking for errors and traces of fraud and helps companies identify anomalous activity quickly by using predefined rules and predictive analytics. For instance, retailers can integrate this system with their point-of-sale system to identify high-risk and anomalous transactions and therefore identify mishandled transactions or internal theft.
- Simpa Networks (www.simpaenergy.in) sells solar-as-a-service to poor households and small businesses in India. Simpa partnered with DataKind (www.datakind.org), whose data scientists analyzed Simpa's historical customer data to help Simpa assess the credit-worthiness of potential customers.

HRM Human Resource Management Examples

- Credit Suisse (www.credit-suisse.com) uses predictive analytics to determine which employees might leave the company and why. Analysts provide this information anonymously to managers so that they can address the issues raised for all employees. In this way, no employee is singled out. This has analysis reduced turnover risk factors and increased

employee retention. The company saves approximately US\$75 to US\$100 million per year due to reduced employee turnover.

- Engaged employees are enthusiastic about their work and take positive action to further the organization's goals. British shoe retailer Clarks (www.clarkscanada.com) used predictive analytics to examine the relationship between employee engagement and the company's financial performance. The results indicated that every 1-percent improvement in engagement led to a 0.4-percent increase in business performance.
- United Kingdom-based KPMG (www.home.kpmg.com) developed a proprietary system, Workplace Analytics, to implement retention solutions as soon as an employee is identified as considering leaving a firm. The system analyzes hundreds of behaviours such as email use, phone use, travel habits, commute times, and paid time off, while considering unemployment and opportunity in the surrounding geographic area, to calculate individuals' retention scores. If that score changes, an employer can take appropriate actions to counter the likelihood that the individual will quit. For example, the employer can promote workplace flexibility, adjust workloads to prevent burnout, or offer perks.

Insurance Examples

- Allstate Insurance (www.allstate.ca) tripled the accuracy of its predictions of bodily injury liability from car crashes based on the characteristics of the insured vehicles. That is, the insurer adjusted the rates based on the vehicle. This process resulted in approximately US\$40 million in annual savings.
- Insurers use predictive analytics to forecast claim amounts and medical coverage costs, classify the most important elements that affect medical coverage, and predict which customers will buy new insurance policies.

Government Examples

- Statistics Canada, an agency of the Government of Canada, uses predictive analytics to project the potential short- and long-term impacts of health and social policies including those related to transmission of COVID-19 in the Canadian population in order to support public health decisions.
- The Government of Canada engages in various uses of predictive analytics through its different agencies. For instance:
- Health Canada uses Big Data analytics to enhance its surveillance of diseases as well as air quality
- Canada Revenue Agency uses predictive analytics to predict non-compliance in a short period of time.
- Justice Canada uses predictive models for a variety of purposes, such as predicting successful case strategies and likely outcomes of judicial decisions based on the deciding judge's previous decisions.

Health Care Examples

- Health care organizations correlate patient demographics with critical illnesses and develop more accurate insights on how to identify and treat symptoms and their causes. For example, Microsoft and Stanford University analyzed the search data of millions of users to successfully identify previously unreported side effects of certain medications.
- Stanford University data scientists used predictive analytics to diagnose breast cancer better than human physicians by discovering an innovative method that takes into account additional contributing factors in tissue samples.

Other Examples

- Sentiment analysis is another type of predictive analysis. *Sentiment analysis* is the process of analyzing opinions expressed in a piece of text (e.g., a Tweet) or in a speech to determine whether the writer's or speaker's attitude toward a particular topic, product, or

service is positive, negative, or neutral. The output of sentiment analysis is a sentiment score, which can be positive or negative. This score can also be any number between -1 and $+1$, indicating the degree of positivity or negativity.

Unintended Consequences of Predictive Analytics

Predictive analytics clearly provides organizations with numerous advantages. In fact, one could say that predictive analytics is critically important for an organization's success. However, predictive analytics applications can also produce questionable, or even harmful, results for organizations. For example, we will look at the unintended consequences of predictive analytics for Target and Uber.

MKT *Target.* Target identified 25 products that, when purchased together, indicate that a woman is likely pregnant. The value of these data was that Target could send coupons to the pregnant woman at a habit-forming period of her life. Unfortunately, Target's algorithms led to a public-relations problem.

A man walked into a Target outside Minneapolis, Minnesota, and demanded to see the manager. He had coupons that had been sent to his daughter, and he was quite angry. He told the manager that his daughter was a teenager, and he wanted to know if Target was trying to encourage her to become pregnant.

The manager did not know what the man was talking about. He noted that the mailer was addressed to the man's daughter and it contained advertisements for maternity clothing, nursery furniture, and pictures of smiling infants. The manager apologized and then called the man a few days later to apologize again. However, now the father was embarrassed. He told the manager that his daughter was indeed pregnant and that he owed the manager an apology.

POM *Uber.* In December 2016, Uber's algorithm automatically raised rates (surge pricing) in Sydney, Australia, as people tried to flee from a downtown restaurant where an armed man was holding 17 people hostage. Three people, including the gunman, died. Uber later apologized for raising fares, which reportedly quadrupled, and then offered refunds.

Problems are most likely to arise when algorithms make things happen automatically, without human intervention or oversight. Uber is now working on a global policy to prevent price increases in times of disaster or emergency.

Example of Descriptive Analytics and Predictive Analytics

Let's consider the following example to demonstrate how descriptive and predictive analytics are used to bridge the gap between data management and actionable business decisions.

POM Weather data can be used to make predictions relating to certain business problems. Suppose you are the manager of the Canadian Automobile Association (CAA) South Central Ontario (CAASCO; www.caasco.com), and your district covers multiple offices in several cities including Windsor, Kingston, and Owen Sound. You need to create a work schedule for your employees, who receive and dispatch service calls. Your goal is to provide optimal coverage in your offices, reduce unnecessary salary expenses, and provide excellent customer service by reducing customers' wait time. Therefore, you decide to predict the number of service calls your offices receive per day during normal business hours based on the daily low temperature measured in degrees.

Data Management: To investigate this business problem, you collect data on service calls for the past year from the CAASCO locations within your territory. You first "clean" the data by adjusting for outliers and missing values, resulting in a final sample of 3,219 service calls.

You are now ready to build a regression model using temperature as the independent variable to predict the number of customer service calls received in any given day; this is the dependent variable. You will use the results to predict how many employees should be available to receive and dispatch customer service calls.

Descriptive Analytics: For this example, the correlation between daily low temperature and the number of service calls was found to be -0.84 , with an average of 48 service calls per day. The correlation is negative because as the temperature decreases, the data indicate that the number of service calls increases.

The square of this correlation, $R^2 = .71$, is the predictive power of the model. That is, the model, using low daily temperature, explains approximately 71 percent of the variation in the number of calls received each day. Therefore, 1 minus R^2 means that 29 percent of the variance in the dependent variable is due to extraneous or unexplained variables.

Predictive Analytics: The manager has decided to use linear regression for his predictive analysis. To do so, certain reasonable assumptions must be met:

- He must have at least 30 data points.
- The relationship between the independent and dependent variables must be linear. The linearity assumption can best be tested with scatter plots.
- Even though the data are assumed to be normally distributed, he should check this assumption.

The sample size of 3,219 calls satisfies the first assumption. The manager then used Excel to test the second assumption, producing a scatterplot to determine if the plot of each ordered pair of data (independent variable, dependent variable) produced a linear pattern. The scatterplot for the data did exhibit a linear pattern. Therefore, linear regression is an acceptable statistical procedure for these data.

To check for normality, the manager calculated the correlation between the data and the normal scores of the data. If the value is near 1, then the sample data set is likely to be normal. This data set met the normality assumption.

Now that the three linear regression assumptions have been met, the next step is to define the linear regression model between these two variables using Excel or a similar statistical package. The linear regression model is:

$$\text{Number of calls received} = 124.79 - 1.5 \times (\text{daily low temperature})$$

These results indicate that for one degree of increase in the daily low temperature, the predicted daily number of calls received will decrease by 1.5. That is, CAASCO will expect to receive fewer calls on warmer days and more calls on colder days. At a temperature of 0° ($x = 0$), the expected number of calls will be approximately 125.

Actionable Business Decision: Based on the linear regression, the district manager is able to use the projected daily low temperature for up to 14 days in advance to predict how many service calls the offices will receive each day. (The Weather Network provides reasonably accurate daily temperatures on a 14-day outlook.) Therefore, he can predict how many employees will be needed to manage the expected number of service calls in order to ensure low wait times for the customers.

Now, ask the next question: At this point, the manager can return to the data management stage with new input variables. For the CAASCO data in this example, it is feasible to consider another business problem with the appropriate inputs or to expand the analysis by considering other variables relevant to the business question in the example. For example, the manager might want to include the actual time of day, by hour, so that he can more accurately decide on staffing levels. He might also want to examine the location of his CAASCO branches as a variable. Adding these variables would require the use of new regression models.

You also want to recall that our example is for the South Central Ontario, where temperatures are warmer than in some other regions of the country. Therefore, if we were to predict data in the northern regions, then we would have to build a different model based on the data from the North.

Our example proceeds from data management, to descriptive analytics, to predictive analytics (through a simple linear regression model). We address how the results of predictive analytics often lead to additional questions that include additional variables, which would require a multiple linear regression model.

From a statistical perspective, we might ask: Aren't there many different analytical approaches to solving the same problem? The answer is yes. But a more important question to ask is: Which one approach is the best? The answer to this question is—none! The best approach depends on the kind of data you are working with. And because data come in all shapes and sizes, there cannot be one best approach for all problems. Therefore, selecting the best model for the particular data is always an important exercise in data analytics.

Before you go on...

1. Describe the purpose of predictive analytics.
2. Discuss the BA tools that are commonly used in predictive analytics.

12.5**Prescriptive Analytics****LEARNING OBJECTIVE**

Provide a definition and a use case example for prescriptive analytics.

prescriptive analytics A type of business analytics that recommends one or more courses of action and shows the likely outcome of each decision.

Prescriptive analytics goes beyond descriptive and predictive models by recommending one or more courses of action and by identifying the likely outcome of each decision. Predictive analytics does not predict one possible future; rather, it suggests multiple future outcomes based on the decision maker's actions. Prescriptive analytics attempts to quantify the effect of future decisions in order to advise on possible outcomes before the decisions are actually made.

Some companies are successfully using prescriptive analytics to optimize production, scheduling, and inventory along the supply chain to ensure they deliver the right products at the right time so they can optimize the customer's experience.

Prescriptive analytics requires predictive analytics with two additional components: actionable data and a feedback system that tracks the outcome produced by the action taken. Because prescriptive analytics is able to predict the possible consequences based on different choices of action, it can also recommend the best course of action to achieve any specified outcome.

BA Tools in Prescriptive Analytics

Organizations use a variety of BA tools and statistical procedures to perform prescriptive analytics. Statistical procedures include optimization, simulation, and others. A discussion of these procedures is beyond the scope of this text.

Examples of Prescriptive Analytics Applications

We present numerous examples of prescriptive analytics in this section. Let's begin by returning once again to our example of Fandango.

POM Fandango Recall that we are using Fandango to illustrate each step in the BA process. Here we discuss examples of Fandango's prescriptive analytics applications. Fandango uses prescriptive analytics so it can change ticket price offerings every hour. The company has identified the most desirable movie times by analyzing millions of show times instantaneously. It then uses these data to set an optimal price for any given time, based on the supply of show times and the demand for movie tickets. This process maximizes profits. The data from each show indicate how much each ticket's price contributes to profits.

MIS Waymo (Google) Driverless Car During every trip, the car makes multiple decisions about what to do based on predictions of future outcomes. For example, when approaching an intersection, the car must determine whether to go left, right, or straight ahead. Based on its destination, it makes a decision. Additionally, the car must anticipate what might be coming with regard to vehicles, pedestrians, bicyclists, and so on. The car must also analyze the impact of a possible decision before it actually makes that decision.

POM The Oil and Gas Industry Companies in this industry analyze a variety of structured and unstructured data, including video, image, and sound data, to optimize hydraulic fracturing (fracking) operations. One prescriptive analytics application optimizes the materials and equipment necessary to pump oil out of the ground. It further optimizes scheduling, production, inventory, and supply chain design to ensure that the right products are delivered in the right amount to the right customers at the right time in the most efficient manner.

UPS provides an outstanding example of how an enterprise can employ all three analytics applications. IT's About Business 12.1 describes how UPS has progressed from descriptive analytics, to predictive analytics, and finally to prescriptive analytics.

IT's About Business 12.1

POM United Parcel Service Uses Three Types of Analytics

The Problem

United Parcel Service (UPS; www.ups.com) is a global organization with 424,000 employees and nearly 100,000 vehicles. UPS drivers deliver roughly 21 million packages per day and far more in December, typically making between 120 and 175 “drops” per day. Between any two drops, drivers can take a number of possible paths. With 55,000 routes in the United States alone, the total number of possible routes is inconceivably vast. Clearly, it is in the best interests of UPS and its drivers to find the most efficient routes. Therefore, any tiny amount of efficiency that can be gained in daily operations yields significant improvements to the company's bottom line. Essentially, “little” things matter a great deal to UPS.

In addition, the rapid increase in electronic commerce, or e-commerce, has shifted an increasing number of UPS's delivery stops from retailers to private residences. (We discussed e-commerce in Chapter 7.) In fact, half of UPS's total deliveries in 2021 were to residences. Historically, drivers would drop off multiple packages at a retailer. Today, they must make scattered stops to drop off packages at individual homes. This scenario involves more routes and is more time-consuming.

In addition, UPS must manage a low-margin business as well as a unionized workforce that is compensated at the high end of the industry scale. Significantly, rival FedEx (www.fedex.com) uses independent contractors for its ground network. Consequently, FedEx does not have the burden of expensive employee benefits packages. UPS also faces intense competition from Amazon with its low-cost package delivery service, called the Delivery Service Partner program.

To address these challenges, UPS is deploying analytics applications. Since 2016, UPS has been collecting and analyzing roughly 1 billion data points per day as the company tracks the real-time status of each package as it moves across the UPS shipping network. Analytics is critical to UPS because its customers have very complex supply chains and are demanding to be informed more precisely as to when their packages will be delivered.

To improve its analytics processes, UPS has implemented the Enhanced Dynamic Global Execution (EDGE) programs, which include DIADs (see below), package placement on UPS vans, routing outbound packages, handling undeliverable packages, and the Package Flow Technologies system. UPS has also developed its Harmonized Enterprise Analytics Tool (HEAT). The two programs are saving the company hundreds of millions of dollars per year.

The Solution

For decades, UPS has been using three types of analytics to produce efficiencies.

- Descriptive analytics asks, “Where are we today?”
- Predictive analytics asks, “With our current trajectory, where *will* we be tomorrow?”
- Prescriptive analytics asks, “Where *should* we be tomorrow?”

As UPS has moved from descriptive to predictive to prescriptive analytics, its data needs have expanded, the skill sets of its employees have improved, and the business impact of analytics has increased. We consider these developments next.

Descriptive Analytics

DIADs. UPS implemented descriptive analytics in the 1990s when the company provided its drivers with hand-held computers, called Delivery Information Acquisition Devices (DIADs). The DIADs enabled UPS to capture detailed data that measured its current status. For example, the company measured driving variables in hundredths of a second. The reasoning was that reducing one mile per driver per day in the United States alone would add up to \$50 million to the bottom line annually.

Package placement on delivery vans. In 2017, UPS began equipping its delivery trucks with Bluetooth receivers to reduce the number of incorrectly loaded packages. The receivers emit a loud beep if a worker puts a package into a vehicle that is not going to the package's destination. When workers enter the correct truck, a different beep confirms that they are in the right place. The system works by transmitting wireless signals between the Bluetooth receivers and the scanning devices that workers wear on their hips and hands to read the labels on UPS packages.

When UPS workers scan packages in the morning, the data update the service that the company has deployed to send customers progress emails about their shipments. Customers who have signed up for the free service then receive a message that their package will arrive that day, along with an estimated delivery time.

Routing outbound packages. Another project informs seasonal workers where to direct the outbound packages that UPS vehicles pick up throughout the day and bring to the company's sorting facilities. UPS hires nearly 100,000 short-term workers from November through January. In the winter of 2018, UPS outfitted roughly 2,500 of these workers with scanning devices and \$8 Bluetooth headphones that issue one-word directions, such as “Green,” “Red,” or “Blue.” These colours correspond to specific conveyor belts, which then transport the packages to other parts of the building for further processing.

Undeliverable packages. UPS does make mistakes with some deliveries. In the past, managers relied on historical data and radio conversations with drivers to estimate how many undeliverable packages they would need to handle each night. To streamline this process, the company has initiated a project that informs managers how many returned packages will arrive at the processing centre, and when. Managers can then assemble the appropriate number of workers to reroute the packages.

Predictive Analytics

One EDGE project was the UPS Package Flow Technologies system, which was designed to provide predictive analytics. With this system, drivers started the day with a DIAD that listed the packages they were to deliver and the order in which they were to deliver those packages. Essentially, the DIAD became the driver's assistant. The system enabled UPS to reduce total delivery driving globally by 85 million miles per year. That process saved the firm 8.5 million gallons of fuel, and it prevented 85,000 metric tons of carbon dioxide from entering the atmosphere.

However, drivers had to provide different services from the same vehicle—for example, deferred service and premium service. Some packages had to be delivered by 10:30 a.m., others by noon, and still others by 2:00 p.m. Drivers had to decide how they were going to service those customers. With so many variables to consider, it was practically impossible for drivers to optimize their routes.

To better manage the enormous amounts of data it captures, UPS created its Harmonized Enterprise Analytics Tool (HEAT). HEAT has the capacity to analyze billions of data points per day, which include customer data, operational data, and planning data. In addition, it can add new events as they occur in the delivery of a package.

HEAT leverages predictive analytics, machine learning, and multi-model forecasting with seasonality growth factors (e.g., the Christmas season) to support forecasting, operations visibility, optimization, and reporting. In short, HEAT creates a digital twin of the entire UPS shipping network. HEAT's ability to help UPS adjust to severe, unexpected events was tested in February 2021, when a massive winter storm impacted much of North America, leaving almost 10 million people without power. HEAT enabled UPS managers to dynamically redistribute its transportation network assets—for example, trucks and regional shipping facilities—to move packages around the hardest-hit areas. The system also enabled UPS to recover quickly after the storm and return operations to normal.

Prescriptive Analytics

Despite these innovations, UPS realized that it needed to take analytics to the next level. So, in mid-2012 the company began deploying its On-Road Integrated Optimization and Navigation (ORION) system. ORION reorganizes drivers' routes based on today's customers, today's needs, and today's packages, and it designs deliveries in a very specific, optimized order. It takes into account UPS business rules, maps, the times when drivers need to be at specific locations, and customer preferences. ORION can alter delivery routes dynamically based on changing weather conditions and accidents. The system can also examine the deliveries that still need to be completed and continue to optimize the remaining route.

At first, ORION used publicly available maps. However, these maps were not detailed enough. Therefore, UPS drew its own maps, which displayed features, such as a customer's half-mile driveway or a back alley, that save time getting to a receiving dock. ORION needed these data points in order to optimize package delivery.

Unfortunately, analytics algorithms cannot anticipate every variable. For example, a business customer typically receives one package per day. If ORION knows that the package is not tied to a certain delivery time, then the algorithm might suggest dropping it off in the morning one day but in the afternoon the next day, depending on that day's tasks. That process might be the most efficient approach for UPS, but customers would not know when to expect deliveries. This can be a problem because customers typically do not like that much uncertainty.

When UPS drivers are on the road, they usually travel at speeds of 20 to 25 miles (32 to 40 km) per hour. Therefore, every mile shaved off the route equates to a savings of two to three minutes. By shortening routes by seven to eight miles per day, ORION enables UPS to deliver more packages.

ORION enhances UPS customer service with more efficient routing and enables the company to offer innovative services and customized solutions. An example of this type of service is UPS My Choice, which is a free system that allows residential customers to decide "how, where, and when home deliveries occur." The company's chatbot, called UPS Bot, is integrated with the UPS My Choice system, so customers are able to obtain information about their incoming packages and deliveries without providing a tracking number.

UPS Bot mimics human conversations and can respond to customer queries such as "Where is the nearest UPS location?" In addition, it can track packages and provide shipping rates. Customers can ask the bot questions through text or voice commands, mobile devices, social media channels, and virtual assistants such as Alexa and Google Assistant. UPS Bot is able to recognize these requests and take the appropriate steps to respond to them.

Another UPS project, Network Planning Tool (NPT), optimizes the flow of packages in the network from loading docks to sorting to the final destination. NPT enables UPS engineers to view activity at UPS facilities around the world and route shipments to the ones with the most capacity. NPT creates forecasts about package volume and weight based on an analysis of historical data.

NPT enables UPS to organize packages by destination and move them at the lowest possible cost while still meeting delivery dates. It helps engineers group all outbound packages into the smallest number of trailers or cargo planes. NPT can also schedule truck and plane trips so that drivers and pilots always pick up parcels on their return trips and therefore do not return home with empty vehicles.

NPT provides a single cloud-based platform where UPS engineers can view data and run simulations to help create their plans and schedules. NPT's algorithms understand the distribution of all of the packages in the UPS logistics system, and they can determine the best way to bypass a problematic facility while meeting deadlines and not overwhelming other UPS facilities.

The Results

In April 2016, UPS won the prestigious Edelman Prize for excellence in analytics and operations research for its ORION project. It completed the deployment of ORION at the end of 2016.

The results from ORION have been outstanding. UPS is realizing savings of between US \$300 and US \$400 million per year in driver productivity and fuel economy. Furthermore, with ORION, UPS drivers have saved 100 million miles (about 160 million kilometres) in driving, decreasing carbon emissions by 100,000 metric tons per year. ORION will generate further environmental benefits and cost reductions when UPS equips its vehicles outside the United States with this technology.

UPS continues to look into the future. As a major example, ORION provides a natural transition to driverless vehicles. The company need only integrate ORION with the software for autonomous delivery vehicles, and those vehicles will take optimal routes to get UPS personnel where they need to go to deliver packages.

Finally, UPS is using drone deliveries for some applications, including dropping essential supplies in Rwanda and demonstrating how medicines could be delivered to islands. In rural areas, where drones have the space to execute deliveries and the distance between stops makes efficient deliveries challenging, drones launched from the roofs of UPS trucks provide a solution to reduce costs and improve service. On October 1, 2019, UPS received the U.S. Federal Aviation Administration's first full approval for the company's drone airline, called UPS Flight Forward.

Questions

1. Explain how DIADs were a descriptive analytics solution for UPS.
2. Explain how the Package Flow Technologies system was a predictive analytics solution for UPS.
3. Explain how the ORION system was a prescriptive analytics solution for UPS.
4. Describe another potential application for the UPS ORION system. That is, what is the next question that UPS managers might ask of ORION?
5. Is UPS's Network Planning Tool a descriptive analytics application, a predictive analytics application, a prescriptive analytics application, or some combination? Support your answer with examples.

Sources: Compiled from T. Olavsrud, "UPS Delivers Resilience, Flexibility with Predictive Analytics," *CIO*, August 6, 2021; "UPS Flight Forward Attains FAA's First Full Approval for Drone Airline," *UPS Press Release*, October 1, 2019; P. High, "UPS's Chief Information and Engineering Officer Champions Prescriptive Analytics," *Forbes*, July 15, 2019; E. Woyke, "How UPS Uses AI to Deliver Holiday Gifts in the Worst Storms," *MIT Technology Review*, November 21, 2018; N. Shields, "UPS Is Turning to Predictive Analytics," *Business Insider*, July 20, 2018; S. Schwartz, "UPS Working to Consolidate Data Points on Single Platform with Analytics, Machine Learning," *CIO Dive*, July 19, 2018; B. Marr, "The Brilliant Ways UPS Uses Artificial Intelligence, Machine Learning and Big Data," *Forbes*, June 15, 2018; S. Rosenbush, "UPS Expands Role of Predictive Analytics," *Wall Street Journal*, April 26, 2018; E. Woyke, "How UPS Delivers Faster Using \$8 Headphones and Code that Decides When Dirty Trucks Get Cleaned," *MIT Technology Review*, February 16, 2018; "How UPS Delivers Predictive Analytics," *CIO*, September 28, 2016; T. Davenport, "Prescriptive Analytics Project Delivering Big Dividends at UPS," *Data Informd*, April 19, 2016; C. Powers, "How UPS Augments Its Drivers' Intuition with Predictive Analytics," *ASUG News*, June 9, 2015; E. Siegel, "Predictive Analytics Driving Results, ROI at UPS," *Data Informd*, June 1, 2015; E. Siegel, "Wise Practitioner—Predictive Analytics Interview Series: Jack Levis of UPS," *Predictive Analytics World*, April 28, 2015; J. Berman, "UPS Is Focused on the Future for Its ORION Technology," *Logistics Management*, March 3, 2015; S. Rosenbush and L. Stevens, "At UPS, the Algorithm Is the Driver," *Wall Street Journal*, February 16, 2015; J. Dix, "How UPS Uses Analytics to Drive Down Costs," *Network World*, December 1, 2014; K. Noyes, "The Shortest Distance Between Two Points? At UPS, It's Complicated," *Fortune*, July 25, 2014; www.ups.com, accessed August 14, 2022.

Augmented analytics is a rapidly emerging type of analytics that integrates artificial intelligence (AI) and machine learning (ML) (see Chapter 14) into the traditional analytics process (see Figure 12.3). IT's About Business 12.2 discusses augmented analytics and provides examples of how organizations are using this type of analytics today.

augmented analytics A type of analytics platform that integrates artificial intelligence (AI) and machine learning (ML) into the traditional analytics process to automate the selection and preparation of data, the generation of insights, and the communication of those insights.

IT's About Business 12.2

MIS Augmented Analytics

Global organizations are collecting exponentially larger volumes of structured and unstructured data, a total that will reach 175 zettabytes by 2025. (One *zettabyte* is approximately equal to 1 billion terabytes.) To utilize all of these data in their decision making, businesses will have to employ augmented analytics.

Definition and capabilities of augmented analytics. Augmented analytics integrates artificial intelligence (AI) and machine learning (ML) (see Chapter 14) into traditional analytics (see Figure 12.3). Doing so augments how people explore and analyze data and automates the processes of selecting and preparing data and then generating and communicating insights based on those data.

Augmented analytics brings analytical capabilities, including recommendations, insights, or guidance on a query, to more people. That is, organizations can *democratize the use of data*. Thus, business users can make decisions based on data without requiring the services of data scientists or IT professionals.

Augmented analytics solutions come with prebuilt models and algorithms, so companies do not need a data scientist to do this work. Leading augmented analytics platforms feature intuitive interfaces that employ natural language processing. Therefore, non-technical users can easily ask questions from data sets using standard business terminology. The system will then utilize *natural language generation* to find and query the correct data set and provide easy-to-understand results and recommendations using data visualization tools such as dashboards.

Let's examine these capabilities more closely.

- **Recommend, prepare, and enrich data:** With traditional analytics, users have to decide which data sets to query. In contrast, an augmented analytics solution will (a) recommend which data sets to include in user analyses, (b) alert users when those data sets are updated, and (c) suggest new data sets if users are not receiving the results they expect.

- Create dashboards and reports: Augmented analytics helps interpret and communicate results in an easily understandable format, thereby enabling users to quickly make business decisions.
- Provide natural language interfaces: Augmented analytics allows users to query data sets using natural language. The system can also provide these results using everyday business language.
- Forecast trends and cluster data: The augmented system uses historical data to make accurate predictions and forecasts.
- Use proactive, personalized analytics with mobile applications: The augmented system provides a personalized assistant that understands individual users. For example, it can determine which information a customer should be shown at an off-site sales meeting based on that customer's location.

Differences between traditional analytics and augmented analytics. You are familiar with the traditional analytics process. Let's differentiate between this process and augmented analytics.

The traditional analytics process typically relies on dashboards. These dashboards are based on business questions that are defined in advance. Answering these questions requires a user to access a database or data warehouse. Answering a new question takes time (days or weeks) and the technical skills of data scientists or analytics specialists.

In contrast, the augmented analytics process is continuous. With augmented analytics, the AI and ML are built into the product. Model building and analyses work constantly in the background so they can keep learning and become better at helping users make good decisions. Keep in mind that data continuously flow into organizations (see Data Streams in Chapter 5). AI and ML process these data in near-real time to provide increasingly accurate predictions, insights, and recommendations.

Traditional analytics uses a publisher/consumer model in which a few data scientists or analytics specialists create reports and dashboards for potentially thousands of users. As noted above, augmented analytics provides results for all users and enables them to access and analyze data sets on their own.

Now that we understand how augmented analytics differs from traditional analytics, let's consider several examples of augmented analytics in action.

POM *Firefighting.* For some time, firefighters have relied on traditional analytics to predict the possible behaviour of fires, using data ranging from weather patterns to satellite footage of potential fire fuels and historical fire behaviour.

Today, firefighters are using augmented analytics to contain and extinguish forest fires. For instance, in the summer of 2021, a team was trying to control a wildfire that had jumped over a firebreak; that is, an area of cleared land that prevents a fire from spreading. As the captain was driving to the fire, he received an email containing a statistical analysis from a researcher. The analysis predicted that the location of the firebreak had only a 10 percent chance of containing the blaze. The researcher had used the Suppression Difficulty Index (SDI), an augmented analytics tool that integrates machine learning, Big Data, and forecasting. The captain was frustrated with the analysis because his team had spent time and effort building that firebreak. He promptly had his team create a new firebreak where the tool indicated it would be the most successful in slowing the fire.

Another popular augmented analytics tool is the potential operational delineations (PODs) package. PODs integrate the data sources used in traditional analytics with firefighter knowledge,

advanced spatial analytics, and other statistical models, including the SDI, to help teams predict the most likely places for a fire to break out. It can also help them plan an attack on a fire before it even breaks out. PODs superimpose these integrated data sources over a map of a region to deliver visual insights.

An even more advanced augmented analytics tool, the potential control locations (PCLs) algorithm, uses machine learning to suggest where firefighters should place their control lines—for example, firebreaks—during a blaze. In addition to all the data sources we have mentioned, the PCLs algorithm integrates data such as distances from roads, the locations of ridges and valleys, what kind of combustible materials there are on the ground, and historical fire perimeters.

Firefighters are also presenting the results of their analyses to communities prior to the fire season. They want to educate the residents and have them map local priorities. That is, the residents note which locations must be defended at all costs and which areas can be exposed to the fire to help thin out the landscape and thus ensure that future fires are less intense.

POM *PepsiCo.* The food and beverage company PepsiCo includes the Frito-Lay, Gatorade, Pepsi-Cola, Quaker, Tropicana, and SodaStream brands. Prior to the COVID-19 pandemic, PepsiCo had developed its augmented analytics Sales Intelligence Platform, which integrates retailer data with PepsiCo's supply chain data. The platform predicts out-of-stock items and alerts retailers to replenish those items.

When the pandemic stuck, the platform encountered unusual supply chain signals as consumers purchased larger-than-normal amounts of staples during global lockdowns. For instance, customers wanted as much oatmeal as possible, along with paper towels and toilet paper. As a result, thousands of retailers experienced out-of-stocks. PepsiCo used its Sales Intelligence Platform to predict many of these out-of-stocks. The company's salespeople then alerted retailers so they could replenish the items.

POM *Agriculture.* The Climate Corporation is a digital agriculture company that helps farmers to determine which crops to plant and where and when to plant them. The company has a seed adviser service that collects a range of historical data such as crop yields and soil types. It then combines those data with other data sources—including weather data—and runs them through thousands of augmented analytics models. In turn, these models provide recommendations regarding which seeds to plant and when, how deep to plant the seeds, and how far apart to space the rows. The company asserted that farmers who used this information were able to increase their yields by more than 9 bushels per acre.

MKT *Retail.* With augmented analytics, retailers can analyze customer data automatically and identify new trends. If you can anticipate which products customers are likely to buy, then you can make better decisions about product assortment, pricing, and promotions.

POM *Manufacturing.* Managers use augmented analytics to automatically analyze sensor and machine data to identify issues and optimize production. Consider factories where managers know the exact state of every assembly line, the output of each human worker, and even the power usage of individual machines. These managers are able to predict bottlenecks before they occur and take measures to prevent them.

FIN *Financial services.* Augmented analytics platforms analyze huge amounts of financial data to help banks prevent fraud by recognizing patterns. Consider, for example, your credit card transactions. Over time, your credit card company's

augmented analytics platform captures data on each transaction and creates a profile of how and where you typically spend money. As you put more transactions on your card, the analytics platform refines its profile of you. Consequently, when a transaction does not fit your profile, you will automatically receive a query, “Did you make this purchase?” In some cases, the platform will cancel your card and notify you that your credit card company is sending you a new one.

Questions

1. Describe why it is necessary to integrate artificial intelligence and machine learning into traditional analytics packages.
2. Identify and discuss the differences between traditional analytics and augmented analytics.

Sources: Compiled from D. Drai, “Five Ways Augmented Analytics Is Protecting Business Revenue,” *Information Age*, August 18, 2022; Q.

Larson, “What Is Augmented Analytics? A Definition and Example Use Cases,” <https://www.freecodecamp.org/news/what-is-augmented-analytics-definition-example/>, April 4, 2022; R. Kaur, “Augmented Analytics 101: A Starter’s Guide,” *SelectHub*, April 2, 2022; Tableau, “Augmented Analytics Explained: Definition, Use Cases, Benefits, Features, and More,” <https://www.tableau.com/learn/articles/augmented-analytics>, 2022; T. Olavsrud, “PepsiCo Tackles Supply Chain with Data,” *CIO*, November 30, 2017; B. Petrova, “Augmented Analytics Guide: Definition, Examples, & Use Cases,” <https://www.revealbi.io/blog/augmented-analytics-definition-examples-use-cases>, November 17, 2021; “Augmented Analytics,” *Technopedia*, July 19, 2021; “Introducing Augmented Analytics & How It Benefits Businesses,” *Monkey Learn*, February 16, 2021; L. Massey, “Fighting Fires with Advanced Analytics and Innovative Tech,” <https://ianalytics.com/community/blog/fighting-fires-with-advanced-analytics-and-innovative-tech>, September 22, 2020; E. Chickowski, “5 Augmented Analytics Examples in the Enterprise,” *TechTarget*, August 20, 2019; “Augmented Analytics Guide: The What, Why, and How,” *AnswerRocket*, February 8, 2019; P. Ghosh, “Augmented Analytics Use Cases,” *Dataversity*, June 20, 2018.

Before you go on...

1. Describe the purpose of prescriptive analytics.
2. Discuss the BA tools that are commonly used in prescriptive analytics.

12.6 Presentation Tools

LEARNING OBJECTIVE

Identify and discuss two examples of presentation tools.

As you saw in Figure 12.3, organizations use presentation tools to display the results of analyses to users in visual formats such as charts, graphs, figures, and tables. This process, known as *data visualization*, makes the results more attractive and easier to understand. Organizations can present the results after they have performed descriptive analytics, predictive analytics, and prescriptive analytics. A variety of visualization methods and software packages that support decision making are available. Dashboards are the most common BA presentation tool. We discuss them next. We also consider geographic information systems, another valuable data visualization tool.

Dashboards

Dashboards evolved from executive information systems, which were designed specifically for the information needs of top executives. Today, however, many employees, business partners, and customers use digital dashboards.

A **dashboard** provides easy access to timely information and direct access to management reports. It is user-friendly, it is supported by graphics, and, most important, it enables managers to examine exception reports and drill down into detailed data. **Table 12.1** summarizes the various capabilities that are common to many dashboards. Some of the capabilities discussed in this section have been incorporated into many BA products, as illustrated in **Figure 12.4**.

dashboard A business analytics presentation tool that provides rapid access to timely information and direct access to management reports.

TABLE 12.1 The Capabilities of Dashboards

Capability	Description
Drill down	The ability to go to details, at several levels; it can be done by a series of menus or by clicking on a drillable portion of the screen.
Critical success factors (CSFs)	The factors most critical for the success of business. These can be organizational, industry-focused, departmental, or for individual workers.
Key performance indicators (KPIs)	The specific measures of CSFs.
Status access	The latest data available on a KPI or some other metric, often in real time.
Trend analysis	Short-, medium-, and long-term trends of KPIs or metrics, which are projected using forecasting methods.
Exception reporting	Reports highlight deviations larger than defined thresholds. Reports may include only deviations.

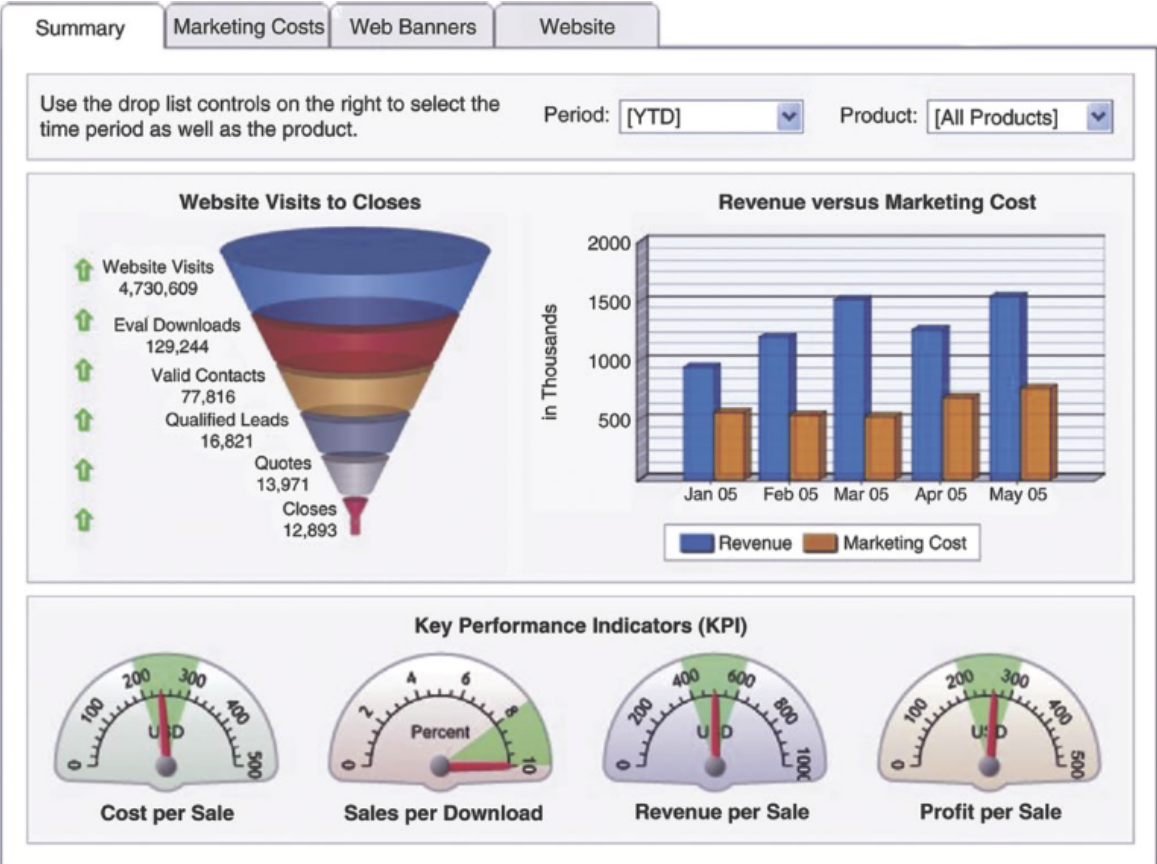


FIGURE 12.4 Sample performance dashboard.

One outstanding example of a dashboard is Bloomberg LP (www.bloomberg.com), a privately held company that provides a subscription service that sells financial data, software to analyze these data, trading tools, and news (electronic, print, TV, and radio). All of this information is accessible through a colour-coded Bloomberg keyboard that displays the desired information on a computer screen—either the user's screen or one that Bloomberg provides. Users can also set up their own computers to access the service without a Bloomberg



Carlos Osorio/Toronto Star/Zuma Press

FIGURE 12.5 Bloomberg Terminal.

keyboard. The subscription service plus the keyboard is called the Bloomberg Terminal. It is literally a do-it-yourself dashboard because users can customize their information feeds as well as the look and feel of those feeds (see [Figure 12.5](#)).

A unique and interesting application of dashboards to support executives' informational needs is the Management Cockpit. Essentially, a Management Cockpit is a strategic management room containing an elaborate set of dashboards that enable top-level decision makers to pilot their businesses better. The goal is to create an environment that encourages more efficient management meetings and boosts team performance through effective communication. To help achieve this goal, the dashboard graphically displays KPIs and information relating to critical success factors on the walls of a meeting room called the *Management Cockpit Room* (see [Figure 12.6](#)). The cockpit-like arrangement of instrument panels and displays helps managers visualize how all of the different factors in the business interrelate.



The Management Cockpit is a registered trademark of SAP, created by Professor Patrick M. Georges.

FIGURE 12.6 Management Cockpit.

Within the room, the four walls are designated by colour: Black, Red, Blue, and White. The Black Wall displays the principal success factors and financial indicators. The Red Wall measures market performance. The Blue Wall projects the performance of internal processes and employees. Finally, the White Wall indicates the status of strategic projects. The Flight Deck, a six-screen, high-end PC, enables executives to drill down to detailed information. External information needed for competitive analyses can easily be imported into the room.

Board members and other executives hold meetings in the Management Cockpit Room. Managers also meet there with the comptroller to discuss current business issues. The Management Cockpit can implement various what-if scenarios for this purpose. It also provides a common basis for information and communication. Finally, it supports efforts to translate a corporate strategy into concrete activities by identifying performance indicators.

geographic information system (GIS) A computer-based system for capturing, integrating, manipulating, and displaying data using digitized maps.

Geographic Information Systems

A **geographic information system (GIS)** is a computer-based system for capturing, integrating, manipulating, and displaying data using digitized maps. Its most distinguishing characteristic is that every record or digital object has an identified geographical location. This process, called *geocoding*, enables users to generate information for planning, problem solving, and decision making. The graphical format also makes it easy for managers to visualize the data. There are countless applications of GISs to improve decision making in both the public and private sectors.

POM As one example, when the Toronto Police Service decided to develop a tool to improve the understanding of policing, increase transparency, and enhance confidence in the service, it found that using geospatial data could help it accomplish this mission better. The result was a public safety data portal built using GIS software from ESRI (www.esri.ca).

The tool provides a centralized platform to easily access useful and timely crime data. A wide range of crime information, including shootings, homicides, and major crime indicators, is included in the app. In addition, users can select a set of dates, types, and neighbourhoods based on which the app will query the data set and visually depict the results on a map. This app is used by various people, such as researchers, media outlets, university professors, students, and residents concerned about public safety in their neighbourhood. The Vancouver Police Department has also developed a similar app using GIS software from ESRI.

These apps help visualize crime hot spots and enable crime analysts to study the reasons why certain areas are targets of criminal activities. They therefore enable the police to develop crime prevention strategies and tactics in order to reduce the number of crime incidents. In addition, these apps can increase police transparency and accountability as they shed light on the key activities and crime issues with which the police are engaged.

Before you go on...

1. Discuss why presentation tools are so valuable in the business analytics process.
2. What is a dashboard? Why are dashboards so valuable to an organization's decision makers?

What's in IT for me?

ACCT For the Accounting Major

BA is used extensively in auditing to uncover irregularities. It is also used to uncover and prevent fraud. CPAs use BA for many of their duties, ranging from risk analysis to cost control.

FIN For the Finance Major

People have been using computers to solve financial problems for decades. Innovative BA applications have been created for activities such as making stock market decisions, refinancing bonds, assessing debt

risks, analyzing financial conditions, predicting business failures, forecasting financial trends, and investing in global markets.

MKT For the Marketing Major

Marketing personnel utilize BA in many applications, from planning and executing marketing campaigns, to allocating advertising budgets, to evaluating alternative routes for salespeople. New marketing approaches such as targeted marketing and database marketing depend heavily on IT in general and on data warehouses and business intelligence applications in particular.

POM For the Production/Operations Management Major

BA supports complex operations and production decisions, from inventory control, to production planning, to supply chain integration.

HRM For the Human Resource Management Major

Human resource personnel employ BA for many of their activities. For example, BA applications can find resumés of applicants posted on the Web and sort them to match needed skills and support management succession planning.

MIS For the MIS Major

MIS provides the data infrastructure used in BA. MIS personnel are also involved in building, deploying, and supporting BA applications.

Summary

12.1 Use a decision-support framework to demonstrate how technology supports managerial decision making at each phase of the decision-making process.

When making a decision, either organizational or personal, the decision maker goes through a three-step process: intelligence, design, and choice. When the choice is made, the decision is implemented. In general, it is difficult to state which information systems support specific decision makers within an organization. Modern information systems, particularly business analytics systems, are available to support everyone in an organization.

12.2 Describe each phase of the business analytics process.

Business analytics is the process of developing actionable decisions or recommendations for actions based on insights generated from historical data. The phases in the business analytics process are shown in Figure 12.3 and include data management, descriptive analytics (with associated analytics tools and statistical procedures), predictive analytics (with associated analytics tools and statistical procedures), prescriptive analytics (with associated analytics tools and statistical procedures), and presentation tools. The results of the business analytics process are actionable business decisions.

12.3 Provide a definition and a use case example for descriptive analytics.

Descriptive analytics summarizes what has happened in the past and allows decision makers to learn from past behaviours. We leave the example to you.

12.4 Provide a definition and a use case example for predictive analytics.

Predictive analytics examines recent and historical data in order to detect patterns and predict future outcomes and trends. We leave the example to you.

12.5 Provide a definition and a use case example for prescriptive analytics.

Prescriptive analytics goes beyond descriptive and predictive models by recommending one or more courses of action and identifying the likely outcome of each decision. We leave the example to you.

12.6 Identify and discuss two examples of presentation tools.

A dashboard provides easy access to timely information and direct access to management reports. It is user-friendly, it is supported by graphics, and, most important, it enables managers to examine exception reports and drill down into detailed data.

A geographic information system (GIS) is a computer-based system for capturing, integrating, manipulating, and displaying data using digitized maps. Its most distinguishing characteristic is that every record or digital object has an identified geographical location.

Key Terms

augmented analytics 377
 business analytics (BA) 356
 business intelligence (BI) 357
 dashboard 379
 data mining 366

decision 358
 decision-support systems (DSSs) 366
 descriptive analytics 365
 geographic information system (GIS) 382
 management 358

multidimensional analysis 365
 online analytical processing (OLAP) 365
 predictive analytics 369
 prescriptive analytics 374
 productivity 358

Discussion Questions

1. Your company is considering opening a new factory in China. List several typical activities involved in each phase of the decision (intelligence, design, and choice).
2. Recall that a market basket analysis (a type of data mining) of convenience store purchases revealed that young male customers tended to buy beer and diapers at the same time when they shopped. Now that the analysis showed that this relationship exists, provide a rationale for it. Note: you will have to decide what the next question is.
3. Chipotle is a restaurant chain with locations in the United States, Canada, United Kingdom, Germany, and France, that focuses on Mexican food, including burritos, tacos, burrito bowls (a burrito without the tortilla), and salads. One of the main decisions that Chipotle's operations managers often need to make is about menu changes (i.e., dishes to add, remove, or change) for its 3,000-plus restaurants. How can the use of BA assist the company in this endeavour?
4. Discuss the strategic benefits of business analytics.
5. In early 2012, the *New York Times* reported the story of a Target data scientist who was able to predict if a customer was pregnant based on her pattern of previous purchases.
 - a. Describe the business analytics models that the data scientist used.
 - b. Refer to Chapter 3 and discuss the ethics of Target's analytics process.
6. Consider the admissions process at your university. The university's admissions process involves the analysis of many variables to decide whom to admit to each year's freshman class. Contact your admissions office and gather information on the variables used in the admissions process. As you recall from applying at your university, typical variables would include high school attended, high school grade point average, and many others. (Do not be surprised if there are variables that your admissions office cannot provide.)
 - a. Provide an example of how your admissions office uses descriptive analytics in the admissions process. Use the variables you have found in your example.
 - b. Provide an example of how your admissions office uses predictive analytics in the admissions process. Use the variables you have found in your example.
 - c. Provide an example of how your admissions office uses prescriptive analytics in the admissions process. Use the variables you have found in your example.

Problem-Solving Activities

1. Consider a large city, which has placed sensors in all its trash dumpsters. The sensors measure how full each dumpster is.
 - a. Describe a descriptive analytics application using these sensor data.
 - b. Describe a predictive analytics application using these sensor data.
 - c. Describe a prescriptive analytics application using these sensor data.
2. Consider an Airbus A220 (previously known as the Bombardier C-Series) jetliner engine. Sensors in this engine measure vibration and several different temperatures (depending on the location of the sensor).
 - a. Describe a descriptive analytics application using these sensor data.
 - b. Describe a predictive analytics application using these sensor data.
 - c. Describe a prescriptive analytics application using these sensor data.
3. You are a business analyst for a chain of grocery stores. You analyze retail sales data, perform a descriptive analytics application, and discover that bread and milk are the two products that are purchased together more often than any other pair of products.
 - a. Describe a predictive analytics application using these data.
 - b. Describe a prescriptive analytics application using these data.
4. Consider Rent the Runway (RTR; www.renttherunway.com). RTR buys designer dresses wholesale and rents them over the Web, charging only a fraction of the price of the dress. When RTR

merchandisers decide whether to buy a new dress, they follow a list of 40 data points such as fabric, zippers, stitching, and shape to determine whether the dress will hold up to the rigours of multiple rentals. The longer the lifespan, the higher the return on capital. In mid-2017, RTR was averaging more than 30 turns (rentals) per dress.

With every dress it rents, RTR's analytics algorithms learn more about effective strategies to track the location of each item, forecast demand, select shipping methods, set prices, and control inventory. RTR's algorithms also examine customer reviews to learn which

clothes women are renting for which kinds of occasions. They then forecast demand to determine whether the prepaid shipping label that goes with a dress should require the customer to return the dress overnight or whether a three-day return, which costs less, is sufficient.

- a. Describe a descriptive analytics application using these data.
- b. Describe a predictive analytics application using these data.
- c. Describe a prescriptive analytics application using these data.

Closing Case

MIS Google's Earth Engine

Google Earth (<https://earth.google.com/web/>) is a platform that presents a three-dimensional representation of Earth based on a 70-petabyte database that contains satellite imagery, aerial photography, Street View imagery, and geographic information systems (GIS) data. The program maps the Earth by superimposing these data onto a three-dimensional globe, enabling users to view cities and landscapes from various angles. Today, Google Earth covers more than 97 percent of the world, and it includes about 16 million kilometres of Street View imagery. (Google Street View provides interactive panoramas from positions along many streets in the world.) As just one interesting example of the data that Google Earth collects every day, users can analyze detailed information on the soil composition more than 30 cm underground and the amount of water vapour rising from farmland.

An important application of Google Earth is the Google Earth Engine. The Google Earth Engine (GEE; <https://earthengine.google.com>) is a cloud computing platform that enables users to analyze Google Earth's database by providing a data catalogue of images, computational power, and data analysis software necessary to analyze the data. Scientists can collaborate with each other, while using the data, algorithms, and visualizations produced by the GEE.

For example, the GEE allows users to monitor farming, natural resource use, and climate, using geospatial data from the Landsat and Sentinel-2 satellite programs to detect any changes. Landsat satellites pass over the same places on Earth every 16 days, and Sentinel-2 satellites every 10 days.

Public and Pro Bono Use Applications

GEE scientists analyze massive data sets to answer critical questions for a number of pro bono clients that include conservation groups, city agencies, community advocates, and researchers. In addition, researchers, organizations, and governments around the world use the GEE for the benefit of the public. Let's consider several examples.

- In the Ferlo region of the West African nation of Senegal, climate change is making it more difficult for herders to find water for their cattle. GEE scientists alert the farmers via radio to the best place to locate water.
- Via a shared website, GEE scientists target locations in Los Angeles where planting trees would be most helpful in lowering surface temperatures.
- The Government of Canada uses the GEE to map the status and trend of vegetation in the country. Specifically, Natural

Resources Canada (NRCan), the federal department that is responsible for natural resources, energy, minerals and metals, forests, earth sciences, mapping, and remote sensing, has been using the GEE to track environmental changes. Every month, it generates maps of vegetation parameters such as canopy: the portion of a plant crop formed by the individual plant crowns that are visible above the ground. These maps help in monitoring and assessing the environment. In addition, they contribute to global data sets, used to reduce the uncertainty in weather forecasts.

In January 2022, a team of NRCan researchers developed an application called the LEAF toolbox, which generates customizable maps of foliage density in real time by building on GEE data. Agriculture Canada is currently exploring using this toolbox to assess the condition and progress of crops, which affect local economies and the global food supply.

- The Food and Agriculture Organization (FAO) of the United Nations has created a free, open-source system called Collect Earth (www.collect.earth) by using Google Earth and the GEE. This system is used for viewing and interpreting high-resolution satellite imagery. Organizations around the world use Collect Earth to detect deforestation, forest degradation, and other changes in the landscape.
- *State of Hawaii*. The State of Hawaii faces many challenges as the climate crisis worsens, including landslides, wildfires, storm surges, flooding, lava flows, rock falls, and cliff erosion. These problems cause serious problems not only for the state's infrastructure and systems but also for the health, safety, and economic opportunities of its citizens.

To address these problems, Hawaii used the GEE to build a public-facing mapping tool to help policy-makers and the public decide where to invest resources as the state seeks to combat climate change. The tool provides an easier, more visual way for residents, public officials, and lawmakers to see where the risks are. The map is coded with green, yellow, and red, mapped across the islands, identifying low- to high-risk areas. The various constituencies can use the map to determine where to place resources and the amount of resources to place in each area.

- Researchers at the University of Maryland used the GEE to survey the extent, loss, and gain of global tree cover over the course of more than a decade. The study analyzed nearly all the land on the planet; treeless areas in the Arctic and Antarctic were the only exceptions. The result was the first map

of global forest change. The researchers noted that it would have taken them 15 years to complete their study on a single computer. In contrast, the GEE platform enabled them to complete the study in only 15 days.

- Using the GEE platform, the Map of Life (www.mol.org) biodiversity team has developed an interactive map to view and analyze habitat ranges and assess the security of individual species. The GEE enables the team to refine their predictions about where species at risk are likely to be. Users can adjust the parameters—for example, a decrease in the amount of water in a particular area—and GEE updates the map dynamically, immediately displaying the impact on the species range and the amount of protected habitat.
- Global Forest Watch (www.globalforestwatch.org), an initiative of the World Resources Institute, is a dynamic online forest monitoring system designed to enhance forest management and conservation. Global Forest Watch uses GEE to measure and visualize changes to the world's forests. Users can analyze data from the past decade or be alerted to potential new problems, almost in real time. Corporations, non-profits, governments, and Indigenous groups use the system to protect against illegal logging and make supply chains more transparent. For example, the GEE places bright pink dots on interactive maps that inform the Indigenous peoples in Peru of the locations of illegal logging activity.
- Members of the Global Health Group at the University of California, San Francisco rely on the GEE to forecast outbreaks of malaria. Health care workers on the ground can use the UCSF tool to upload their data about confirmed malaria cases. The platform then uses this information plus satellite data to make real-time predictions about where new cases may occur.
- The European Commission's Joint Research Centre (JRC) uses the GEE to develop high-resolution maps of global surface water occurrence, change, seasonality, recurrence, and transitions. Understanding changes in water resources is vital to ensure the security of our global water supply for agriculture, industry, and human consumption; to assess water-related disaster reduction and recovery; and to study waterborne pollution and the spread of disease.

Unfortunately, the insights provided by the GEE are sometimes accompanied by risks. Consider, for example, the case of Cloud to Street, a company that maps drought and flood zones in communities at risk from climate change. In South Sudan, Cloud to Street was warned not to make its maps public after locals worried that gangs of marauders from rebel factions in the ongoing civil war might use them to target vulnerable villages.

Commercial Applications

GEE developers have also been working on commercial applications. In October 2021, the company announced a for-profit version of the service. Customers included Unilever Plc and Swiss Re AG.

- **Unilever.** Unilever is using the GEE to ensure that its palm oil, a key ingredient in many consumer goods, does not come from illegal logging in tropical forests. The company is trying to meet its pledge to keep its supply chain free of deforestation. It monitors some 17 million hectares of farms and tracks the images of agriculture and traffic through 77,000 small

villages to assess which of its 1,900 mills might be receiving palm oil from illegal farms.

- **Regrow.** Sydney, Australia, start-up Regrow Ag uses the GEE to measure agricultural *carbon sequestration*—the process whereby atmospheric carbon dioxide is captured and stored—and its clients' crop yields. The goal is to identify opportunities to reduce emissions and improve yields. Regrow analyzes data such as shortwave infrared imaging that reveals the health of plants, the proportion of green cover to soil in a field, and the amount of crop residue left over after harvest. Farmers can use these data to adjust their inputs or crop types and to calculate the amount of carbon their farming practices emit or sequester.

Based on the information provided by Regrow, farmers now often reduce field cultivation and plant cover crops rather than leaving their fields bare. Cover crops are non-cash crops that are planted to cover the soil rather than for the purpose of being harvested and sold. The less often farmers till a field, the less carbon they release into the atmosphere. If they plant cover crops, the plants prevent the soil from eroding over the winter. In that way, Regrow can give the farmers some knowledge of what they are going to be paid for adopting these practices and taking part in the carbon market.

Questions

1. Describe the various types of data that Google Earth Engine uses.
2. Provide an example of a descriptive analytics application that Google Earth Engine employs.
3. Provide an example of a predictive analytics application that Google Earth Engine employs.

Sources: Compiled from D. Balestri and Y. Vasyunin, "What Is Google Earth Engine and Why It's Key for Sustainability Data Analysis," *Codemotion*, March 14, 2023; A. Dalton, "Sydney Start-Up Regrow Ag First to Harness Google Earth Engine," *Sydney Morning Herald*, August 2, 2022; D. du Perez, "Hawaii Maps Investment Priorities to Tackle Climate Crisis Using Google Cloud," *Diginomica*, July 6, 2022; "Google's Earth Observation Data Now Accessible to Businesses, Governments Worldwide," *Business Review Live*, June 28, 2022; N. Mott, "Google Expands Availability of Earth Engine to 'Restore a Livable Planet'," *PC Magazine*, June 28, 2022; B. Mitchell and F. Amalfi, "Google Cloud Launches New Sustainability Offerings to Help Public Sector Agencies Improve Climate Resilience," *Google Cloud*, June 23, 2022; F. Amalfi, "Climate Scientist Monitors Canada's Leaf Canopy with Google Earth Engine on Google Cloud," *Google Cloud*, April 20, 2022; L. Kaufman, "Google Wants to Save the Planet with Satellite Images," *Bloomberg BusinessWeek*, November 10, 2021; N. Gorelick, "The Nature of Water: Unveiling the Most Detailed View of Water on Earth," *Google Blog*, December 7, 2016; A. Joshi, et al., "Tracking Changes and Preventing Loss in Critical Tiger Habitat," *Science Advances*, April 1, 2016; M. Gunther, "Google-Powered Map Helps Fight Deforestation," *The Guardian*, March 10, 2015; W. Jetz, "Map of Life: A Preview of How to Evaluate Species Conservation with Google Earth Engine," *Google Blog*, January 8, 2015; L. Kurtzman, "UCSF, Google Earth Engine Making Maps to Predict Malaria," <https://www.ucsf.edu/news/2014/09/116906/ucsf-google-earth-engine-making-maps-predict-malaria>, September 10, 2014; M. Hansen, et al., "High-Resolution Global Maps of 21st Century Forest Cover Change," *Science*, November 15, 2013; <https://earthengine.google.com>; www.globalforestwatch.org, accessed August 14, 2022; <https://www.collect.earth/>, accessed May 3, 2023.

Acquiring Information Systems and Applications

CHAPTER OUTLINE

LEARNING OBJECTIVES

13.1 Planning for and Justifying IT Applications

13.1 Discuss the different cost–benefit analyses that companies must consider when they formulate an IT strategic plan.

13.2 Strategies for Acquiring IT Applications

13.2 Discuss the four business decisions that companies must make when they acquire new applications.

13.3 Traditional Systems Development Life Cycle

13.3 Enumerate the primary tasks and the importance of each of the six processes involved in the systems development life cycle.

13.4 Alternative Methods and Tools for Systems Development

13.4 Describe alternative development methods and the tools that augment these methods.

Opening Case

Southwest Airlines Meltdown Due to Technical Debt

In December 2022, a winter storm dropped multiple feet of snow across much of the United States, leading to widespread flight cancellations over the holiday season. Most airlines returned to normal operations within two to four days. There was one major exception: Southwest Airlines.

Southwest's meltdown began on December 21 and lasted through the end of the year. The airline cancelled nearly 17,000 flights and reported a net loss of US \$220 million for the fourth quarter of 2022. By comparison, it had reported a profit of US \$68 million for the same period in 2021.

Why did Southwest perform so poorly? The company's IT systems were adequate to operate under normal operations, when schedules and assignments were created and executed. Its systems proved inadequate, however, when major problems arose. Multiple departments had to manually read just flight schedules and reassign crews. Under this system, Southwest could manage a maximum of roughly 300 changes. In fact, the epic nature of the storm resulted in more than 2,500 changes, as well as continued cancellations and issues involving employees' time.

Significantly, executives at Southwest were aware of these issues. In 2016, the Southwest Airlines Pilots Association (SWAPA) unanimously approved a vote of no confidence in then-CEO Gary Kelly. Their main issue was his refusal to invest in their critically outdated IT infrastructure and flight operations. Meltdowns had begun—although on a much smaller scale—as early as 2014. In November 2022, SWAPA President Casey Murray again encouraged executives to invest in their IT, fearing a significant meltdown if a catastrophic event occurred. That event occurred a month later.

Southwest experienced many challenges during this time. First, its process for reassigning pilots and crew members could not operate at the national level. When a flight was cancelled, crew members had to report their location and receive their next assignment by phone. Due to the number of cancellations, the phone system was overloaded. There were not enough lines or agents to keep up with the demand. Some crew members reported waiting on hold for as long as 17 hours to receive their new assignments.

Compounding this problem, Southwest flies primarily point-to-point rather than moving passengers through a hub with connecting flights. Again, this model is efficient and cost-effective when operations are normal. It is not resilient, however, when

challenges arise. Because many Southwest flights are short and need to be rescheduled very quickly, one flight delay immediately triggers numerous other delays and disrupts the overall schedule.

Further complicating matters is the fact that the U.S. Federal Aviation Administration (FAA) enforces a timeout period. Flight crews consisting of one pilot cannot be on duty more than 8 hours, and crews with two pilots cannot be on duty more than 10 hours. While crews are sitting on the ramp waiting for flight instructions or for flight attendants to be scheduled, they are technically on duty. If their remaining duty time is insufficient to complete the planned flight, then the flight must be cancelled.

Southwest, then, faced multiple challenges: the nearly nationwide weather patterns, its outdated rescheduling system, insufficient phone support, and FAA regulations. It is no wonder its system melted down and it could function only at a minimal capacity.

The Problem—Technical Debt

Southwest relied on old, deficient software that the company failed to update, despite repeated calls from its pilots. When organizations choose not to keep their systems up to date and capable of delivering all their business needs, they incur technical debt. *Technical debt* refers to a gap between what the software needs to be and what it actually is. Expenditures to update software are considered debt. In effect, the organization “owes money” to the system. Furthermore, the longer organizations wait to update their information systems, the more “interest” they accrue, and the more expensive the update will be. Meltdowns, such as the one experienced by Southwest, result from this technical debt.

Technical debt can be necessary for the development process, and it may be deliberately incurred. For example, imperfect but functional sections of code might not be touched—especially if other, more important, program features are urgently needed. However, organizations always need to remember that some technical debt exists and will need to be managed eventually. To make matters worse, companies don’t find it appealing to invest in software and systems that aren’t directly visible to customers. It sometimes takes away from the “very appealing” bottom line. Not many companies issue press releases to boast about investments that simply maintain the current situation.

How the Systems Development Process Addresses Technical Debt

System maintenance is a vital component of the systems development life cycle (SDLC). Periodic maintenance is essential for security purposes and for keeping the system compatible with the latest hardware devices that will access it. However, an updated system might not be able to scale to meet an organization’s current needs, leaving the organization with a functioning system that cannot manage capacity requirements. System maintenance also addresses the critical issue of keeping the system in alignment with current business needs, operations, and disaster planning.

Few companies will ever experience a systems failure as massive or as widely publicized as Southwest did. However, many companies make the same mistake; that is, they neglect investments that impact both customer and employee experiences. Sometimes, as in the case of Southwest, improvements occur only when the situation reaches a breaking point.

Southwest neglected its systems, building up massive technical debt. How great was this debt? The airline announced plans to spend US \$1.3 billion on IT infrastructure during 2023. This sum represents 30 percent of its planned capital spending for the entire year. Further, that does not include lost revenue during the fourth quarter of 2022 or the future lost revenue when 2 million customers use the 25,000 frequent flyer miles they received as compensation for the inconvenience the meltdown may have caused. Finally, it does not take into account the vast amounts of negative publicity and the devastating impact on the airline’s reputation.

Many CEOs are evaluated based on the bottom line, and investments must be justified by the potential return they bring to the organization. This focus on the bottom line makes it easy to push maintenance to the side. However, the technical debt must still be repaid. The question is whether to pay it now or to postpone it until a catastrophe occurs.

Questions

1. What is technical debt, and how is it repaid?
2. Why did Southwest incur so much technical debt?
3. How can organizations better manage systems development to avoid technical debt?

Sources: Compiled from T. Brown, “A Look at Technical Debt,” *IT Chronicles*, April 4, 2022; D. Meyer, “Southwest Airlines’ Post-Christmas Meltdown Thanks to ‘Outdated IT’ Systems, Poor Scheduling,” *nypost.com*, December 27, 2022; D. Goldman, “Why Southwest Is Melting Down,” *CNN.com*, December 28, 2022; N. Chau, “What Caused Southwest’s Holiday Meltdown? It Wasn’t Just Weather, Pilots Say,” *cbsnews.com*, December 29, 2022; Z. Tufekci, “The Shameful Open Secret Behind Southwest’s Failure,” *The New York Times*, December 31, 2023; R. Jennings, “Southwest Airlines: ‘Shameful’ Technical Debt Bites Back,” *DevOps*, January 5, 2023, <https://devops.com/southwest-technical-debt-richixbw/>, January 5, 2023; R. Dooley, “Southwest’s \$825 Million Loss Signals Why Companies Shouldn’t Put Off Internal Investments,” *Forbes*, January 6, 2023; D. Cameron, “Southwest Airlines Earnings Hit by \$220 Million Loss After Holiday Meltdown,” *Wall Street Journal*, January 26, 2023; The Stack, “Southwest Airlines’ \$825M Writedown Is Not a Salutory Tale about Technical Debt for CIOs,” *The Stack*, January 9, 2023, <https://www.thestack.technology/southwest-airlines-technical-debt-meltdown-warnings/warnings/>, accessed on January 25, 2023; ProductPlan, “Technical Debt,” <https://www.productplan.com/glossary/technical-debt/>, accessed on January 25, 2023.

Introduction

Competitive organizations move as quickly as they can to acquire new information technologies or modify existing ones when they need to improve efficiencies and gain strategic advantage. As you learned from the chapter opening case, technical debt can bring a company down. Instead organizations will need to use effective systems development methodologies aimed at creating the right product at the right time for the right customer.

Today, acquisition goes beyond building new systems in-house, and IT resources involve far more than software and hardware. The old model in which firms built their own systems is being replaced with a broader perspective of IT resource acquisition that provides companies with a number of options. An organization such as Southwest Airlines needs to be able to improve its internal systems rapidly to be able to respond to extreme weather and climate change, as well as international issues such as pandemics. Now companies must decide which IT tasks will remain in-house, and even whether the entire IT resource should be provided and managed by outside organizations. Regardless of which approach an organization chooses, however, it must be able to manage IT projects adeptly.

In this chapter, you learn about the process of acquiring IT resources from a managerial perspective. This means from *your* perspective, because you will be closely involved in all aspects of acquiring information systems and applications in your organization. In fact, when we mention “users” in this chapter, we are talking about you. You also study the available options for acquiring IT resources and how to evaluate those options. Finally, you learn how organizations plan and justify the acquisition of new information systems.

13.1 Planning for and Justifying IT Applications

LEARNING OBJECTIVE

Discuss the different cost–benefit analyses that companies must take into account when formulating an IT strategic plan.

Organizations must analyze the need for applications and then justify each purchase while considering their goals, costs and benefits. The need for information systems is usually related to organizational planning and to the analysis of the organization’s performance vis-à-vis its competitors. The cost–benefit justification must consider the wisdom of investing in a specific IT application versus spending the funds on alternative projects. This chapter focuses on the formal processes used in large organizations. Smaller organizations employ fewer formal processes, or no processes at all. It is important to note, however, that even if a small organization does not have a formal process for planning and justifying IT applications, the steps of a formal process exist for a reason, and they have value. At the very least, decision makers in small organizations should consider each step when they are planning changes in their information systems.

When a company examines its needs and performance, it generates a prioritized list of both existing and potential IT applications, called the **application portfolio**. These are the applications that have to be added, or modified if they already exist.

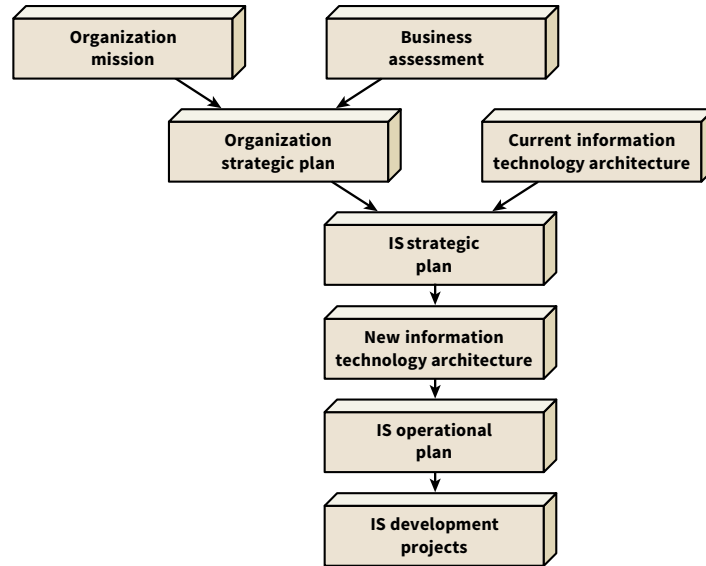
application portfolio The set of recommended applications resulting from the planning and justification process in application development.

IT Planning

The planning process for new IT applications begins with an analysis of the *organizational strategic plan*, which is illustrated in **Figure 13.1**. The organization’s strategic plan identifies the firm’s overall mission, the goals that follow from that mission, and the broad steps required to reach these goals. The strategic planning process modifies the organization’s objectives and resources to match its changing markets and opportunities.

The organizational strategic plan and the existing IT architecture provide the inputs in developing the IT strategic plan. The *IT architecture* delineates how an organization should utilize its information resources to accomplish its mission. It encompasses both the technical and the managerial aspects of information resources. The technical aspects include hardware and operating systems, networking, data management systems, and applications software. The managerial aspects specify how the IT department will be managed, how the functional area managers will be involved, and how IT decisions will be made.

FIGURE 13.1 The information systems planning process.



IT strategic plan A set of long-range goals that describe the IT infrastructure and major IT initiatives needed to achieve the organization's goals.

The **IT strategic plan** is a set of long-range goals that describe the IT infrastructure and identify the major IT initiatives needed to achieve the organization's goals. The IT strategic plan must meet three objectives:

1. *It must be aligned with the organization's strategic plan.* This alignment is critical because the organization's information systems must support the organization's strategies. (Recall the discussion of organizational strategies and information systems in Chapter 2.)
Consider the example of lululemon athletica versus Walmart. An application that improves customer service at a low cost would be considered favourably at lululemon, but it might be rejected at Walmart. The reason is that the application would fit in favourably (i.e., align) with lululemon's customer service priority strategy. However, it would not fit in well with Walmart's low-cost strategy. You see two retail stores considering the same application, with the same cost and same benefits—but different answers to the question, "Should we develop the application?"
2. *It must provide for an IT architecture that seamlessly networks users, applications, and databases.*
3. *It must efficiently allocate IS development resources among competing projects so that the projects can be completed on time and within budget and still have the required functionality.*

The existing IT architecture is a necessary input into the IT strategic plan because it acts as a constraint on future development efforts. It is not an absolute constraint, however, because the organization can change to a new IT architecture. Companies prefer to avoid this strategy, however, because it is expensive and time-consuming.

Consider this example. You have a Mac (Apple) system, and you need a new software application. You search and find several such packages for both Mac and MS Windows. Unfortunately, the best package runs only on Windows. How much better would this package have to be for you to justify switching from Mac to Windows?

One critical component in developing and implementing the IT strategic plan is the **IT steering committee**. This committee, composed of a group of managers and staff who represent the various organizational units, is created to establish IT priorities and to ensure that the MIS function is meeting the organization's needs. The committee's major tasks are to link corporate strategy with IT strategy, to approve the allocation of resources for the MIS function, and to establish performance measures for the MIS function and ensure they are met. The IT

IT steering committee

A committee composed of a group of managers and staff representing various organizational units that is set up to establish IT priorities and to ensure that the MIS function is meeting the enterprise's needs.

steering committee is important to you because it ensures that you get the information systems and applications that you need to do your job.

After a company has agreed on an IT strategic plan, it next develops its **IS operational plan**. This plan consists of a clear set of projects that the IS department and the functional area managers will execute in support of the IT strategic plan. A typical IS operational plan contains the following elements:

- *Mission*: The mission of the IS function (derived from the IT strategy).
- *IS environment*: A summary of the information needs of the individual functional areas and of the organization as a whole.
- *Objectives of the IS function*: The best current estimate of the goals of the IS function.
- *Constraints on the IS function*: Technological, financial, personnel, and other resource limitations on the IS function.
- *The application portfolio*: A prioritized inventory of present applications and a detailed plan of projects to be developed or continued during the current year.
- *Resource allocation and project management*: A listing of who is going to do what, how, and when.

IS operational plan Consists of a clear set of projects that the IS department and the functional area managers will execute in support of the IT strategic plan.

Evaluating and Justifying IT Investment: Benefits, Costs, and Issues

Developing an IT plan is the first step in the acquisition process. Because all companies have limited resources, they must justify investing resources in some areas, including IT, rather than in others. Essentially, justifying IT investment involves calculating the costs, assessing the benefits (values), and comparing the two. This comparison is frequently referred to as *cost-benefit analysis*. Cost-benefit analysis can be complex.

Assessing the Costs Calculating the dollar value of IT investments is not as simple as it may seem. One of the major challenges that companies face is to allocate fixed costs among different IT projects. *Fixed costs* are those costs that remain the same regardless of any change in the company's activity level. Fixed IT costs include infrastructure costs and the costs associated with IT services and IT management. For example, the IT director's salary is fixed, and adding one more application will not change it.

Another complication is that the costs of a system do not end when the system is installed. Rather, costs for maintaining, debugging, and improving the system can accumulate over many years. This is a critical point because organizations sometimes fail to anticipate these costs when they make the investment.

A dramatic example of unanticipated expenses was the Year 2000 (Y2K) reprogramming projects, which cost organizations worldwide billions of dollars. In the 1960s, computer memory was very expensive. To save money, programmers coded the "year" in the date field 19__, instead of ____. With the "1" and the "9" hard-coded in the computer program, only the last two digits varied, so computer programs needed less memory. However, this process meant that, when the year 2000 rolled around, computers would display the year as 1900. This programming technique could have caused serious problems with financial applications, insurance applications, and countless other apps.

Programmers who wanted to avoid the Y2K bug had two options: rewrite the code entirely or adopt a quick fix called windowing, which would treat all dates from 00 to 20 as from the 2000s rather than the 1900s. As estimated 80 percent of computers fixed in 1999 used the quicker, cheaper option. The theory was that these systems would no longer be in use in 2020, but many are still operational.

The Year 2020 bug (Y2020) is a lingering side effect of attempts to fix the Y2K, or millennium, bug. Programmers chose 1920 to 2020 as the standard window because of the significance of the midpoint, 1970. Many programming languages and systems manage dates and times as seconds from 1970/01/01, also called Unix time.

As of January 1, 2020, systems that used the quick fix had rolled back to 1920. Utility company bills had reportedly been produced with the erroneous date of 1920, while tens of thousands of parking meters in New York City declined credit card transactions. Thousands of cash registers manufactured by the Polish firm Novitus were unable to print receipts due to a problem with the register's clock. *WWE 2K20*, a professional wrestling video game, stopped working at midnight on January 1, 2020. Within 24 hours, the game's developers, 2K, issued a downloadable fix.

The Y2K and Y2020 examples illustrate the point that database design choices tend to affect organizations for a long time. As the twenty-first century approached, no one was still using hardware or software from the 1960s (other than a few legacy applications). Database design choices made in the 1960s, however, were often still in effect decades after the companies implemented them.

Assessing the Benefits Evaluating the benefits of IT projects is typically even more subjective than calculating their costs. Benefits may be more difficult to quantify, especially because many of them are intangible (e.g., improved customer or partner relations and improved decision making). As an employee, you will probably be asked for input about the intangible benefits that an IS provides for you.

The fact that organizations use IT for many purposes further complicates benefit analysis. To obtain a return from an IT investment, the company must also implement the technology successfully. In reality, many systems are not implemented on time, within budget, or with all of the features originally envisioned for them. Also, the proposed system may be “cutting edge.” In these cases, there may be no precedent for identifying the types of financial payback the company can expect. Companies may actually implement the technology at one or more locations to verify that it functions effectively and is accepted by consumers. For example, Walmart tested the use of iPhones for scanning products as they are placed into bags. Consumers still had to pay for the purchases at a self-checkout counter. The test was conducted near Walmart's headquarters in the United States (a supercentre in the town of Rogers, Arkansas). This type of test helps a company confirm how a technology will function and solidify the estimates of costs and benefits. As of April 2023, the option to use “Mobile scan & go” was available to people who signed up as Walmart members for US \$12.95 per month. This service was not available in Canada.

Conducting the Cost-Benefit Analysis After a company has assessed the costs and benefits of IT investments, it must compare them. You have studied, or will study, cost-benefit analyses in more detail in your finance courses. The point is that real-world business problems do not come in neatly wrapped packages labelled “this is a finance problem” or “this is an IS problem.” Rather, business problems span multiple functional areas.

There is no uniform strategy for conducting a cost-benefit analysis. In fact, an organization can perform this task in several ways. Here we describe four common approaches: (1) net present value, (2) return on investment, (3) break-even analysis, and (4) the business case approach.

1. Analysts use the *net present value (NPV)* method to convert future values of benefits to their present-value equivalent by “discounting” them at the organization's cost of funds. They can then compare the present value of the future benefits with the cost required to achieve those benefits to determine whether the benefits exceed the costs.
2. *Return on investment (ROI)* measures management's effectiveness in generating profits with its available assets. ROI is calculated by dividing the net income generated by a project by the average assets invested in the project. ROI is a percentage, and the higher the percentage return, the better.
3. *Break-even analysis* determines the point at which the cumulative dollar value of the benefits from a project equals the investment made in the project.
4. In the *business case approach*, system developers write a business case to justify funding one or more specific applications or projects. IS professionals will be a major source of input when business cases are developed because these cases describe what you do, how you do it, and how a new system could better support you.

Before you go on...

1. What are some problems associated with assessing the costs of IT?
2. Why are the intangible benefits of IT so difficult to evaluate?
3. Describe the NPV, ROI, break-even analysis, and business case approaches.

13.2 Strategies for Acquiring IT Applications

LEARNING OBJECTIVE

Discuss the four business decisions that companies must make when they acquire new applications.

After a company has justified an IT investment, it must then decide how to pursue it. As with cost-benefit analyses, there are several options for acquiring IT applications. To select the best option, companies must make a series of business decisions. The fundamental decisions are the following:

- *How much computer code does the company want to write?* A company can choose to use a totally prewritten application (write no computer code), customize a prewritten application (write some computer code), or custom-write an entire application (write all new computer code).
- *How will the company pay for the application?* Once the company has decided how much computer code to write, it must decide how to pay for it. With prewritten applications or customized prewritten applications, companies can buy them or lease them. With totally custom applications, companies may also use internal funding.
- *Where will the application run?* The next decision is whether to run the application on the company's platform or on someone else's platform. In other words, the company can employ either a software-as-a-service vendor or an application service provider. (You will examine these options later in this chapter.)
- *Where will the application originate?* Prewritten applications can be open-source software or they can come from a vendor. The company may choose to customize prewritten open-source applications or prewritten proprietary applications from vendors. Furthermore, it may customize applications in-house, or it can outsource the customization. Finally, it can write totally custom applications in-house, or it can outsource this process.

In the following sections, you will find more details on the variety of options that companies looking to acquire applications can select from. A good rule of thumb is that an organization should consider all feasible acquisition methods in light of its business requirements. You will learn about the following acquisition methods:

- Purchase a prewritten application
- Customize a prewritten application
- Lease the application
- Use application service providers and software-as-a-service vendors
- Use open-source software
- Use outsourcing
- Employ continuous development
- Employ custom development

TABLE 13.1 Advantages and Limitations of the Buy Option

Advantages

- Many different types of off-the-shelf software are available.
- The company can try out the software before purchasing it.
- The company can save time by buying rather than building.
- The company can know what it is getting before it invests in the product.
- Purchased software may eliminate the need to hire personnel specifically dedicated to a project.

Disadvantages

- Software may not exactly meet the company’s needs.
- Software may be difficult or impossible to modify, or it may require huge business process changes to implement.
- The company will not have control over software improvements and new versions.
- Purchased software can be difficult to integrate with existing systems.
- Vendors may discontinue a product or go out of business.
- The software is controlled by another company with its own priorities and business considerations.
- The purchasing company lacks intimate knowledge about how and why the software functions as it does.

Purchase a Prewritten Application

Many commercial software packages contain the standard features required by IT applications. Therefore, purchasing an existing package can be a cost-effective, time-saving strategy compared with custom-developing the application in-house. Nevertheless, a company should carefully consider and plan the buy option to ensure that the selected package contains all of the features necessary to address the company’s current and future needs. Otherwise, these packages can quickly become obsolete. Before a company can perform this process, it must decide which features a suitable package must include.

In reality, a single software package can rarely satisfy all of an organization’s needs. For this reason, a company must sometimes purchase multiple packages to fulfill different needs. It must then integrate these packages with one another as well as with its existing software. Table 13.1 summarizes the advantages and limitations of the buy option, also discussed in IT’s About Business 13.1.

MIS IT’s About Business 13.1

Software Packages with Heart

Organizations need well-functioning information systems for tasks such as processing transactions, making payments, and receiving funds for work or products provided. As discussed in IT’s About Business 3.1, information technology services can be provided with heart (or love): a set of values that include respect and a willingness to learn from each other. This worldview prevails at Xyntax (www.xyntax.ca), which provides both an integrated software suite called Inexsuite and human resources in finance and management.

In 2021, Xyntax adopted a logo created by Indigenous artist Joe Wilson that represents the sun. Xyntax’s press release referred to the traditional legends and stories of active interaction with the sun and of its logo as representing balance and harmony via the sun’s rays. The company was founded in 1984 and stated that it served “over 100 Indigenous governments and organizations that range in size from 200 to over 14,000 members with an estimated

combined yearly operating budget of over \$900 million.” Xyntax’s goals include facilitating effective management and administration of Indigenous communities and resources, which is important, as information technology use and implementations can easily go awry.

The First Nations in BC Knowledge Network (www.firstnationsbc.ca) lists resources such as information technology service providers and provides copies of reports of technology assessment at bands or their related corporations. The site has a checklist for effective information management that is recommended for use in planning to help clearly identify needs before contacting potential suppliers for information technology services. The checklist is available to members of the site.

Another Indigenous community software provider, Abenaki Associates (<https://www.abenaki.com/>), has partnered with Sage, an ERP (enterprise resource planning system) vendor. Also in business for over 35 years, Abenaki provides training in

the use of Sage products, as well as a software suite focusing on case management and child and family services. Linking multiple functional areas within a single software suite offered by a single vendor such as Sage is complex. Customization is often required.

This example shows us that software packages can be complex and one package may be used to link other software packages. Customization or products known as middleware are then used.

“Heart” in IT is also expressed when work is made easier and more seamless, and the new system makes it possible to treat customers with more respect. For example, consider the issues around sales tax exemption processing. Most retail software packages charge provincial sales tax and federal Goods and Services Tax (GST), which may be combined as Harmonized Sales Tax (HST) in Canada. Depending on their legal status, many Indigenous persons have some tax exemptions available to them. Most retail packages do not have an easy process for providing such exemptions and would require customer file set-up and adjustments as the customer (and others) wait in line, which can result in the perception of time wasted and embarrassment for the customer.

Wiz-Tec Computing Technologies Inc. (<https://wiz-tec.ca/en/home/>), in business for over 30 years, provides retail solutions, including those for gas stations and travel centres. As of April 2023, its website stated that it had implemented solutions for over 300 First Nations sites as well as other retailers. Two of its products are iPOS and Bridge. Wiz-Tec states that the iPOS system reduces tax-exemption paperwork, while Bridge is used to allow data to be transferred from franchise systems (such as Esso) to the retailer’s POS (point-of-sale) system without the need to re-enter data. The company site gave examples of two locations, Bears paw First Nation in Kananaskis, Alberta, and Pelletier’s Gas Bar and Native Art Gallery in Nipigon, Ontario, that had saved time and were effectively using the Wiz-Tec systems.

These examples show us that software packages, although useful, need technical support to be effectively implemented and maintained over time. Wherever there is a large enough potential user base, such as Indigenous communities and retail locations, package software providers will develop to fill a need.

Questions

1. What are the advantages to Indigenous communities of implementing software packages that address their tax issues?
2. What are the disadvantages to such communities of implementing custom software from a vendor that is not familiar with Indigenous communities or their tax issues?
3. How can the installation and maintenance of information technology be implemented with heart? (Tip: Research the values shown on the websites of the companies discussed here and in IT’s About Business 3.1.)

Sources: Compiled from: Abenaki Associates, “About Abenaki,” 2023, <https://abenaki.com/about/>, accessed April 24, 2023; First Nations in BC Knowledge Network, “Resource Library: Information Management,” 2023, https://firstnationsbc.ca/resource-categories?field_resource_category_tid%5B%5D=163, accessed April 24, 2023; GlobeNewswire, “Xyntax Group Inc. Appoints Dharmesh Makwana as President and Chief Executive Officer,” *National Post*, June 21, 2021, <https://www.globenewswire.com/en/news-release/2021/06/21/2250532/0/en/Xyntax-Group-Inc-Appoints-Dharmesh-Makwana-as-President-and-Chief-Executive-Officer.html>, accessed April 24, 2023; GlobeNewswire, “Xyntax Group Inc. Proudly Honours Indigenous Ownership in Re-Branding,” June 21, 2021, <https://www.globenewswire.com/en/news-release/2021/06/21/2250531/0/en/Xyntax-Group-Inc-Proudly-Honours-Indigenous-Ownership-in-Re-branding.html>, accessed April 24, 2023; Wiz-Tec Computing Technologies Inc., “How a First Nations Gas Bar Saved Over 120 Hours on Inventory with Wiz-Tec’s Bridge,” April 28, 2021, <https://wiz-tec.ca/en/blog/bearspaw-travel-centre/>, accessed April 25, 2023; Wiz-Tec Computing Technologies Inc., “How Pelletier’s Gas Bar Saved 8 Hours on Tax Exemption Paperwork with iPOS by Wiz-Tec,” September 4, 2020, <https://wiz-tec.ca/en/blog/how-pelletiers-gas-bar-saved-8-hours-in-tax-exemption-paperwork/>, accessed April 25, 2023; Xyntax Group Inc., “Finance and Management Services,” <https://www.xyntax.ca/services>, accessed April 24, 2023.

Customize a Prewritten Application

Customizing existing software is an especially attractive option if the software vendor allows the company to modify the application to meet its needs. However, this option may not be attractive in cases when customization is the *only* method of providing the necessary flexibility to address the company’s needs. It is also not the best strategy when the software is either very expensive or likely to become obsolete very soon. Furthermore, customizing a prewritten application can be extremely difficult, particularly for large, complex applications. Extra maintenance costs will occur since, every time the vendor updates its software, the custom changes may need to be re-installed.

Lease the Application

Compared with the buy option and the option to develop applications in-house, the lease option can save a company both time and money. Of course, leased packages (like purchased packages) may not exactly fit the company’s application requirements. However, as noted, vendor software generally includes the features that are most commonly needed by organizations in a given industry. Again, the company will decide which features are necessary.

Interested companies commonly apply the 80/20 rule when they evaluate vendor software. Put simply, if the software meets 80 percent of the company’s needs, then the company should

seriously consider modifying its business processes so that it can use the remaining 20 percent. This is often a better long-term solution than modifying the vendor software. Otherwise, the company will have to customize the software every time the vendor releases an updated version.

Leasing can be especially attractive to small and medium-sized enterprises (SMEs) that cannot afford major investments in IT software. Large companies may also prefer to lease packages to test potential IT solutions before committing to major investments. A company that does not employ sufficient IT personnel with the appropriate skills for developing custom IT applications may also choose to lease instead of develop the software it needs in-house. Even companies that employ in-house experts may not be able to afford the long wait for strategic applications to be developed internally. Therefore, they lease (or buy) applications from external resources to establish a quicker presence in the market.

Companies can lease software in one of three ways. The first way is to lease the application from a software developer, install it, and run it on the company's platform. The vendor can assist with the installation and will frequently offer to contract for the support and maintenance of the system. Many conventional applications are leased this way.

The other two options involve leasing an application and running it on the vendor's platform. Organizations can do this by using an application service provider or a software-as-a-service vendor.

Rely on Application Service Providers and Software-as-a-Service Vendors

application service provider (ASP) An agent or vendor who assembles the software needed by enterprises and packages it with outsourced development, operations, maintenance, and other services.

software-as-a-service (SaaS) A method of delivering software in which a vendor hosts the applications and provides them as a service to customers over a network, typically the internet.

An **application service provider (ASP)** is an agent or a vendor who assembles the software needed by enterprises and then packages it with services such as development (which could include customization), operations, and maintenance. The customer then accesses these applications through the internet. **Figure 13.2** illustrates the operation of an ASP. Note that the ASP hosts both an application and a database for each customer.

Software-as-a-service (SaaS) is a method of delivering software in which a vendor hosts the applications (normally, packaged software) and provides them as a service to customers over a network, typically the internet. Customers do not own the software. Rather, they pay to use it. SaaS eliminates the need for customers to install and run applications on their own computers. Therefore, SaaS customers save the expense (money, time, IT staff) of buying, operating, and maintaining the software. For example, Salesforce (www.salesforce.com), a well-known SaaS provider of customer relationship management (CRM) software solutions, gives its customers these advantages. **Figure 13.3** displays a SaaS vendor's operation. Note that the vendor hosts an application that multiple customers can use. The vendor also hosts

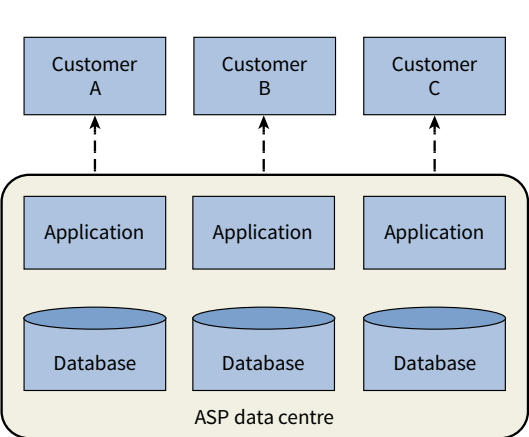


FIGURE 13.2 Operation of an application service provider.

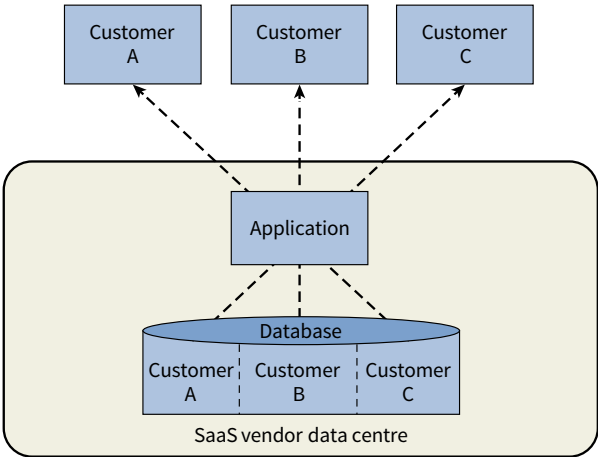


FIGURE 13.3 Operation of a software-as-a-service vendor.

a database that is partitioned for each customer to protect the privacy and security of each customer's data.

At this point, companies have made the first three decisions and must now decide where to obtain the applications, which could be from multiple vendors. Recall that in general, for prewritten applications, companies can use open-source software or obtain the software from a vendor. For customized prewritten applications, they can customize open-source software or vendor software. For totally customized applications, they can write the software in-house, or they can outsource the process.

Use Open-Source Software

Organizations obtain a licence to implement an open-source software product and either use it as is, customize it, or develop applications with it. Unless the company is one of the few that want to tinker with their source code, open-source applications are basically the same as a proprietary application except for licensing, payment, and support. Open-source software is really an alternative source of applications rather than a conceptually different development option. (We discuss open-source software in Technology Guide 2.)

Turn to Outsourcing

Acquiring IT applications from outside contractors or external organizations is called **outsourcing**. Companies can use outsourcing in many situations. For example, they might want to experiment with new IT technologies without making a substantial upfront investment. They also might use outsourcing to obtain access to outside experts. One disadvantage of outsourcing is that companies must frequently place their valuable corporate data under the control of the outsourcing vendor.

Several types of vendors offer services for creating and operating IT systems, including e-commerce applications. Many software companies, from IBM to Oracle, offer a range of outsourcing services for developing, operating, and maintaining IT applications. IT outsourcers, such as NCR and Infosys, offer a variety of services. In addition, the large public accounting firms and management consultants—such as Accenture—offer outsourcing services.

For example, Philip Morris International outsourced its IT infrastructure management to Indian services firm Wipro. The companies concluded a five-year contract in which Wipro manages the tobacco company's applications and IT using Wipro's cloud-based management platform. (We discuss cloud computing in Technology Guide 3.) The contract was reported to be worth some US\$35 million.

Some companies outsource offshore, particularly in India and China. *Offshoring* can save money, but it has its risks as well. The risks depend on which services are being offshored. If a company is offshoring application development, then the major risk is poor communication between users and developers. In response to these risks, some companies are bringing outsourced jobs back in-house, a process called *reverse outsourcing*, or *insourcing*.

outsourcing Use of outside contractors or external organizations to acquire IT applications or services.

Engage in Continuous Development

Continuous application development automates and improves the process of software delivery. In essence, a software development project is not viewed as having a defined product, with development stopped when the product is implemented. Rather, a software development project is viewed as constantly changing in response both to changing business conditions and to user acceptance.

Continuous application development is the process of steadily adding new computer code to a software project as the new code is written and tested. Each development team member submits new code when it is finished. Automated testing is performed on the code to ensure that it functions within the software project. Continuous code submission provides developers with immediate feedback from users and status updates for the software on which they are working.

continuous application development The process of steadily adding new computer code to a software project as the new computer code is written and tested.

Employ Custom Development

Another option is to custom-build an application. Companies can either perform this operation in-house or outsource the process. Although custom development is usually more time-consuming, error-prone, and costly than buying or leasing, it often results in a better fit with the organization's specific requirements.

The development process starts when the IT steering committee (discussed earlier in this chapter), having received suggestions for a new system, decides it is worth exploring. These suggestions come from users (you, in the near future). Understanding this process will help you obtain the systems that you need. Conversely, not understanding this process will reduce your chances, because other people who understand it better will make suggestions that use up available resources.

As the company goes through the development process, its mindset changes. In systems investigation (the first stage of the traditional systems development life cycle), the organization is trying to decide whether to build something. Everyone knows it may or may not be built. In the later stages of the development process, the organization is committed to building the application. Although a project can be cancelled at any time, this change in attitude is still important.

The basic, backbone methodology for custom development is the systems development life cycle, which you will read about in the next section. Section 13.4 examines the methodologies that complement the SDLC: prototyping, joint application development, integrated computer-assisted systems development tools, and rapid application development. You will also consider four other methodologies: agile development, end-user development, component-based development, and object-oriented development.

Before you go on...

1. Describe the four fundamental business decisions that organizations must make when they acquire information systems.
2. Discuss each of the seven development methods described in this section with regard to the four business decisions that organizations must make.

13.3 Traditional Systems Development Life Cycle

LEARNING OBJECTIVE

Enumerate the primary tasks and the importance of each of the six processes involved in the systems development life cycle.

systems development life cycle (SDLC) Traditional structured framework, used for large IT projects, that consists of sequential processes by which information systems are developed.

The **systems development life cycle (SDLC)** is the traditional systems development method that organizations use for large-scale IT projects. The SDLC is a structured framework that consists of sequential processes by which information systems are developed. For our purposes (see [Figure 13.4](#)), we identify six processes, each of which consists of clearly defined tasks:

1. Systems investigation
2. Systems analysis
3. Systems design
4. Programming and testing
5. Implementation
6. Operation and maintenance

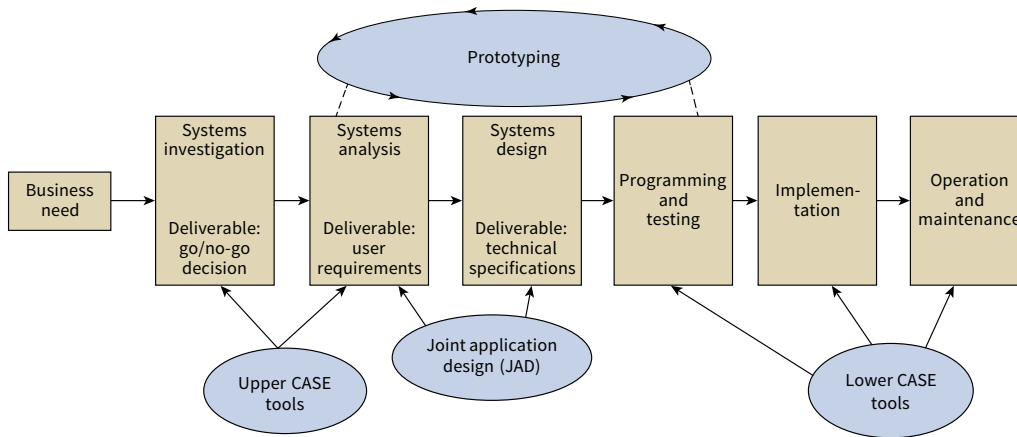


FIGURE 13.4 A six-stage systems development life cycle with supporting tools.

Alternative SDLC models contain more or fewer stages. The flow of tasks, however, remains largely the same. When problems occur in any phase of the SDLC, developers must go back to previous phases.

Systems development projects produce desired results through team efforts. Development teams typically include users, systems analysts, programmers, and technical specialists. *Users* are employees from all functional areas and levels of the organization who interact with the system, either directly or indirectly. **Systems analysts** are IS professionals who specialize in analyzing and designing information systems. **Programmers** are IS professionals who either modify existing computer programs or write new programs to satisfy user requirements. **Technical specialists** are experts on a certain type of technology, such as databases or telecommunications. The **systems stakeholders** include everyone who is affected by changes in a company's information systems—for example, users and managers. All stakeholders are typically involved in systems development at various times and in varying degrees.

Figure 13.5 indicates that users have high involvement in the early stages of the SDLC, lower involvement in the programming and testing stage, and higher involvement in the later stages. **Table 13.2** discusses the advantages and disadvantages of the SDLC and of other systems acquisition methods, which will be described in Section 13.4.

systems analysts

IS professionals who specialize in analyzing and designing information systems.

programmers IS professionals who modify existing computer programs or write new computer programs to satisfy user requirements.

technical specialists Experts on a certain type of technology, such as databases or telecommunications.

systems stakeholders

All people who are affected by changes in information systems.

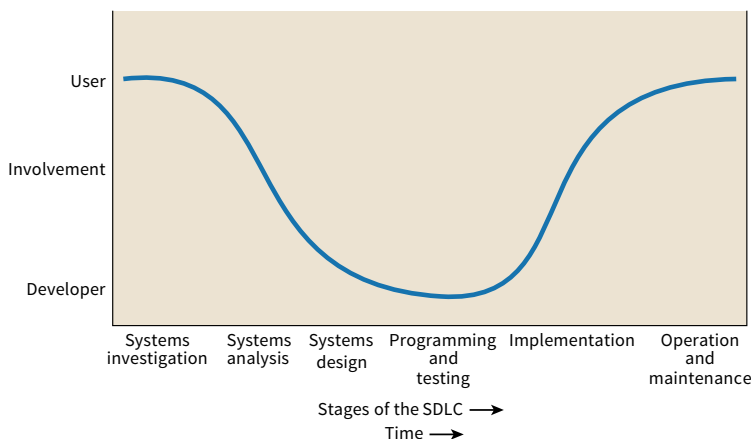


FIGURE 13.5 Comparison of user and developer involvement over the SDLC.

TABLE 13.2 Advantages and Disadvantages of System Acquisition Methods

Traditional Systems Development (SDLC)	
Advantages	Disadvantages
• Forces staff to systematically go through every step in a structured process • Enforces quality by maintaining standards • Has lower probability of missing important issues in collecting user requirements	• May produce excessive documentation • Users may be unwilling or unable to study the approved specifications • Takes too long to progress from the original ideas to a working system • Users have trouble describing requirements for a proposed system
Prototyping	
Advantages	Disadvantages
• Helps clarify user requirements • Helps verify the feasibility of the design • Promotes genuine user participation • Promotes close working relationship between systems developers and users • Works well for ill-defined problems • May produce part of the final system	• May encourage inadequate problem analysis • Is not practical with large number of users • User may not want to give up the prototype when the system is completed • May generate confusion about whether the system is complete and maintainable • System may be built quickly, but can result in lower quality
Joint Application Design (JAD)	
Advantages	Disadvantages
• Involves many users in the development process • Saves time • Generates greater user support for the new system • Improves the quality of the new system • The new system is easier to implement • The new system has lower training costs	• Difficult to get all users to attend the JAD meeting • Subject to all of the problems associated with any group meeting
Integrated Computer-Assisted Software Engineering (ICASE)	
Advantages	Disadvantages
• Can produce systems with a longer effective operational life • Can produce systems that closely meet user requirements • Can speed up the development process • Can produce systems that are more flexible and adaptable to changing business conditions • Can produce excellent documentation	• Systems are often more expensive to build and maintain • Requires more extensive and accurate definition of user requirements • Difficult to customize the end product
Rapid Application Development (RAD)	
Advantages	Disadvantages
• Can speed up systems development • Users are intensively involved from the start • Improves the process of rewriting legacy applications	• Produces functional components of final systems, but not the final systems themselves
End-User Development	
Advantages	Disadvantages
• Bypasses the IS department and avoids delays • User controls the application and can change it as needed • Directly meets user requirements • Promotes increased user acceptance of new system • Frees up IT resources	• May eventually require maintenance from IS department • Documentation may be inadequate • Leads to poor quality control • System may not have adequate interfaces to existing systems • May create lower-quality systems
Object-Oriented Development	
Advantages	Disadvantages
• Objects model real-world entities • New systems may be able to reuse some computer code	• Works best with systems of more limited scope (i.e., with systems that do not have huge numbers of objects)

Systems Investigation

The initial stage in a traditional SDLC is systems investigation. Systems development professionals agree that the more time they invest in (1) understanding the business problem to be solved, (2) specifying the technical options for the systems, and (3) anticipating the problems they are likely to encounter during development, the greater the chances of success. For these reasons, **systems investigation** addresses *the business problem* (or business opportunity) by means of a feasibility study.

The primary task in the systems investigation stage is the feasibility study. Organizations have three basic solutions to any business problem relating to an information system: (1) do nothing and continue to use the existing system unchanged, (2) modify or enhance the existing system, or (3) develop or acquire a new system. The **feasibility study** analyzes which of these three solutions best fits the particular business problem. It also provides a rough assessment of the project's technical, economic, and behavioural feasibility.

- **Technical feasibility** determines whether the company can develop or otherwise acquire the hardware, software, and communications components needed to solve the business problem. Technical feasibility also determines whether the organization can use its existing technology to achieve the project's performance objectives.
- **Economic feasibility** determines whether the project is an acceptable financial risk and, if so, whether the organization has the necessary time and money to successfully complete the project. You have already learned about the commonly used methods to determine economic feasibility: NPV, ROI, break-even analysis, and the business case approach.
- **Behavioural feasibility** addresses the human issues of the systems development project. You will be heavily involved in this aspect of the feasibility study.

After the feasibility analysis is completed, a go/no-go decision is reached by the steering committee if there is one or by top management in the absence of a committee. The go/no-go decision does not depend solely on the feasibility analysis. Organizations often have more feasible projects than they can fund. Therefore, the firm must prioritize the feasible projects and pursue those with the highest priority. Unfunded feasible projects may not be presented to the IT department at all. These projects therefore contribute to the *hidden backlog*, which are projects that the IT department is not aware of.

If the decision is no-go, then the project is either put on the shelf until conditions are more favourable or it is discarded. If the decision is go, then the project proceeds, and the systems analysis phase begins.

Systems Analysis

Once a development project has the necessary approvals from all participants, the systems analysis stage begins. **Systems analysis** is the process whereby systems analysts examine the business problem that the organization plans to solve with an information system.

The primary purpose of the systems analysis stage is to gather information about the existing system to determine the requirements for an enhanced system or a new one. The end product of this stage, known as a *deliverable*, is a set of *system requirements*.

Arguably, the most difficult task in systems analysis is to identify the specific requirements that the system must satisfy. These requirements are often called *user requirements*, because users (meaning you) provide them. When the systems developers have accumulated the user requirements for the new system, they proceed to the systems design stage.

Systems Design

Systems design describes how the system will resolve the business problem. The deliverable of the systems design phase is the set of *technical system specifications*, which specify the following:

- System outputs, inputs, calculations or processing, and user interfaces
- Hardware, software, databases, telecommunications, personnel, and procedures
- A blueprint of how these components are integrated

systems investigation The initial stage in the traditional SDLC that addresses the business problem (or business opportunity) by means of a feasibility study.

feasibility study Investigation that gauges the probability of success of a proposed project and provides a rough assessment of its feasibility.

systems analysis The examination of the business problem that the organization plans to solve with an information system.

systems design Describes how the new system will resolve the business problem.

scope creep Adding functions to an information system after the project has begun.

programming The translation of a system's design specifications into computer code.

implementation The process of converting from an old computer system to a new one.

direct conversion

Implementation process in which the old system is cut off and the new system is turned on at a certain point in time.

pilot conversion

Implementation process that introduces the new system in one part of the organization on a trial basis. When the new system is working properly, it is introduced in other parts of the organization.

phased conversion

Implementation process that introduces components of the new system in stages, until the entire new system is operational.

parallel conversion

Implementation process in which the old and new systems operate simultaneously for a time.

When the system specifications are approved by all participants, they are “frozen.” That is, they should not be changed. Adding functions after the project has been initiated causes **scope creep**, in which the time frame and expenses associated with the project expand beyond the agreed-upon limits. Scope creep endangers both the project's budget and its schedule. Because scope creep is expensive, successful project managers place controls on changes requested by users. These controls help to prevent runaway projects.

Programming and Testing

If the organization decides to construct the software in-house, then programming begins. **Programming** involves translating the design specifications into computer code. This process can be lengthy and time-consuming, because writing computer code is as much an art as it is a science. Large-scale systems development projects can involve hundreds of computer programmers who are charged with creating hundreds of thousands of lines of computer code. These projects employ programming teams, which often include functional area users, who help the programmers focus on the business problem.

Thorough and continuous testing occurs throughout the programming stage. Testing is the process that assesses whether the computer code will produce the expected and desired results. It is also intended to detect errors, or bugs, in the computer code.

Implementation

Implementation (or *deployment*) is the process of converting from an old computer system to a new one. The conversion process involves organizational change. Both end users and the MIS department work together to manage organizational change. The MIS department typically does not have enough credibility with the business users to manage the change process. Organizations use three major conversion strategies: direct, pilot, and phased.

In a **direct conversion**, the old system is cut off and the new system is turned on at a certain point in time. This type of conversion is the least expensive. It is also the riskiest because, if the new system does not work as planned, there is no support from the old system. However, even with these risks, most systems are implemented using direct conversion.

A **pilot conversion** introduces the new system in one part of the organization, such as in one plant or one functional area. The new system runs for a period of time and is then assessed. If the assessment confirms that the system is working properly, then it is implemented in other parts of the organization.

A **phased conversion** introduces components of the new system, such as individual modules, in stages. Each module is assessed. If it works properly, then other modules are introduced until the entire new system is operational. Large organizations commonly combine the pilot and phased approaches. That is, they execute a phased conversion using a pilot group for each phase.

A fourth strategy is **parallel conversion**, in which the old and new systems operate simultaneously for a time. This strategy is seldom used today. One reason is that parallel conversion is totally impractical when both the old and new systems are online. Imagine that you are completing an order on Amazon, only to be told, “Before your order can be entered here, you must provide all the same information again, in a different form, and on a different set of screens.” The results would be disastrous for Amazon. Regardless of the type of implementation process that an organization uses, the new system may not work as advertised. In fact, the new system may cause more problems than the old system that it replaced. A variation, called a “historic parallel,” is used in which real transactions are run through the new system and the results compared to the old system before the new systems are moved in for live usage.

Operation and Maintenance

After the new system is implemented, it will operate for some time, until (like the old system it replaced) it no longer meets its objectives. Once the new system's operations are stabilized, the company performs audits to assess the system's capabilities and to determine if it is being used correctly.

Systems require several types of maintenance. The first type is *debugging* the program, a process that continues throughout the life of the system. The second type is *updating* the system to accommodate changes in business conditions. An example is adjusting to new governmental regulations, such as changes in tax rates. These corrections and upgrades usually do not add any new functions. Instead, they simply help the system continue to achieve its objectives. In contrast, the third type of maintenance *adds new functions* to the existing system without disturbing its operation.

Before you go on...

1. Describe the feasibility study.
2. What is the difference between systems analysis and systems design?
3. Describe structured programming.
4. What are the four conversion methods?

13.4

Alternative Methods and Tools for Systems Development

LEARNING OBJECTIVE

Describe alternative development methods and the tools that augment these methods.

Alternative methods for systems development include joint application design, rapid application development, agile development, and end-user development.

Joint Application Design

Joint application design (JAD) is a group-based tool for collecting user requirements and creating system designs. It is most often used within the systems analysis and systems design stages of the SDLC. JAD involves a group meeting attended by the analysts and all of the users that can be conducted either in person or through the computer. During this meeting, all users jointly define and agree on the systems requirements. This process saves a tremendous amount of time. Table 13.2 lists the advantages and disadvantages of the JAD process.

joint application design (JAD) A group-based tool for collecting user requirements and creating system designs.

Rapid Application Development

Rapid application development (RAD) is a systems development method that can combine JAD, prototyping, and integrated computer-assisted software engineering (ICASE) tools (discussed later in this section) to rapidly produce a high-quality system. In the first RAD stage, developers use JAD sessions to collect system requirements. This strategy ensures that users are intensively involved early on. The development process in RAD is iterative; that is, requirements, designs, and the system itself are developed and then undergo a series, or sequence, of improvements. RAD uses ICASE tools to quickly structure requirements and develop prototypes. As the prototypes are developed and refined, users review them in additional JAD sessions. RAD produces the functional components of a final system rather than prototypes. To understand how RAD functions and how it differs from SDLC, see [Figure 13.6](#). Table 13.2 highlights the advantages and disadvantages of the RAD process.

rapid application development (RAD) A development method that uses special tools and an iterative approach to rapidly produce a high-quality system.

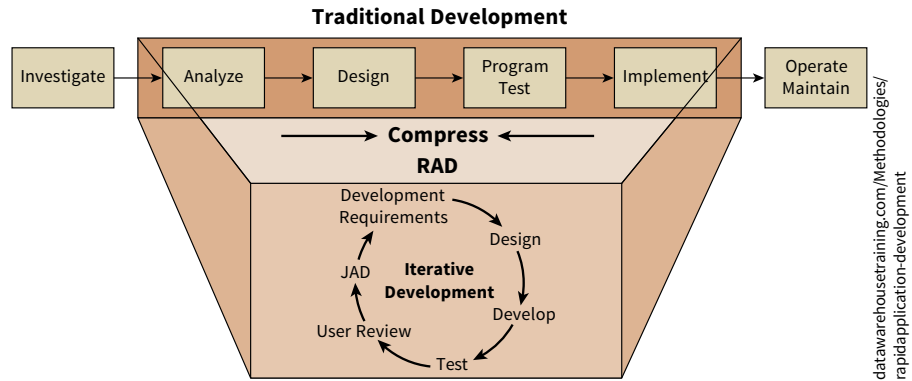


FIGURE 13.6 A rapid prototyping development process versus SDLC.

Agile Development

agile development

A software development methodology that delivers functionality in rapid iterations, measured in weeks, requiring frequent communication, development, testing, and delivery.

Agile development is a software development methodology that delivers functionality in rapid iterations, which are usually measured in weeks. To be successful, this methodology requires frequent communication, development, testing, and delivery. Agile development focuses on rapid development and frequent user contact to create software that addresses business users' needs. This software does not have to include every possible feature the user will require. Rather, it must meet only the user's more important and immediate needs. It can be updated later to introduce additional functions as they become necessary. The core tenet of agile development is to do only what you have to do to be successful right now.

One type of agile development uses the *scrum approach*. A key principle of scrum is that, during a project, users can change their minds about what they want and need. Scrum acknowledges that a development problem cannot be fully understood or defined from the start. Therefore, scrum focuses on maximizing the development team's ability to deliver iterations quickly and to respond effectively to additional user requirements as they emerge.

Scrum contains sets of practices and predefined roles. The primary roles are:

- **Scrum master:** Maintains the processes (typically replaces a project manager)
- **Product owner:** Represents the business users and any other stakeholders in the project
- **Team:** A cross-functional group of about seven people who perform the actual analysis, design, coding, implementation, and testing

Scrum works this way: during each *sprint*—typically a two- to four-week period—the team creates a potentially shippable product increment, such as working and tested software. The set of features that goes into each sprint comes from the product backlog, which is a prioritized set of high-level work requirements to be completed.

The sprint planning meeting determines which backlog items will be addressed during a sprint. During this meeting, the product owner informs the team of the items in the product backlog that they want to have completed. The team members then determine how many of these projects they can commit to during the next sprint, and they record this information in the sprint backlog.

During a sprint, no one is allowed to change the sprint backlog, which means that the requirements are frozen for the sprint. Each sprint must end on time. If the requirements are not completed for any reason, then they are left out and returned to the product backlog. After each sprint is completed, the team demonstrates how to use the software.

An interesting type of agile development is a methodology called *minimum viable product (MVP)* development. Applications developed using MVP methodology have just the required amount of functionality to operate successfully. On the other hand, MVP applications do not have so much functionality (i.e., too many features) that the development process takes too long and cost too much.

DevOps

DevOps (a combination of “development” and “operations”) is a practice that was first presented in 2009 and has really gained traction in the last few years. DevOps is a form of software development that brings the developers and the users (operations) together throughout the entire process with the goal of reducing the time to deployment, increasing the usability of the finished product, and lowering the cost of new app development.

There are several factors that have increased the applications of DevOps methodology. First, organizations have less time to develop and deploy applications, there is less room for error, and the number of applications being developed is on the rise. In fact, a recent study showed that most organizations plan to release 17 applications each year. The DevOps framework is a solid response to the business pressures organizations face today.

End-User Development

End-user development is an approach in which the organization’s end users develop their own applications with little or no formal assistance from the IT department. Table 13.2 lists the advantages and disadvantages of end-user development. Sometimes this form of IT development or acquisition is called **Shadow IT** (also known as *Stealth IT* or *Rogue IT*). Although, if the end users bypass the IT department, it might make it easier for them to adopt the tools that they want to work with, this process also bypasses the security measures that the IT department is trying to enforce. These shadow IT systems can open up systems to vulnerabilities and create avenues for criminals to access private company and customer data. As an employee, it is important to be very cautious about adopting something that has not been approved by your organization. If your Shadow IT creates a vulnerability that allows a breach, you will probably lose your job!

end-user development

Approach in which the organization’s end users develop their own applications with little or no formal assistance from the IT department.

shadow IT Technology implemented by end users without receiving proper approvals from the organizational IT department.

Tools for Systems Development

Several tools can be used with various systems development methods. These tools include prototyping, integrated computer-assisted software engineering, component-based development, and object-oriented development. These tools focus on improving the effectiveness of the design and development process. A soft skill, *design thinking*, is important to enhance user-IT collaboration.

Design Thinking Design thinking is a user-centred approach to application development. As you saw in the discussion of the SDLC, users’ needs are considered at the very beginning of the process and users are considered in all development methodologies. Unfortunately, development teams often move away from users’ needs as they move toward the technical development of applications, integrations, implementations, and other considerations. Design thinking is an approach that, when used in conjunction with other development methodologies, will keep the user’s needs front and centre, increasing the chances that the project will be successful. There are five steps to the design thinking process.

(1) *Empathize*: Empathy is the ability to see how a situation could feel to another person. Empathy does not mean you agree with the feeling, problem, or situation. Rather, you simply learn to see it as the other person does. In the design process, this helps designers and managers to set aside their own assumptions and feelings in order to see the situation as if they were the person who would be the recipient of the final product. This is critical to successful IT projects and the reason why so many projects today include users in the entire process.

(2) *Define*: In the Define stage, the problem is defined from the perspective of the user that the developers empathized with in the first stage. The problem is not stated in terms of systems, managerial goals, or corporate strategy. Rather, the focus is kept on the user and how the outcome of the project will change how they accomplish their tasks.

(3) *Ideate*: Brainstorming comes in many forms and methods. The important thing at this stage is that ideas are based on steps 1 and 2. Ideas are more likely to move the team toward a successful outcome when they are generated from a well-formed, empathy-based problem

statement. There is no magic potion, except that all ideas have to stay aligned with the first two stages.

(4) *Prototype and Test*: Design thinking can incorporate any of the development tools discussed below and any of the methods presented above. SDLC, RAD, JAD, and Agile all include users, but not to the extent or in the fashion of the design thinking process.

Design thinking is presented here as a linear process, but in practice, it is very non-linear. The goal is to keep these considerations at the top of your mind during the entire project. For example, as you prototype and test a program, you will likely deepen your empathy for the users, which can improve ideas and future iterations of the application.

prototyping An approach that defines an initial list of user requirements, builds a prototype system, and then improves the system in several iterations based on users' feedback.

prototype A small-scale working model of an entire system or a model that contains only the components of the new system that are of most interest to the users.

computer-aided software engineering (CASE)

Development approach that uses specialized tools to automate many of the tasks in the SDLC.

upper CASE tools Tools that are used to automate the early stages of the SDLC (systems investigation, analysis, and design).

lower CASE tools Tools used to automate later stages in the SDLC (programming, testing, operation, and maintenance).

integrated CASE (ICASE) tools CASE tools that provide links between upper CASE and lower CASE tools.

component-based development A software development methodology that uses standard components to build applications.

object-oriented development A systems development methodology that begins with aspects of the real world that must be modelled to perform a task.

Prototyping The **prototyping** approach defines an initial list of user requirements, builds a model of the system, and then refines the system in several iterations based on users' feedback. Developers do not try to obtain a complete set of user specifications for the system at the outset, and they do not plan to develop the system all at once. Instead, they quickly develop a smaller version of the system known as a **prototype**. A prototype can take two forms. In some cases, it contains only the components of the new system that are of most interest to the users. In other cases, it is a small-scale working model of the entire system.

Users make suggestions for improving the prototype based on their experiences with it. The developers then review the prototype with the users and use their suggestions to refine it. This process continues through several iterations until the users approve the system or it becomes apparent that the system cannot meet the users' needs. If the system is viable, then the developers can use the prototype to build the full system. One typical use of prototyping is to develop screens that a user will see and interact with. Table 13.2 describes the advantages and disadvantages of the prototyping approach.

A practical problem with prototyping is that a prototype usually looks more complete than it actually is. That is, it may not use the real database, it usually does not have the necessary error checking, and it almost never includes the necessary security features. Users who review a prototype that resembles the finished system may not recognize these problems. Consequently, they might have unrealistic expectations about how close the actual system is to completion.

Integrated Computer-Assisted Software Engineering Tools **Computer-aided software engineering (CASE)** refers to a group of tools that automate many of the tasks in the SDLC. Tools that are used to automate the early stages of the SDLC (systems investigation, analysis, and design) are called **upper CASE tools**. Tools used to automate later stages in the SDLC (programming, testing, operation, and maintenance) are called **lower CASE tools**. CASE tools that provide links between upper CASE and lower CASE tools are called **integrated CASE (ICASE) tools**. Table 13.2 lists the advantages and disadvantages of ICASE tools.

Component-Based Development **Component-based development** uses standard components to build applications. Components are reusable applications that generally have one specific function, such as a shopping cart, user authentication, or a catalogue. Compared with other approaches, component-based development generally involves less programming and more assembly. Component-based development is closely linked with the idea of Web services and service-oriented architectures, which you will study in Technology Guide 3.

Many startup companies are pursuing the idea of component-based application development. One example is Ning (www.ning.com), which allows organizations to create, customize, and share their own social network.

Object-Oriented Development **Object-oriented development** is based on a different view of computer systems than the perception that characterizes traditional development approaches. Traditional approaches can produce a system that performs the original task but may not be suited for handling other tasks. This limitation applies even when these other tasks involve the same real-world entities. For example, a billing system will handle billing, but it probably cannot be adapted to handle mailings for the marketing department or to generate leads for the sales force. This is true even though the billing, marketing, and sales functions all use similar data, including customer names, addresses, and purchases. In

contrast, an *object-oriented (OO) system* begins not with the task to be performed, but with the aspects of the real world that must be modelled to perform that task. Therefore, in our example, if the firm has a good model of its customers and its interactions with them, then it can use this model equally well for billings, mailings, and sales leads.

The development process for an object-oriented system begins with a feasibility study and an analysis of the existing system. Systems developers identify the *objects* in the new system—the fundamental elements in OO analysis and design. Each object represents a tangible, real-world entity such as a customer, bank account, student, or course. Objects have *properties*, or *data values*. For example, a customer has an identification number, a name, an address, an account number(s), and so on. Objects also contain the *operations* that can be performed on their properties. For example, operations that can be performed on the customer object may include obtain-account-balance, open-account, withdraw-funds, and so on. Operations are also referred to as *behaviours*.

This approach enables OO analysts to define all the relevant objects needed for the new system, including their properties and operations. The analysts then model how the objects interact to meet the objectives of the new system. In some cases, analysts can reuse existing objects from other applications (or from a library of objects) in the new system. This process saves the analysts the time they otherwise would spend coding these objects. In most cases, however, even with object reuse, some coding will be necessary to customize the objects and their interactions for the new system.

Containers Containers are a method of developing applications that run independently of the server's base operating system. Containers allow application providers to develop, test, and deploy technology that will always run in practice exactly like it does in testing. This would allow software to be developed more rapidly. Primarily, they provide a level of portability that has brought about one of the biggest shifts in application development in years.

To better understand containers, imagine that your vehicle is a container. You only interact with the environment inside the vehicle (the container). Your vehicle can travel on different types of terrain (platforms), but you do the same things inside (e.g., use the gas, brakes, lights, signals). The vehicle (container) has features built in to help manage the external environment (e.g., tires, shocks, windshield wipers). Containers have begun to revolutionize the speed of development because developers can focus on the container rather than the environments.

Application developers have always been plagued with platform challenges. (A platform is an underlying computer system on which application programs can run. On personal computers, Windows and Mac OS X are examples of platforms.) As one example, if a developer built an application in a Windows environment, then it might not run properly if it were deployed after a Windows update. In addition, it probably would not work in a Linux environment. Furthermore, multiple versions of an application need to be developed to run on different environments, and they have to be continuously tested on platform updates.

One solution for this problem is to build and test applications on a virtual machine and then implement them on an identical virtual machine for customers. A *virtual machine* is a self-contained operating environment that behaves as if it were a separate physical computer. Building and testing on a virtual machine ensures that an application developed on one platform will run on a different platform. But what if you could develop an application that included its own environment and would run as it was developed regardless of the operating system on which it was deployed? That is exactly the idea behind a container.

Containers are not new; in fact, they have been tested since 2005. However, they were not widely embraced by mainstream IT leaders until 2014. Their increased popularity is largely due to Docker, an open-source project by Docker, Inc. (www.docker.com). Docker is a Linux-based product that enables applications to be developed and deployed in a container. Docker-created apps will run on any platform.

containers A method of developing applications that run independently of the server's base operating system.

Low-Code/No-Code Development Platform Low-Code Development Platforms (LCDPs) make use of visual interfaces to develop applications rather than traditional procedural hand-coding. LCDPs were first described as “no-code” but this was not practical because any integration with other existing systems relied on code. The amount of code necessary was reduced, but not removed, so the name “low-code” was adopted for this tool. This method allows

for more rapid app development (because it reduces the amount of code that has to be written), and an expansion of the people who can contribute to a project. LCDPs allow non-technical users to provide input and efforts into app development. LCDPs will help to extend end-user development by making it easier to produce new programs with less formal training.

Apple has introduced a new enterprise development platform with low-code/no-code capabilities. Its product, called Claris Connect, allows users with little to no programming experience to stitch together apps by connecting components of popular online services such as Trello, Slack, DocuSign, and Box, among others. Claris Connect uses a drag-and-drop interface for users to create workflows. Similarly, on the consumer side, Apple has created an app called “Shortcuts” that is a drag-and-drop development that also stitches together apps that are installed on users’ devices. It creates automation, reminders, and triggers to create workflows across apps, saving users time and effort.

No-code is exactly that. No code is required from the programmer. Visual tools are used to drag and drop components to design functional apps. Both low-code and no-code are discussed in the closing case. One example of no-code is Robotic Process Automation (RPA). This emerging technology is discussed in IT’s About Business 13.2.

IT’s About Business 13.2

Robotic Process Automation

When people hear the term “robotic,” they might think of R2D2 from *Star Wars*. The term “process” might create images of workflow, steps, procedures, and directions. “Automation” likely brings to mind an assembly line with robots performing repetitive tasks.

But what is robotic process automation (RPA), also known as software robotics, within the context of digital computer technology? To answer this question, we first need to define a robot as any technology that can be programmed to complete a repetitive task independent of outside user interaction. We then need to define automation within the context of any physical or intellectual workflow.

Let’s consider one example before we define RPA. Think about a smartphone. It does many things for you. These actions are referred to as *shortcuts*. In addition, you can customize many of these shortcuts to match your specific needs. For example, your phone can send a command to turn your home lights on or off when you reach a specific location. You can also install shortcuts to communicate your arrival time, identify music, compare prices, create GIFs, and more. The possibilities are almost endless. These shortcuts are designed to automate a series of tasks. All you need to do is trigger the shortcut. It will then open the app and navigate through the steps for you.

Within this context, we will now define RPA: RPA is an emerging technology that replaces human effort by programming computers to perform repetitive, mundane tasks using rules. Computers can perform these tasks faster and more consistently than humans. RPA mimics human actions within digital systems just as assembly-line robots mimic human activities on a physical product. With this technology, organizations can automate rule-based, repetitive tasks by building shortcuts that accurately complete mundane work for their business operations.

Why Are Companies Investing in Robotic Process Automation?

Many companies are using RPA to streamline their operations and cut costs by improving efficiency and accuracy. RPA also frees employees from routine, repetitive tasks so they can focus on higher-value work.

PA operates in three ways: attended, unattended, and hybrid. We will define each of these and then present applications and examples.

Attended RPA is a method that an employee triggers. For example, imagine an employee who is copying product information from the sales system into the inventory system. This process involves more than 10 steps. With RPA, the employee can run a program to perform the same process. However, the employee has to launch the process: it is not automatic.

Unattended RPA is an event-based method that does not require human interaction to run. When a specific event occurs, the RPA launches a sequence of tasks. The trigger is typically time-based, enabling unattended RPA to run according to a predetermined schedule. However, it can also be based on other events.

Hybrid RPA is the most common type of RPA. An end-to-end workflow generally employs attended and unattended RPA that work together to complete a task. For example, an unattended RPA could analyze data and present the output to a user. After considering the insights, the user identifies a solution and utilizes attended RPA to execute the next series of actions. Together, these activities make up a hybrid RPA process.

Applications

Now that we understand what RPA is and how it functions, we will examine several applications where RPA has impacted and will continue to impact daily routines.

Returns processing has traditionally been a costly manual process (see IT’s About Business 11.2). With RPA, companies can manage returns faster and less expensively. RPA software can manage the bulk of the process, which includes a series of repetitive steps. Each organization’s process is unique, but most systems perform the same basic actions: (1) send a message acknowledging that the return has been received, (2) update the inventory, (3) make a payment adjustment to the customer, and (4) update the internal billing system. RPA can easily automate these tasks.

Customer service agents deal with situations that vary from routine to highly unique. However, the process of gathering the necessary information is the same. When a customer contacts customer service with a question or problem, several pieces of data are necessary to identify the customer and the order. Many organizations have turned to RPA-driven chatbots to gather information and direct customers to the correct agent. RPA enables organizations to resolve problems more quickly, thereby enhancing customer satisfaction.

Manufacturing has utilized RPA to automate accounts payable, invoice processing, and supply chain management. RPA can also order standardized inventory, report inventory levels, send automated reports to management, file invoices, drive sales, and handle data management for better reporting standards. Employing RPA to execute these processes improves the consistency and accuracy of the data.

Health care involves numerous manual tasks, each of which affects patient satisfaction. A single appointment to a medical facility involves numerous activities: processing invoices, managing claims, scheduling appointments, billing, and so on. Today, RPA performs all these functions. In addition, it contributes to a faster patient checkout experience.

Cybersecurity employs RPA to improve security within applications, secure networks, and enhance threat prevention. RPA can also minimize potential attacks and threats by providing continuous protection. It can perform routine audits and help to eliminate unauthorized access. If a security breach occurs, RPA can quickly lock down the system and contact the appropriate individual or group. Without this rapid intervention, a breach can develop into a large-scale attack.

Benefits of RPA

RPA can increase a team's work capacity by 35 to 50 percent. For example, a task such as copying and pasting information between business systems can be done 30 to 50 percent faster when RPA is used. Additionally, organizations report improved compliance (92 percent), better accuracy and quality (90 percent), enhanced productivity (86 percent), and reduced costs (59 percent). According to a 2022 Forrester research report, the market for RPA software solutions is expected to reach US \$22 billion by 2025.

RPA is growing in popularity and application. It streamlines workflows, which makes organizations more profitable, flexible, and responsive. It also increases employee satisfaction, engagement, and productivity by freeing them from mundane tasks. RPA can be rapidly deployed, and it can accelerate digital transformation. It is a growing field with a bright future.

And why shouldn't it be? After all, we like shortcuts on our phones. Why wouldn't we like them for work?

Potential Difficulties with RPA

RPA is an extension of other forms of automation that can increase efficiency and eliminate the need for repetitive tasks. This can improve a job, making it more challenging, but it can also cut the workforce. Consequently, organizational culture will need to facilitate job training or relocation, focusing more on team-based and analytical skills. Innovation should be encouraged and assisted.

How does RPA compare to other forms of workflow automation? For example, organizations have automatic matching of information from multiple sources (e.g., matching a receiving document to an invoice to make sure that you only pay for what you received). It becomes RPA when machine learning, natural language processing, specified reasoning (advanced rules), or complex analyses are included. It can be difficult for organizations to implement such systems accurately, which requires systematic monitoring to implement multiple RPAs and assist the system in learning to deal with exceptions. Skilled people are still needed.

Questions

1. What is RPA?
2. Identify and explain the three types of RPA.
3. Why are organizations so interested in RPA initiatives?
4. Discuss how organizations can prevent RPA disadvantages.

Sources: Compiled from A. Singh, "What Is Robotic Process Automation and How Can It Save You Time?" *makeuseof.com*, October 22, 2022; L. Raj, "Leveraging AI To Empower Your Knowledge Workforce," *Forbes*, October 18, 2022; J. Duez, "Surviving The Perfect Storm," *Forbes*, October 17, 2022; C. Basu Mallick, "What Is Robotic Process Automation (RPA)? Meaning, Working, Software, and Uses," *Spiceworks*, October 11, 2022; E. Ajao, "RPA vendor Automation Anywhere aims at process discovery," *TechTarget*, October 4, 2022; J. Bloomberg, "How UiPath hopes to reinvent enterprise automation," *SiliconANGLE*, October 1, 2022; J. Edwards, "Is Robotic Process Automation (RPA) the Next Big Thing in Automation?" *readwrite.com*, July 16, 2022; IBM, "What is robotic process automation (RPA)?" *ibm.com*, April 21, 2023, from: <https://www.ibm.com/topics/rpa>; T. Olavsrud and C. Boulton, "What is RPA? A revolution in business process automation," *CIO*, June 29, 2022; D. Edwards, "How is Robotic Process Automation revolutionising businesses around the world?" April 20, 2022; L. Joseph and B. Schaffrik, "The RPA Market Will Grow To \$22 Billion By 2025," *Forrester*, February 22, 2022; K. Casey, "4 Robotic Process Automation (RPA) trends to watch in 2022," *The Enterprisers Project*, January 6, 2022; S. Pritchard, "How robotic process automation is getting smarter as it evolves," *ComputerWeekly*, April 12, 2021; K. Casey, "How to explain Robotic Process Automation (RPA) in plain English," *The Enterprisers Project*, July 30, 2020; <https://www.microsoft.com/en-us/worklab/work-trend-index/>, accessed October 24, 2022.

You have studied many methods that can be used to acquire new systems. Table 13.2 provides an overview of the advantages and disadvantages of each of these methods.

Before you go on...

1. Describe the tools that augment the traditional SDLC.
2. Describe the alternate methods that can be used for systems development other than the SDLC.

What's in IT for me?

ACCT For the Accounting Major

Accounting personnel help perform cost-benefit analyses on proposed projects. They may also monitor ongoing project costs to keep them within budget. Accounting personnel will undoubtedly find themselves involved with systems development at various points throughout their careers.

FIN For the Finance Major

Finance personnel are frequently involved with the financial issues that accompany any large-scale systems development project (e.g., budgeting). They also are involved in cost-benefit and risk analyses. To perform these tasks, they need to stay abreast of the emerging techniques used to determine project costs and ROI. Finally, because they must manage vast amounts of information, finance departments are also common recipients of new systems.

MKT For the Marketing Major

In most organizations, marketing, like finance, involves massive amounts of data and information. Like finance, then, marketing is also a hotbed of systems development. Marketing personnel will increasingly find themselves participating in systems development teams. Such involvement increasingly means helping to develop systems, especially Web-based systems that reach out directly from the organization to its customers.

POM For the Production/Operations Management Major

Participation in development teams is a common role for production/operations people. Manufacturing is becoming increasingly

computerized and integrated with other allied systems, from design to logistics to customer support. Production systems interface frequently with marketing, finance, and human resources. They may also be part of a larger enterprise-wide system. Also, many end users in POM either develop their own systems or collaborate with IT personnel on specific applications.

HRM For the Human Resources Management Major

The human resources department is closely involved with several aspects of the systems acquisitions process. Acquiring new systems may require hiring new employees, changing job descriptions, or terminating employees. Human resources staff perform all of these tasks. Furthermore, if the organization hires consultants for the development project, or outsources it, the human resources department may handle the contracts with these suppliers.

MIS For the MIS Major

Regardless of the approach that the organization adopts when acquiring new systems, the MIS department spearheads it. If the organization chooses either to buy or to lease the application, the MIS department leads in examining the offerings of the various vendors and negotiating with the vendors. If the organization chooses to develop the application in-house, then the process falls to the MIS department. MIS analysts work closely with users to develop their information requirements. MIS programmers then write the computer code, test it, and implement the new system.

Summary

13.1 Discuss the different cost-benefit analyses that companies must consider when they formulate an IT strategic plan.

The four common approaches to cost-benefit analysis are the following:

1. *The net present value* method converts future values of benefits to their present-value equivalent by discounting them at the organization's cost of funds. It can then compare the present value of the future benefits with the cost required to achieve those benefits to determine whether the benefits exceed the costs.
2. *Return on investment* measures management's effectiveness in generating profits with its available assets. ROI is calculated by dividing net income attributable to a project by the average assets invested in the project. ROI is a percentage, and the higher the percentage return, the better.
3. *Break-even analysis* determines the point at which the cumulative dollar value of the benefits from a project equals the investment made in the project.
4. In the *business case approach*, system developers write a business case to justify funding one or more specific applications or projects.

13.2 Discuss the four business decisions that companies must make when they acquire new applications.

- *How much computer code does the company want to write?* A company can choose to use a totally prewritten application (write no computer code), to customize a prewritten application (write some computer code), or to customize an entire application (write all new computer code).
- *How will the company pay for the application?* Once the company has decided how much computer code to write, it must decide how to pay for it. With prewritten applications or customized prewritten applications, companies can buy them or lease them. With totally custom applications, companies use internal funding.
- *Where will the application run?* Companies must decide where to run the application. A company may run the application on its own platform or on someone else's platform (use either a software-as-a-service vendor or an application service provider).
- *Where will the application originate?* Prewritten applications can be open-source software or come from a vendor. Companies may choose to customize prewritten open-source applications or prewritten proprietary applications from vendors. They may

customize applications in-house or outsource the customization. They can also write totally custom applications in-house or outsource this process.

13.3 List and explain the primary tasks and the importance of each of the six processes involved in the systems development life cycle.

The six processes are the following:

1. *Systems investigation*: Addresses the business problem (or business opportunity) by means of the feasibility study. The main task in the systems investigation stage is the feasibility study.
2. *Systems analysis*: Examines the business problem that the organization plans to solve with an information system. Its main purpose is to gather information about the existing system to determine the requirements for the new system. The end product of this stage, known as a “deliverable,” is a set of system requirements.
3. *Systems design*: Describes how the system will resolve the business problem. The deliverable is the set of technical system specifications.
4. *Programming and testing*: Programming translates the design specifications into computer code; testing checks to see whether the computer code will produce the expected and desired results and detects errors, or bugs, in the computer code. A deliverable is the new application.
5. *Implementation*: The process of converting from the old system to the new system through three major conversion strategies: direct, pilot, and phased. Historic parallel may be used to assess the accuracy of the new system prior to implementation. A deliverable is a properly working application.
6. *Operation and maintenance*: Types of maintenance include debugging, updating, and adding new functions when needed.

13.4 Describe alternative development methods and the tools that augment these methods.

These are the *alternative methods*:

- *Joint application design (JAD)* is a group-based tool for collecting user requirements and creating system designs.

- *Rapid application development* is a systems development method that can combine JAD, prototyping, and ICASE tools to rapidly produce a high-quality system.
- *Agile development* is a software development methodology that delivers functionality in rapid iterations, which are usually measured in weeks.
- *DevOps* is a software development methodology that includes employees from the IT *DE*velopment group and the user *OP*erations group. The goal is to keep users involved in the entire development process.
- *End-user development* refers to an organization's end users developing their own applications with little or no formal assistance from the IT department.
- *Design thinking* directs developers to acquire a deep understanding of users' needs by empathizing with those needs and defining the problem from the user perspective. Ideas and prototypes are generated to address this problem. The testing phase reveals a deeper appreciation for the user, clarifying empathy, and directing future revisions to the project.
- The *prototyping* approach defines an initial list of user requirements, builds a model of the system, and then improves the system in several iterations based on users' feedback.
- *Integrated computer-aided software engineering* combines upper CASE tools (which automate systems investigation, analysis, and design) and lower CASE tools (programming, testing, operation, and maintenance).
- *Component-based development* uses standard components to build applications. Components are reusable applications that generally have one specific function, such as a shopping cart, user authentication, or a catalogue.
- *Object-oriented development* begins with the aspects of the real world that must be modelled to perform that task. Systems developers identify the objects in the new system. Each object represents a tangible, real-world entity such as a customer, bank account, student, or course. Objects have *properties*, or *data values*. Objects also contain the *operations* that can be performed on their properties.

Table 13.2 shows the advantages and disadvantages of alternative methods and tools.

Key Terms

agile development 404
 application portfolio 389
 application service provider (ASP) 396
 component-based development 406
 computer-aided software engineering (CASE) 406
 containers 407
 continuous application development 397
 direct conversion 402
 end-user development 405
 feasibility study 401
 implementation 402
 integrated CASE (ICASE) tools 406
 IS operational plan 391

IT steering committee 390
 IT strategic plan 390
 joint application design (JAD) 403
 lower CASE tools 406
 object-oriented development 406
 outsourcing 397
 parallel conversion 402
 phased conversion 402
 pilot conversion 402
 programmers 399
 programming 402
 prototype 406
 prototyping 406
 rapid application development (RAD) 403

scope creep 402
 shadow IT 405
 software-as-a-service (SaaS) 396
 systems analysis 401
 systems analysts 399
 systems design 401
 systems development life cycle (SDLC) 398
 systems investigation 401
 systems stakeholders 399
 technical specialists 399
 upper CASE tools 406

Discussion Questions

1. Discuss the advantages of a lease option over a buy option for the acquisition of an information system.
2. Why is it important for all business managers to understand the issues of IT resource acquisition?
3. Why is it important for everyone in a business organization to have a basic understanding of the systems development process?
4. Should prototyping be used on every systems development project? Why or why not?
5. Discuss the various types of feasibility studies. Why are they all needed?
6. Discuss the issue of assessing intangible benefits and the proposed solutions.
7. Discuss the reasons why end-user-developed information systems can be of poor quality. What can be done to improve this situation?

Problem-Solving Activities

1. Access www.ecommerceguide.com. Find the product review area. Read reviews of three software payment solutions. Assess them as possible software components.
2. Use an internet search engine to obtain information on CASE and ICASE tools. Select several vendors and compare and contrast their offerings.
3. Access www.ning.com. Observe how the site provides components for you to use to build applications. Build a small application at the site.
4. Enter www.ibm.com/software. Find its WebSphere Liberty product. Read recent customers' success stories. What makes this software so popular?
5. Enter the websites of Gartner (www.gartner.com), 451 Research (<https://451research.com>), and CIO (www.cio.com). Search for recent material about ASPs and outsourcing, and prepare a report on your findings.
6. Shopify (www.shopify.com/ca) is a vendor of e-business software. At its site, the company provides demonstrations illustrating the types of storefronts that it can create for shoppers. The site also provides demonstrations of how the company's software is used to create a store.
 - a. Run the Shopify demonstration to see how this is done.
 - b. What features does Shopify provide?
 - c. Does Shopify support smaller or larger stores?

What other products does Shopify offer for creating online stores? What types of stores do these products support?

Closing Case

Low-Code/No-Code Development

The Business Problem

Most companies are not in the business of writing computer code to build software applications. All companies, however, employ software applications to run their business. Furthermore, all software applications need to be regularly monitored and updated. Most organizations hire employees to perform this task. However, what do they do when the system needs a programming update, a new integration, or an extra feature added to support customers? Going further, what does an organization do when it needs to acquire an entirely new system?

Most organizations look to their IT department to address these scenarios. Today, however, the rate of change is quickly outpacing the availability of professional programmers. As a society, we are facing a developer shortage. Moreover, as the supply of programmers decreases relative to the increased demand, prices—in this case, salaries—will also increase. Consequently, many businesses cannot afford the wages that programmers can earn.

At the same time, the demand for software is increasing, and most companies cannot keep up with that demand. As a result, many IT projects simply never get completed.

The Technology Solution

What if advances in technology could help resolve this problem? Specifically, what if software designers and programmers could build programs that enable less technologically skilled workers to create programs with minimal or no coding required? This idea is referred to as *low-code/no-code* software development. Low-code/no-code applications enable employees who do not have software backgrounds to automate parts of their day-to-day responsibilities. At the same time, the IT group continues to oversee security and access rights.

Although low-code and no-code are closely related, they are not the same, and it is important to know the difference. Let's take a closer look.

Low-Code. Low-code is a rapid application development technique that utilizes visual building blocks, such as point-and-click, drag-and-drop, and pull-down menu options. This automation

enables users to focus on what makes their software unique rather than repeat the same code used in other applications.

For example, low-code might offer a drag-and-drop function that enables the user to upload files. This function would be a pre-written option: The user would simply drag-and-drop the “upload file” option into the application. They would not write the code that would access the file browser and upload and store the identified file. This function is standard and does not create a competitive advantage.

However, what the user does with that file might create a competitive advantage. For example, they could customize the file by scanning it for data, editing it, adding it to other files, or timestamping it. In contrast to the upload feature, these custom pieces need to be coded. This technique is referred to as *low-code* because only part of the process needs to be coded.

Although low-code development has limitations, it is effective when users are reorganizing workflows and updating interfaces. According to Gartner, the most common uses of low-code development are forms, workflows, and tools that replace paper, email, or spreadsheets.

From a skills perspective, low-code development lies in the middle of the app development spectrum. “Pro-code,” the traditional model, lies at one extreme, and “no-code” at the other.

No-Code. No-code development operates just as it sounds: it does not require any coding at all. No-code tools typically focus on a relatively narrow set of solutions or operations such as mobile app and chatbot builders, workflow automation, and website-design tools.

In contrast to low-code environments, where developers might be involved in scripting and manual coding, the no-code approach depends entirely on visual tools. In this situation, a user can point and click and drag and drop, but there is no direct access to the code. No-code development opens the world of technology to a whole new audience of users who are not technical experts.

No-code tools can perform a broad range of functions. For example, they can create custom user interfaces for the Web or mobile applications. They can also create dashboards for analytics, display key performance indicators, and more. No-code methods increase process automation and implement decision authorizations.

Success Stories

Intercom (www.intercom.com) provides an engagement OS; that is, a unified solution for all customer-facing areas such as sales, customer support, and marketing to collaborate. Its product enables businesses to connect with customers throughout the customer journey. Intercom’s engagement OS is a low-code/no-code platform that empowers customer support professionals to develop automation themselves rather than wait for someone in the IT group to build it.

Intercom’s next-generation Messenger enables customers to completely customize the platform with their colours, fonts, and styling to match their brand. More importantly, it allows for multiple feature configurations so a company can enable different levels of communications for different accounts. Other improvements include spaces such as “home,” “help,” or “news,” Web and mobile messengers, content suggestions based on machine learning, and checklists.

Infragistics (www.infragistics.com) designs development tools that allow customers to develop meaningful user interfaces and user experiences. The company has low-code features that accelerate the transition from the design for an application to the code production. Modifications are easy, so Infragistics users can build

and test multiple options before they fully implement an update. This process is iterative, enabling the company to engage in user-informed development until the customer experience is perfected.

The **Salesforce** (www.salesforce.com/ca/) developer product is a free low-code/no-code platform that enables users to create mobile and desktop customer relationship management applications. Examples include managing customer data, sending automatic email replies, and managing internal decision making using built-in social functions.

Students and instructors can learn how to create apps for a fictitious venture, including creating dashboards, a Web form and supporting documentation, and the database schema, via **The Max Labs Project** (www.themaxlabsproject.com). Created by Timothy Hill from San José State University, the first assignment in the Max Labs learning environment (Lab 1a) is free, while access to the others and their support systems costs US \$19.99. Max Lab Project assignments are used by universities and colleges in Canada and many other countries around the world to provide an interesting way of finding out that low-code and no-code development processes can be useful, easy to learn, and yes, even fun!

Conclusions

Modern organizations are searching for tools and strategies to overcome the gap between their software development needs and the availability of skilled programmers. Using low-code/no-code platforms empowers organizations to increase the speed of deployment while decreasing their reliance on professional programmers.

The number of tools and platforms designed to move development from IT professionals to employees in other departments will continue to grow. However, there will always be a need for skilled programmers. Thousands of legacy systems need to be prepared to work with modern information systems or even replaced. Moreover, low-code/no-code systems do not build themselves. Someone must do the work of deciding what needs to be developed, then developing the system.

Questions

1. What is low-code programming?
2. What is no-code programming?
3. How will low-code/no-code programming shift the labour needs in IT?
4. How will organizations benefit from the use of low-code/no-code platforms?

Sources: Compiled from R. Wood, “How to Balance Risk and Empowerment with Low-Code/No-Code Apps,” *Acceleration Economy*, October 20, 2022; K. Mullican, “How Low-Code/No-Code Addresses Custom Software Development Challenges,” *Acceleration Economy*, October 20, 2022; G. Hulbert, “Low-Code, Not Low Tech,” *Forbes*, October 18, 2022; J. Torres, “The Software Developer’s Fate in Low-Code/No-Code World,” *CMSWire*, October 12, 2022; Intercom, Inc., “Intercom Announces Major Updates to Its Most Used Product: The Intercom Messenger” [press release], *prnewswire.com*, October 12, 2022; P. Britt, “Low-Code and No-Code Making Inroads in Financial Services,” *CMSWire*, October 4, 2022; S. Clark, “How Low-Code/No-Code Are Changing CX Design,” *CMSWire*, September 21, 2022; A. Beatty, “Banking Gets Up to Code: Low-Code and No-Code Development That Is...,” *Finextra*, August 29, 2022; Infragistics, “Infragistics Adds Low-Code Features & UI/UX Controls for Major Frameworks in Ultimate 22.1 Toolkit Release” [press release], *globenewswire.com*, July 14, 2022; R. Cameron,

“Why Low-Code Development Is a Game Changer,” *Forbes*, July 7, 2022; V. Kruse, “Co-Code—Is This How We Deliver Value for Both IT and Business?” *diginomica.com*, June 10, 2022; D. Preez, “CEO Bill McDermott’s Next Play Will See ServiceNow Go after ERP Modernization,” *diginomica.com*, May 11, 2022; V. Aiyer, “Are No-Code Platforms Making Developers Redundant?” *Forbes*, March 14, 2022; K. Bhasin, “6 Technologists Discuss How No-Code Tools Are Changing Software Development,” *TechCrunch*, March 10, 2022; V. Takru, “The Fundamentals of Mobile Application Development:

Five Things to Consider,” *Forbes*, November 29, 2021; D. Binunsky, “How Low-Code and No-Code Solutions Compare to RAD”, *DevOps.com*, July 24, 2019; R. Sheldon, “What Are the Advantages of Rapid Application Development?,” *Tech Target*, January 5, 2018; T. Hill and W. Nance, “Innovating Business Systems Labs for Engaging iGeneration Students,” *Twenty-Second Americas Conference on Information Systems*, August 2016, https://www.researchgate.net/publication/306563083_Innovating_Business_Systems_Labs_for_Engaging_iGeneration_Students.

Artificial Intelligence

CHAPTER OUTLINE

LEARNING OBJECTIVES

14.1 Introduction to Artificial Intelligence

14.1 Explain the potential value and the potential limitations of artificial intelligence.

14.2 Machine Learning and Deep Learning

14.2 Differentiate among supervised, semi-supervised, unsupervised, reinforcement, and deep learning.

14.3 Neural Networks

14.3 Describe the structure of a neural network, and discuss how that structure contributes to the purpose of neural networks in machine learning.

14.4 Artificial Intelligence Applications

14.4 Provide use case examples of computer vision, natural language processing, robotics, image recognition, and intelligent agents.

14.5 Artificial Intelligence in the Functional Areas

14.5 Provide use case examples of artificial intelligence applications in accounting, finance, marketing, production and operations management, human resource management, and management information systems.

14.6 Appendix

14.6 Understand the process by which a neural network transforms data values from the input node to the output node and then calculates the loss function to initiate the backpropagation process.

Opening Case

MIS POM Artificial Intelligence in Amazon Fulfillment Centres

The Good News

Amazon fulfillment centres are behind every same-day delivery that we enjoy. These centres process millions of items per day, three times more than what was possible at Amazon's warehouses only a decade ago. Constantly improving technology helps Amazon remain ahead of Walmart, Target, and many other retailers, which are now adopting many of the practices that Amazon pioneered years ago. One

of these technologies is machine learning, which includes robots, computer vision systems, and productivity-tracking systems. Let's begin our discussion of Amazon's use of artificial intelligence by examining the company's fulfillment centre operations.

At the fulfillment centres, workers unload inventory items from trucks and place them on conveyor belts. The system automatically scans items as they come in, lists them for sale on the website, and generates payments for suppliers. Other workers remove products from the conveyor belts and place them on shelves. In the past, these workers physically scanned bar codes to determine where an item should go. Today, video cameras automatically identify the

items that workers take from bins, and green light beams illuminate the places on the shelves where workers should place each item.

In 2012, Amazon purchased Kiva Systems, which developed and produced warehouse robots. Previously, when a customer placed an order, workers had to walk through warehouse aisles to retrieve products from shelves, sometimes using hard-copy print-outs to locate certain items. In contrast, today the Kiva robots bring shelves of products to waiting employees, who pick the necessary items from each shelf to fulfill the order, place them in a bin, and send them along the assembly line to be packed and shipped.

Managers once used Excel spreadsheets to determine the number of workers needed at each station to keep up with customers' orders. To automate this process, Amazon spreadsheet experts met with software engineers to develop the firm's warehouse management system, which is based on machine learning.

At first, this system was error-prone and slow. It overreacted to small changes in demand, sending workers hurrying to new stations, only to send them back to their previous positions after a couple of hours, a time-consuming and wasteful process. However, the system learned from experience and improved over time.

Today, Amazon fulfillment centre managers rely on the warehouse management system's recommendations. Significantly, they can override the system if they notice a problem. For the most part, however, they follow the system's recommendations. Also, rather than have a manager at each fulfillment centre monitor the system, Amazon performs that task from a central location where managers monitor multiple warehouses simultaneously.

Today at Amazon fulfillment centres, managers watch multiple computer screens to monitor operations. Blue dots represent robots moving products around the facility, and yellow figures indicate the humans who load and unload the robots. Green lines show conveyor belts moving orders to stations and eventually to delivery trucks.

The Bad News

Another machine learning application is Amazon's productivity-tracking system. This system can measure the number of seconds it takes a worker to complete a particular task. The system instructs workers what to do on the warehouse floor, sets productivity targets, and identifies employees who fail to meet those targets. Amazon has acknowledged that its system is not perfect, but it claims that most processes in its facilities allow managers to intervene when they feel it is necessary.

Unfortunately, Amazon's productivity-tracking technology has placed intense pressure on its employees. Workers contend that the pace of work pushes them to skirt safety rules and skip rest breaks. In fact, Amazon workers in the United States and the United Kingdom stated that they skipped bathroom breaks for fear of being disciplined for idling and ultimately losing their jobs. Workers also contend that Amazon's rules create an unsafe working environment. In fact, investigations have found that the rate of serious injuries at Amazon fulfillment centres has been almost double the industry average.

Similarly, employees in the Greater Toronto Area are facing increasing pressures from Amazon. This applies to both warehouse employees and delivery drivers. According to the company's targets, drivers are expected to deliver around 17 packages per hour. They use a hand-held GPS device from Amazon called a "rabbit" that tracks their package deliveries. It is not uncommon for drivers to keep working until they deliver all their packages, even if their shift has ended. According to a driver who spoke with CBC News, he worked seven to nine days at a stretch, with barely enough time for lunch or bathroom breaks.

Like their employees, Amazon managers also work according to recommendations from the company's machine learning systems. One manager claimed that he took naps in his car after 12-hour shifts so that he could feel fresh enough to drive home.

On September 22, 2021, California Governor Gavin Newsome signed a bill into law that prohibits companies from imposing production quotas that prevent workers from complying with health and safety laws or from taking breaks to rest or use the bathroom. That same year, regulators in Washington State fined Amazon for its conduct at one warehouse, asserting that there was a direct connection between the fast pace of work and injuries at the facility. Amazon, which was appealing the fine, claimed that it was modifying its productivity-tracking tools to better identify problems that its employees face. In Ontario, Bill 148 has introduced amendments to the Employment Standards Act regarding minimum wage, scheduling, vacation and holiday pay, various leaves of absences, equal pay for equal work, and more.

Amazon has adopted the long-term goal of building fully automated fulfillment centres that would minimize, if not eliminate, human intervention. This idea remains one for the future, however. First, the company must develop a technology to teach robotic arms and hands to grasp objects of different sizes and textures.

Questions

1. Describe the benefits that Amazon realizes from its use of machine learning (ML) applications in its fulfillment centres.
2. Discuss the human resource problems that Amazon is encountering with its use of ML applications in its fulfillment centres. Describe possible technology solutions to help Amazon workers. Now, propose management solutions to help Amazon workers.
3. From an Amazon customer's perspective, do the advantages of ML applications to Amazon outweigh worker problems in the company's warehouses? Why or why not? Support your answer.

Sources: Compiled from J. P. Moorhead, "Amazon Increased Output in 2021 Orders of Magnitude More Than Carbon Emissions," *Forbes*, August 5, 2022; M. Watson, "Emerging Trend: Four Ways Amazon and Others Are Using AI to Personalize Work Schedules," *Field Technologies Online*, July 25, 2022; T. Bishop, "With New Warehouse Robots, Amazon Looks to Invent Its Way Out of Its Safety Problems," *GeekWire*, June 22, 2022; IT World Canada Staff, "Canadian Amazon Employees Make Second Attempt at Union Certification," *IT World Canada*, April 28, 2022, <https://www.itworldcanada.com/article/canadian-amazon-employees-make-second-attempt-at-union-certification/481299>, accessed June 8, 2023; R. Spiegel, "AI Comes Alive in Industrial Automation," *Design News*, December 14, 2021; N. Scheiber, "California Senate Passes Bill Reining in Amazon Labor Model," *The New York Times*, October 21, 2021; M. Kelley, L. Guerriero, and L. Ellenwood, "Workers Pushing to Unionize Amazon Say They Faced Retaliation and Unfair Tactics," *CBC News*, October 21, 2021; M. Day, "When the Boss's Boss Is a Machine," *Bloomberg BusinessWeek*, September 27, 2021; J. Diaz, "A New Law in California Aims to Protect Workers at Retail Warehouses like Amazon's," *NPR*, September 23, 2021; C. Harrington, "California Senate Passes Warehouse Workers Bill, Taking Aim at Amazon," *Ars Technica*, September 11, 2021; CBS, "Meet the Robots Inside Amazon's Fulfillment Centers," *CBS News*, June 13, 2021; Amazon Staff, "New Technologies to Improve Amazon Worker Safety," <https://www.aboutamazon.com/news/innovation-at-amazon/new-technologies-to-improve-amazon-employee-safety>, June 13, 2021; A. Stanley, "Amazon Unveils Fleet of Cutesy-Named

Robots to Make Its Warehouses Less of a Hazardous Hellscape,” *Gizmodo*, June 13, 2021; J. Morse, “Amazon Announces New Employee Tracking Tech, and Customers Are Lining Up,” *Mashable*, December 1, 2020; A. Farinacci, “AI, Robots, and Humans: Inside an Amazon Fulfillment Center,” <https://ny1.com/nyc/all-boroughs/news/2019/06/27/ai-robots-and-humans-inside-an-amazon-fulfillment-center->, June 26, 2019; B. Ames, “Amazon Unveils Xanthus and Pegasus Fulfillment Robots,” *DC Velocity*, June 6, 2019; M. Coyle, “New Robots, New Jobs,” <https://www.aboutamazon.com/news/operations/new-robots-new-jobs>, June 5, 2019; S. Herget, “Amazon Uses AI to Track and Fire Its Warehouse Workers,”

NextPit, May 1, 2019; N. Statt, “Amazon Says Fully Automated Shipping Warehouses Are at Least a Decade Away,” *The Verge*, May 1, 2019; L. Dormehl, “Amazon Is Using Smart Technology to Track Warehouse Worker Productivity,” *Digital Trends*, April 29, 2019; C. Jee, “Amazon’s System for Tracking Its Warehouse Workers Can Automatically Fire Them,” *MIT Technology Review*, April 26, 2019; S. Liao, “Amazon Warehouse Workers Skip Bathroom Breaks to Keep Their Jobs, Says Report,” *The Verge*, April 16, 2018; L. Samfiru, “Amazon HQ2: Will They Play by Ontario’s Rules?” January 18, 2018, <https://stlawyers.ca/blog-news/amazon-hq2/>, accessed June 8, 2023.

14.1 Introduction to Artificial Intelligence

LEARNING OBJECTIVE

Explain the potential value and the potential limitations of artificial intelligence.

Artificial intelligence (AI) is a subfield of computer science that studies the thought processes of humans and recreates the effects of those processes through information systems. We define **artificial intelligence** as the theory and development of information systems that are capable of performing tasks that normally require human intelligence. That is, we define AI in terms of the tasks that humans perform, rather than how humans think.

This definition raises the question, “What is *intelligent behaviour*?” The following capabilities are considered to be signs of intelligence: learning or understanding from experience, making sense of ambiguous or contradictory messages, and responding quickly and successfully to new situations.

The ultimate goal of AI is to build machines that mimic human intelligence. A widely used test to determine whether a computer exhibits intelligent behaviour was designed by Alan Turing, a British AI pioneer. The *Turing test* proposes a scenario in which a human being and a computer both pretend to be human, and a human interviewer has to identify which is the real person. Based on this standard, the intelligent systems exemplified in commercial AI products are far from exhibiting any significant intelligence.

We can better understand the potential value of AI by contrasting it with *natural (human) intelligence*. AI has several important commercial advantages over natural intelligence, but it also displays some limitations. The strengths and limitations are outlined in **Table 14.1**.

artificial intelligence (AI)

A subfield of computer science concerned with studying the thought processes of humans and recreating the effects of those processes with machines such as computers.

TABLE 14.1 The Capabilities of Natural versus Artificial Intelligence

Capabilities	Natural Intelligence	Artificial Intelligence
Preservation of knowledge	Perishable from an organizational point of view	Permanent
Duplication and dissemination of knowledge in a computer	Difficult, expensive, time-consuming	Easy, fast, inexpensive
Total cost of knowledge	Can be erratic and inconsistent, incomplete at times	Consistent and thorough
Documentation of process and knowledge	Difficult, expensive	Fairly easy, inexpensive
Creativity	Can be very high	Low, uninspired
Use of sensory experiences	Direct and rich in possibilities	Must be interpreted first; limited
Recognizing patterns and relationships	Fast, easy to explain	Still not as good as people in most cases, but in some cases better than people
Reasoning	Making use of a wide range of experiences	Good only in narrow, focused, and stable domains

strong AI Hypothetical artificial intelligence that matches or exceeds human intelligence and could perform any intellectual task that humans can.

weak AI (also called narrow AI) Artificial intelligence that performs a useful and specific function that once required human intelligence to perform and does so at human levels or better.

narrow AI See **weak AI**.

Before we proceed, it is important to distinguish between strong artificial intelligence and weak artificial intelligence. **Strong AI**—also known as *artificial general intelligence*—is *hypothetical* artificial intelligence that matches or exceeds human intelligence. In other words, it refers to the intelligence of a machine that could successfully perform any intellectual task that a human being can. Strong AI, therefore, could be considered to have consciousness or sentience. **Weak AI**—also called **narrow AI**—performs a useful and specific function that once required human intelligence to perform, and it does so at human levels or better. Common examples are character recognition, speech recognition, machine vision, robotics, data mining, medical informatics, and automated investing.

Today, systems that are labelled “artificial intelligence” are typically examples of weak AI. However, weak AI is already powerful enough to make a dramatic difference in human life. Weak AI applications enhance human endeavours by complementing what people can do. For example, when you call your bank and talk to an automated voice, you are probably talking to a weak AI program. Researchers at universities and companies around the world are building weak AI applications that are rapidly becoming more capable.

Consider chess, which weak AI systems now play better than any human. In 1997, IBM’s Deep Blue system beat the world chess champion, Garry Kasparov, for the first time. Since then, chess-playing systems have become significantly more powerful.

In December 2017, Alphabet (Google’s parent corporation) introduced AlphaZero, a deep reinforcement learning system (discussed later in this chapter). AlphaZero began with no knowledge of chess beyond the basic rules of the game. It then played against itself millions of times and learned from its mistakes. In a matter of hours, AlphaZero became the world’s best chess player.

Interestingly, the advent of AI did not diminish the performance of purely human chess players. Instead, the opposite occurred. Cheap, highly functional chess programs have inspired more people than ever to play chess. Furthermore, the players have become better than ever. In fact, today there are more than twice as many grandmasters as there were when Deep Blue beat Kasparov.

Similar to chess players, physicians who are supported by AI will have an enhanced ability to spot cancer in medical images; speech recognition algorithms running on smartphones will bring the internet to millions of illiterate people in developing countries; digital assistants will suggest promising hypotheses for academic research; and image classification algorithms will enable wearable computers to layer useful digital information onto people’s views of the real, physical world.

Despite these impressive results, however, AI does present challenges. For example, consider the power that AI gives national security agencies in both autocracies and democracies. The capacity to monitor billions of conversations and to pick out every citizen in a crowd by their voice or face poses serious threats to privacy and liberty. In addition, many people could become unemployed when AI develops the capabilities to perform their jobs.

Weak AI has become so powerful that scientists from University College London (www.ucl.ac.uk)¹ compiled a list of AI-enabled crimes based on academic papers, news stories, popular culture, and a discussion with several dozen experts.

- *AI-enabled crimes of high concern*: Audio/video impersonation, also known as deepfakes (i.e., manipulated image, video, or other digital representations produced by sophisticated AI); driverless vehicles used as a weapon; spear phishing and whaling; disrupting AI-controlled systems (see SCADA systems in Chapter 4); large-scale ransomware; and AI-authored fake news.
- *AI-enabled crimes of moderate concern*: Misuse of military robots; autonomous attack drones; tricking facial recognition systems; manipulating financial or stock markets; and data poisoning. *Data poisoning* is an attack that tries to manipulate a machine learning system’s training data set to control the predictive behaviour of a trained model such that the model will label malicious examples as belonging to a desired class (e.g., labelling spam emails as safe).

¹Caldwell, M., Andrews, J. T., Tanay, T., & Griffin, L. D. (2020). AI-enabled future crime. *Crime Science*, 9(1), 1–13.

- *AI-enabled crimes of low concern:* AI-authored fake reviews; AI-assisted stalking; forgery of content such as art and music; and burglar bots. *Burglar bots* are very small robots that can enter a home through a letter slot or a pet door and then send information to a human thief about what is inside the home and whether anyone is there.

Several technological advancements have led to enhancements of artificial intelligence. We take a brief look at each of them here.

- *Advancements in chip technology:* AI systems employ graphics processing units (called GPU chips; discussed in Technology Guide 1), which were developed to meet the visual and parallel processing demands of video games. GPU chips facilitate parallel processing in neural networks, which are the primary information architecture of AI software. (We discuss neural networks later in this chapter.)
- *Big Data:* As we discussed in Chapter 5, Big Data consists of diverse, high-volume, high-velocity information assets that require new types of processing that enhance decision making, insight discovery, and process optimization. Big Data is now being used to train *deep learning* software. (We discuss deep learning later in this chapter.)
- *The internet and cloud computing:* The internet (discussed in Chapter 6) and cloud computing (discussed in Technology Guide 3) make Big Data available to AI systems, specifically neural networks, and provide the computational capacity needed for AI systems.
- *Improved algorithms:* An **algorithm** is a problem-solving method expressed as a finite sequence of steps. Researchers are rapidly improving the capabilities of AI algorithms. AI algorithms also run much faster on GPU chips.

algorithm A problem-solving method expressed as a finite sequence of steps.

Before you go...

1. What is artificial intelligence?
2. Differentiate between artificial intelligence and human intelligence.
3. Differentiate between strong AI and weak AI.

14.2 Machine Learning and Deep Learning

LEARNING OBJECTIVE

Differentiate among supervised, semi-supervised, unsupervised, reinforcement, and deep learning.

Machine learning (ML) is an application of artificial intelligence that provides systems with the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use those data to learn from themselves.

First we discuss how machine learning differs from traditional computer programming and expert systems. We then discuss problems inherent to developing ML systems. We close this section with a discussion of several types of machine learning: supervised, semi-supervised, unsupervised, and reinforcement.

machine learning (ML) An application of artificial intelligence that provides systems with the ability to automatically learn and improve from experience without being explicitly programmed.

Traditional Programming versus Machine Learning

Fundamentally, traditional programming is a structured combination of data and a computer algorithm (computer program) that produces answers. In supervised machine learning, developers train the system with labelled input data and the expected output results. After the

system is trained, developers feed it with unlabelled input data and examine the accuracy of the output data. Let’s look at an example of the difference between traditional programming and supervised machine learning.

Traditional Programming Let’s say that we want to know the product of two numbers. The first column is **a** and the second column is **b**. With traditional programming, we create an algorithm (computer code), or **c = a × b**. The results are 24, 15, and 18.

a	b	c = a × b
6	4	24
3	5	15
9	2	18

Supervised Machine Learning Let’s use the same numbers as our example above as labelled input data to train a supervised machine learning system. We feed the system with these relationships:

- 6 and 4 are related to 24
- 3 and 5 are related to 15

We want to know how these numbers relate, so we let the system evaluate the relationships of known values and check its accuracy.

- 6 ? 4 = 24
- 3 ? 5 = 15

The system determines that the relationship between each pair is “multiply.” If we say that the question mark is multiply and check our results, we find that they are correct.

So, if we then feed 9 and 2 into the system, it will tell us that the relationship is $9 \times 2 = 18$.

When the machine learning algorithm is trained on large amounts of labelled training data, it produces predictions for additional examples.

Expert Systems versus Machine Learning

Expert systems (ESs) are computer systems that attempt to mimic human experts by applying expertise in a specific domain. Essentially, an ES transfers expertise from a human domain expert (or other source) to the system. This knowledge is then stored in the system, typically in the form of IF-THEN rules. The more complex ESs are composed of thousands of these rules.

ESs can make inferences and arrive at conclusions. Then, like a human expert, they offer advice or recommendations. Also like human experts, they can explain the logic behind the advice.

Expert systems do present some problems. For instance, transferring domain expertise from human experts to the expert system can be difficult because humans cannot always explain *how* they know what they know. In addition, even if the domain experts can explain their entire reasoning process, it might not be possible to automate that process. The process might be either too complex or too vague, or it might require too many rules. Essentially, it is very difficult to program all the possible decision paths into an expert system.

There are significant differences between expert systems and machine learning systems. First, ESs require human experts to provide the knowledge for the system. In contrast, ML systems do not require human experts. Further, much like traditional programming, expert systems must be formally structured in the form of rules. By contrast, machine learning algorithms learn from ingesting vast amounts of data and adjusting hyperparameters and parameters (discussed below).

Machine Learning Bias (Also Called Algorithm Bias)

Designers must consider the many types of bias when developing machine learning systems. The sources of bias include underspecification, how developers approach a problem, and the data used to train the system.

Underspecification The training process for a machine learning system can produce multiple models, all of which pass the testing phase. However, these models will differ in small, arbitrary ways, depending on things such as the random values given to the nodes in a neural network before training starts, the number of training runs, and more (see Section 14.3). Developers typically overlook these differences if they do not impact how an ML model performs on its test. Unfortunately, these differences can lead to huge variations in how the model performs in the real world. Essentially, even if a training process *can* produce a good model, it could still ultimately produce a poor model. The process will not know the difference, and neither will the developers, until the model is employed in the real world.

How Developers Approach a Problem Let's look at a simple example that illustrates how you might frame a problem. Consider the following numbers: 4, 9, 3, 6, 11, and 5. What is the next number in this series? Your answer to this problem is a product of how you intuitively see the problem and how you frame it. If you think in arithmetic terms, you may try some combination of addition and subtraction based on a pattern that you think exists. If you are a statistician, you may try to perform regression on the numbers to determine what the next one would be. There are many possible approaches.

The “answer” here is that there is no right answer because we picked these numbers at random. The critical point is how you chose to approach the problem. Your approach reveals your bias as to how you would try to solve the problem.

This simple example illustrates an essential issue in the field of AI. How developers approach or frame a problem determines how they set up the process of building the AI system and, ultimately, how the algorithm learns and produces answers.

How Data Can Bias an ML System The third type of bias comes from the data that are used to train the system. One type of data bias, known as *data shift*, comes from a mismatch between the data used to train and test the system and the data the system actually encounters in the real world. For example, an ML system trained only with current customers might not be able to predict the behaviours of new customers who are not represented in the training data. Another source of data bias is hidden relationships in the data. For example, it is common for people to live in neighbourhoods where mostly people of their own racial background live. Therefore, when ML systems use postal codes/areas/neighbourhoods (for marketing, hiring, etc., purposes), it can lead to outcomes that are biased against people of certain races.

In addition, an ML system trained on biased data will likely pick up the same biases that already exist in society. For instance, ML systems used for criminal risk assessment have been found to be biased against people of colour.

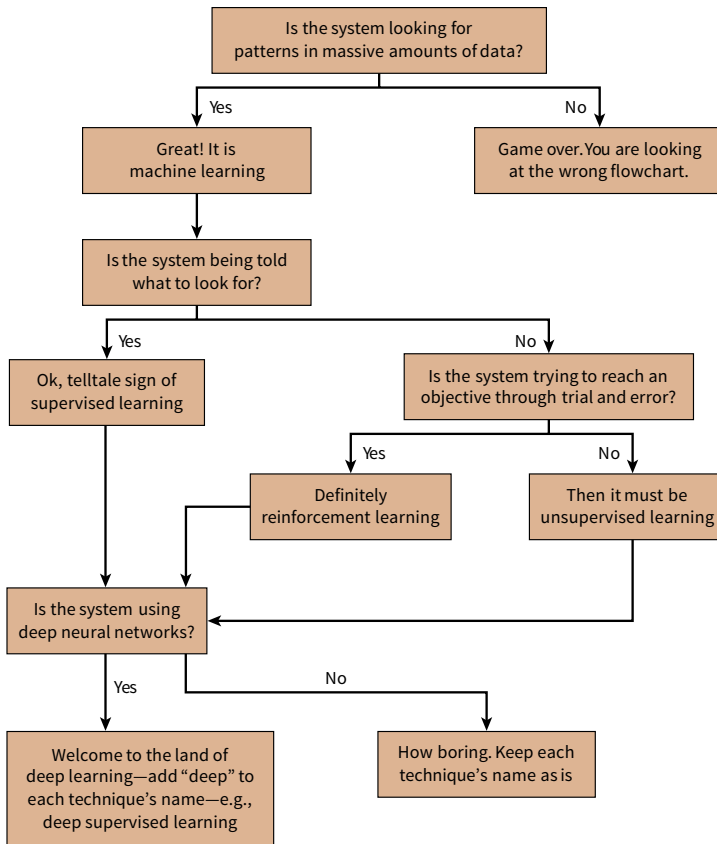
As a result, machine learning raises many ethical questions. ML systems trained on data sets collected from biased samples can exhibit these same biases when they are used, a problem called *algorithmic bias*. For example, using job hiring data from a firm with biased hiring policies could cause an ML system to duplicate this bias by scoring job applicants accordingly. Clearly, collecting the data and documenting the algorithmic rules used by an ML system in a responsible manner is a critical component of developing ML systems.

False Positives

Another challenging problem when building AI systems or evaluating outputs is seeing conditions where none actually exist, which is called a false positive. A *false positive* is a result that indicates that a given condition exists when it in fact does not. An example of a false positive is convicting an innocent person, identifying an email as spam when it is not, flagging a legitimate transaction as fraudulent, and many others.

Analyzing complex data sets can be difficult. However, by being aware of false positives, AI practitioners can assess data objectively and not be misled by apparent, but erroneous, conditions.

We now turn our attention to the various types of machine learning: supervised, semi-supervised, unsupervised, reinforcement, and deep. **Figure 14.1** provides a look at how these types differ.



Source: K. Hao, “What Is Machine Learning?” MIT Technology Review, November 17, 2018.

Supervised Learning

As we discussed in the previous section, **supervised learning** is a type of machine learning in which the system is given labelled input data and the expected output results. Developers input massive amounts of data during the training phase and stipulate what output should be obtained from each specific input value. Developers then input unlabelled, never-been-seen data values to verify that the model is accurate.

Classification and regression analysis are important techniques for supervised learning. Classification algorithms are used when the outputs are restricted to a limited set of values; regression algorithms are used when the outputs can have any numerical value within a certain range.

Classification refers to a predictive modelling problem in which the system generates a class label for a given set of input data. There are four types of classification.

- *Binary classification* refers to classification problems that have only two class labels. Examples are email spam detection (spam or not), churn prediction (churn or not), and conversion prediction (buy or not).
- *Multi-class classification* refers to classification problems with more than two class labels. Examples are news article categories, plant species classification, and optical character recognition.

supervised learning A type of machine learning where the system is given labelled input data and the expected output results.

- *Multi-label classification* refers to classification problems that have two or more class labels, where one or more class labels can be predicted for each example. Consider the example of photo classification, where a given photo may have multiple objects in the scene. The classification model may predict the presence of multiple known objects in the photo, such as an automobile, a person, a stop sign, and so on.

The main difference between multi-class classification and multi-label classification is that, in multi-class classification, the classes are mutually exclusive (e.g., an email is either spam or not). However, in multi-label classification, each label represents a different classification task.

- *Imbalanced classification* refers to classification problems in which the number of classes in each class is unequally distributed. Typically, imbalanced classification problems are binary classification problems in which the majority of data points in the training data belong to one class and a minority to another class. Examples are fraud detection, outlier detection, and medical diagnostic tests.

Linear regression is a supervised machine learning algorithm in which the predicted output is continuous and has a constant slope. This algorithm is used to predict continuous variables such as sales or price, rather than classifying them into categories with a classification algorithm. There are two main types of linear regression: simple and multiple.

In *simple linear regression*, a single independent variable is used to predict the value of a dependent variable. For example, the Italian clothing company Benetton is examining the relationship between its annual sales and the amount the firm spends on advertising. Benetton uses simple linear regression, using advertising as the independent (predictor) variable to predict the dependent variable, sales.

In *multiple linear regression*, two or more independent variables are used to predict the value of a dependent variable. Suppose that Benetton wants to analyze the impact of product price, product advertising expense, store location, and season of the year on product sales. The firm would conduct a multiple linear regression, with price, advertising expense, store location, and season as the independent variables predicting the dependent variable, product sales.

Semi-Supervised Learning

Semi-supervised learning is a type of machine learning that combines a small amount of labelled data with a large amount of unlabelled data during training. For example, semi-supervised learning is excellent for text document classification because it is very difficult to find a large amount of labelled text documents. The reason is that it is not efficient to have a human read through entire text documents to classify and label them. In this case, the algorithm learns from a small amount of labelled text documents while still being able to classify large amounts of unlabelled text documents in the training data.

semi-supervised learning

A type of machine learning that combines a small amount of labelled data with a large amount of unlabelled data during training.

Unsupervised Learning

Unsupervised learning is a type of machine learning that searches for previously undetected patterns in a data set with no pre-existing labels and with minimal human supervision. The best time to use unsupervised learning is when an organization does not have data on desired outcomes. An example is when the firm wants to determine a target market for an entirely new product that it has never sold before.

Cluster analysis is one of the primary techniques in unsupervised learning. Cluster analysis groups, or segments, data points to identify common characteristics. It then reacts based on whether each new piece of data exhibits these characteristics.

Example: Finding customer segments. Clustering is an unsupervised ML technique in which the goal is to find groups or clusters in input data. Developers use clustering to determine customer segments in marketing data using variables such as gender, location, age, education, income bracket, and many others.

Example: Feature selection. Assume that developers want to predict which customers of a bank are likely to be interested in a new credit card promotion. Since the bank cannot offer the promotion to all its customers, the goal is to find customers who are most likely to be interested in the new credit card promotion. The bank needs to analyze large amounts of data about each customer to make these predictions, including the customer's average monthly income, average monthly debt payments, credit history, age, interest in similar prior promotions, and many other variables.

Because banks typically collect more data than they use for such decisions, not all of the variables are relevant for predicting a customer's likelihood of interest in a new promotion. For instance, does an applicant's age make any difference in deciding whether they would be interested in the promotion? Is the customer's gender important? (Note that, in certain countries, it might be illegal to include gender or age considerations in such decisions.) For this reason, eliminating unnecessary variables is an essential part of training an ML system. In feature selection, developers try to eliminate a subset of the original set of features (variables).

unsupervised learning

A type of machine learning that looks for previously undetected patterns in a data set with no pre-existing labels and with a minimum of human supervision.

Reinforcement Learning

Reinforcement learning is a type of machine learning in which the system learns to achieve a goal in an uncertain, potentially complex environment. In reinforcement learning, the system faces a game-like situation where it employs trial and error to find a solution to a problem. The developer awards penalties or rewards to the system for the actions it performs so that it will do what the developer wants. The system's goal is to maximize the total reward.

Although the designers set the reward policy—that is, the rules of the game—they give the model no hints or suggestions for how to solve the problem. The system must determine

reinforcement learning

A type of machine learning where the system learns to achieve a goal in an uncertain, potentially complex environment.

how to perform the task to maximize the reward, beginning with totally random trials and finishing with sophisticated tactics.

There are numerous examples of reinforcement learning applications. Some of these are:

- Recommendation systems
- Automated ad bidding and buying
- Dynamic resource allocation in wind farms, HVAC (heating and air conditioning) systems, and computer clusters in data centres
- Automated calibration of engines and other machines
- Robotic control
- Autonomous vehicles such as self-driving cars
- Supply chain optimization

Deep Learning

deep learning A subset of machine learning where artificial neural networks learn from large amounts of data.

Deep learning is a subset of machine learning in which artificial neural networks learn from large amounts of data. When supervised, semi-supervised, unsupervised, and reinforcement learning systems use neural networks, we add the term *deep* to each one, resulting in deep supervised learning, deep semi-supervised learning, and so on.

Deep learning systems can solve complex problems even when they utilize a data set that is very diverse and unstructured. These systems can discover new patterns without being exposed to labelled historical or training data. Widely used examples of deep learning are automatic speech recognition, image recognition, natural language processing, customer relationship management, recommendation systems, and drug discovery.

IT's About Business 14.1

POM **HRM** AI in the Global Shipping Industry

The Shipping Industry

The shipping industry is changing with the aim of enhancing efficiency and safety at ports and at sea. From small boats to huge container ships, vessels are integral components of the global economy. According to the United Nations, ships transport approximately 90 percent of all worldwide commerce.

Maritime companies are leveraging machine learning and other technologies to design smart ports. In addition, they are working to create more autonomous ships. At times, transforming a port involves updating an existing technical infrastructure made up of less sophisticated components. For example, historically some ports have relied on low-tech, manual solutions. In these ports, workers physically visit a vessel with ropes, which they use to measure the length and width of the ship. Then they decide which dock the ship should enter.

Smart ports. In contrast, smart ports employ advanced, innovative technologies to monitor and improve their operations. These technologies frequently take the form of digital twins. A *digital twin* is a digital representation of a physical system that maps that entity into a three-dimensional virtual system. Digital twins integrate and analyze multiple data sources, including sensors on port equipment and vessels, inbound and outbound ship traffic, harbour size, live weather conditions, and many other variables. Digital twins also enable port authorities to improve mooring and casting off, and to remotely control cranes and other equipment.

For example, in shallow water, the tides play a major role in scheduling loading and unloading operations, especially for larger vessels. Buoys equipped with sensors monitor tidal changes, water temperature, and other variables. These metrics provide a clearer picture of real-time conditions. Instead of the port sending a human team to check the buoys, the buoys transmit their information to the port in real time.

When ships arrive or leave the dock, they must be loaded and unloaded efficiently and safely. To do so, ports use industrial cranes to transfer containers to and from each ship and around the port. Over time, the transfer of tonnes of cargo as winds blow through a port can compromise the cranes' structural integrity. At times, metal fatigue can even cause the catastrophic collapse of a crane itself. By monitoring the crane's structure and the meteorological environment at the port, operators can adjust docking and crane operations to increase safety. Cranes are equipped with cameras, an anemometer—an instrument that measures wind velocity—and other sensors to monitor the stress on the crane's structure while it is operating. Machine learning can then analyze these data to monitor trends and predict failures before they occur.

When a ship arrives and is unloading, port authorities must have the necessary number and types of trucks and trains waiting to receive the containers. The authorities monitor GPS sensors on the trucks and trains to precisely determine their locations, thus increasing the efficiency of transferring the containers.

Once the various sensors, ships, and port systems are integrated, machine learning systems can then optimize maritime scheduling. The system can answer such questions as: Which

dock should we send the ship to? Which train or trucks should be waiting as the ship offloads its cargo? Where should the trains or trucks be positioned in the port when a ship is ready to load? These insights help to reduce bottlenecks and prevent accidents.

The largest port in Europe, the Port of Rotterdam (Netherlands), has embraced digitization. Through its Smart Infrastructure program, it aims to have ships autonomously enter and leave the port by 2030. Further, the port operates an unstaffed container terminal that utilizes autonomous cranes.

The second-largest port in Europe is the Port of Antwerp (Belgium), which has also digitized. The port utilizes a digital three-dimensional map that contains actionable real-time information as its digital twin. Smart cameras and computer vision are integrated into the map to produce an “intelligent wharf” that ensures that ships are safely and properly moored while also reducing wait times. The cameras have automatic image-recognition capabilities that increase security around the port and enable authorities to analyze and optimize equipment movements.

Ports are also working to prevent human operators from getting too tired. In the past, crane operators had to work under difficult conditions with narrow margins for error. They would sit for hours in a cockpit 10 to 12 stories high and watch several monitors while they controlled a giant crane. They also had to constantly take wind pressure into account. This job was stressful and caused fatigue.

In contrast, crane operators can now utilize sensor data to control their cranes remotely from buildings on the ground. This process reduces both operator fatigue and the risk of error during loading and unloading operations.

Smart ships. The shipping industry is reimagining the way cargo moves at sea. Smart ships use a number of sensors such as GPS, cameras, radar, and LIDAR for operations. (LIDAR is a system that measures distance to a target by illuminating the target with laser light and measuring the reflected light with a sensor.) Sensors enable these ships to operate with reduced crew sizes. Because the system reduces the number of crew members, the ship can be constructed without the life-support systems used to accommodate human crew members such as galleys, housing compartments, food storage, and restrooms. In turn, reducing ship size can minimize construction costs and fuel consumption and leave more room for storage. Put simply, a smaller autonomous ship can carry roughly the same amount of cargo as a much larger crewed vessel.

Smart ships must provide for control of the vessel and have the capacity to monitor the condition of each component of the vessel. Therefore, these ships typically contain redundant systems that prevent the system from failing in the event of a malfunction. Machine learning systems can analyze trends in data to predict

operational failures in advance and notify ship owners of necessary maintenance.

Questions

1. Which type of machine learning applies to the following applications in this case? Support your answer for each application.
 - Port operations;
 - Crane operations;
 - Predicting preventive maintenance on port equipment;
 - Optimizing the loading and unloading of ships.
2. What are the advantages to ship owners of implementing ML applications? Support your answer.
3. What are the disadvantages to ship owners of implementing ML applications? Support your answer.
4. What are the advantages to crew members of implementing ML applications on ships? Support your answer.

Sources: Compiled from Fine Art Shippers, “What Is Smart Shipping, and How Can It Change Art Logistics?,” *Fine Art Shippers*, August 12, 2022; C. Cole, “Creating a Digital Twin: The Key to Building a Smart Vessel,” *Siemens.com blog*, January 27, 2022; Sobel Network Shipping, “Smart Shipping for the Supply Chain,” *Sobel Network Shipping Company, Inc.*, December 21, 2021; N. Joshi, “Why AI Adoption Is Lagging in International Shipping,” *BBN Times*, December 7, 2021; M. Ball, “New AI-Powered Smart Shipping Solutions,” *Unmanned Systems Technology*, November 5, 2021; A. Inam, “5 Ways AI Can Help Mitigate the Global Shipping Crisis,” *TechCrunch*, August 9, 2021; J. Donnelly, “How Can Digital Twins Help Ports?” *Port Technology*, July 20, 2021; J. Donnelly, “Digital Twin Shortens Playing Field for Expansive Belfast Harbour,” *Port Technology*, May 21, 2021; J. Donnelly, “Measure, Optimise Terminal Machinery to Truly Greenify Ports,” *Port Technology*, April 1, 2021; J. Donnelly, “AIDrivers Emphasises Digital Twin in PSA Singapore Project,” *Port Technology*, March 19, 2021; N. Joshi, “Charting the Role of Artificial Intelligence in Shipping,” *BBN Times*, October 7, 2020; A. Oriel, “Decoding the Future of Global Shipping with Artificial Intelligence,” *Industry Wired*, August 28, 2020; J. Jackson, “What Are Smart Ports and How Will They Change the Shipping Industry?” *Searates*, August 21, 2020; R. Adams, “AI on the High Seas: Digital Transformation Is Revolutionizing Global Shipping,” *TechRepublic*, August 19, 2020; F. Martin, “How AI & Automation Has Overhauled the Shipping Industry,” *Analytics India Magazine*, January 31, 2019; G. Spencer, “AI and Cargo Shipping: Full Speed Ahead for Global Maritime Trade,” *Microsoft.com*, April 23, 2018.

Before you go on...

1. What is the difference between traditional computer programming and machine learning systems?
2. What is the difference between expert systems and machine learning systems?
3. Describe three types of bias that can negatively impact the development of machine learning systems.
4. Differentiate between supervised learning, semi-supervised learning, unsupervised learning, reinforcement learning, and deep learning.

14.3

Neural Networks

LEARNING OBJECTIVE

Describe the structure of a neural network, and discuss how that structure contributes to the purpose of neural networks in machine learning.

neural network (NN) A set of virtual neurons, placed in layers, which work in parallel in an attempt to simulate the way the human brain works, although in a greatly simplified form.

node Software unit in a neural network that has one or more weighted connections, a transfer function that combines the inputs in some way, and an output connection.

An artificial neural network, also known as a **neural network (NN)**, is a set of *virtual neurons*, or *nodes*, that work in parallel to simulate the way the human brain works, although in a greatly simplified form. Improvements in algorithms and increasingly powerful computer chips and storage are enabling developers to create neural networks with billions of neurons. As a result, developers are training them to learn, recognize patterns, and make decisions in a humanlike way.

Neural networks consist of nodes, synapses (connections between nodes), weights, biases, and functions. A **node** in a neural network has one or more weighted input connections, a bias, an activation function, and one or more output connections.

The nodes are arranged in several layers: one input layer, one or more hidden layers, and one output layer (see [Figure 14.2](#)). The hidden layers are called “hidden” simply because they are located between the input and output layers. See [Figure 14.3](#) for an example of a generic neural network with one hidden layer. Note that a *deep neural network* contains multiple hidden layers.

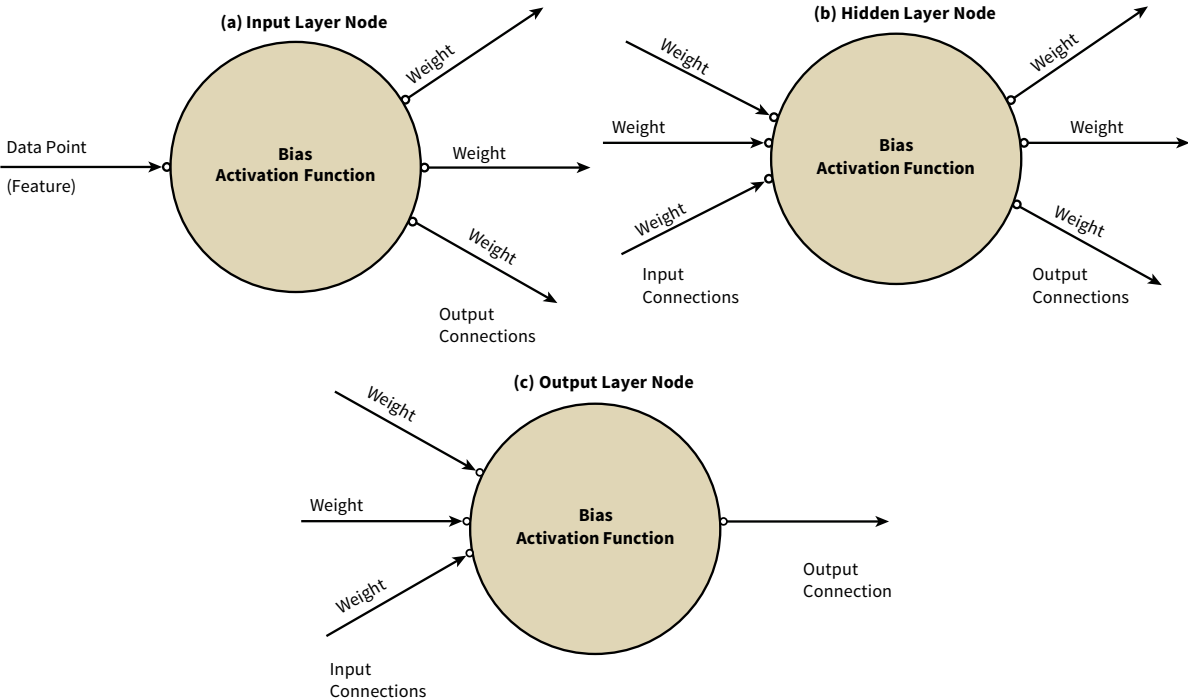


FIGURE 14.2 Various types of nodes in neural networks.

Neural network developers choose the network’s *hyperparameters*, which include the number of hidden layers, the number of nodes in each layer, the learning rate (how much the system is allowed to change the parameters after each training iteration), and the activation functions in each node.

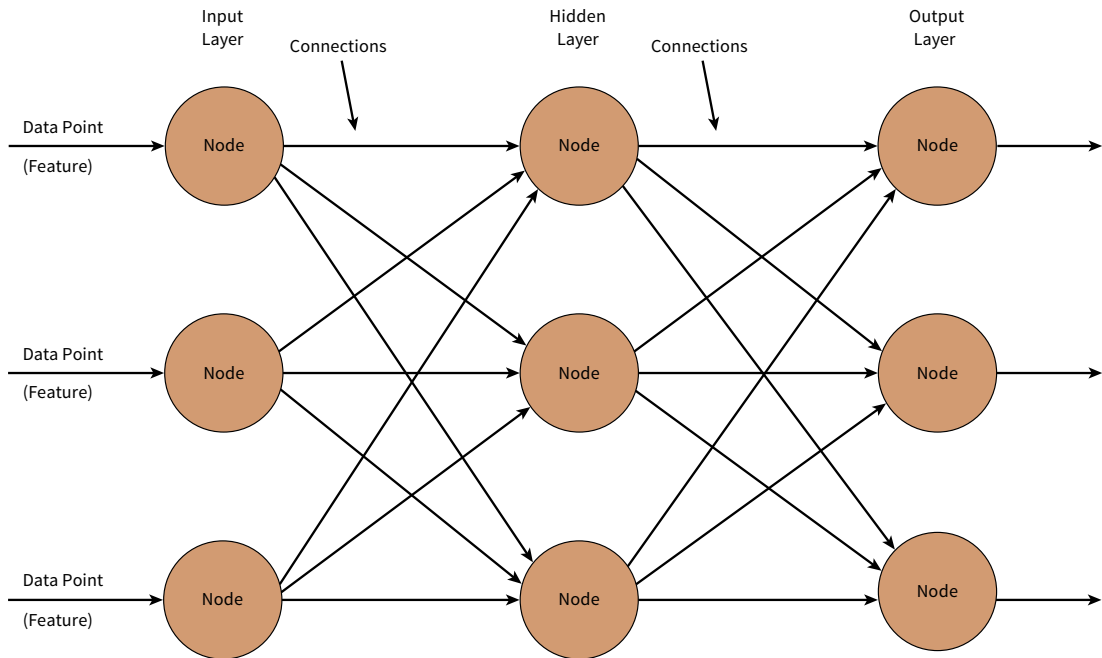


FIGURE 14.3 A generic neural network.

The *activation functions (AFs)* that reside at each node define the output of that node given an input or a set of inputs. **Figure 14.4** shows a popular activation function, called *Swish*, developed by Google. AFs are a critical component of neural network design, and their selection is crucial for efficient and accurate performance. Dozens of activation functions are available to developers. These functions process incoming data in different ways, and developers choose them to provide the best model for the data. The key is to match the correct activation function with the data and the desired output predictions. For example, some activation functions are better suited for binary classification, while others perform best with continuous data.

Weights and biases are examples of *parameters* in a neural network. For the first training iteration, developers set weights and biases to some neutral value, such as 0 or 0.5, depending on the particular application. In subsequent iterations, weights and biases are adjusted by the network's loss function with the goal of minimizing system inaccuracies.

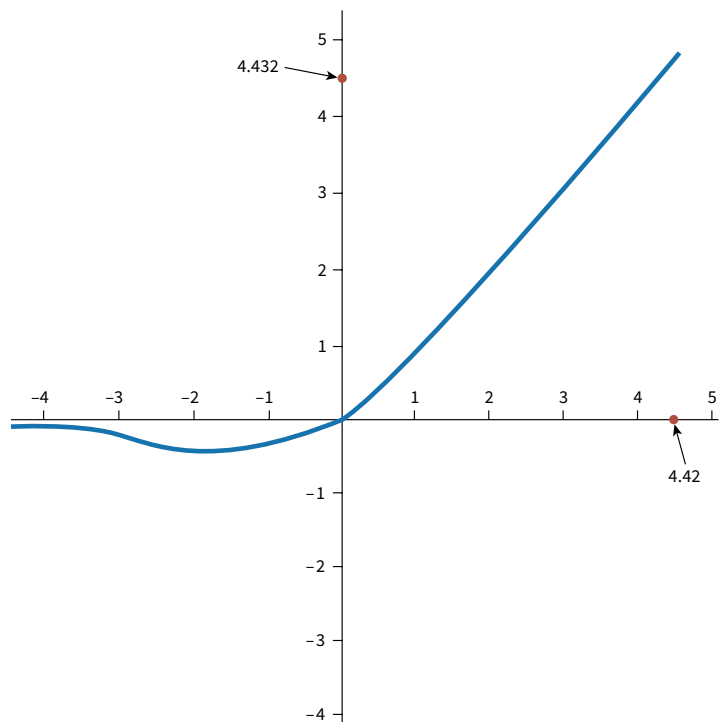


FIGURE 14.4 Swish activation function.

Training Neural Networks

NNs learn best from large data sets. Developers randomly separate the data into *training*, *validation*, and *test* data sets. One popular approach is to use approximately 60 percent of the overall data set for training, 10 percent for validation, and the remaining 30 percent for testing. During training, developers use the validation data to evaluate how well the training process

is progressing and to adjust the hyperparameters to better tune the network. When training is completed, developers use the test data to measure the NN's performance to determine whether it is optimally trained and is a viable system that the organization can deploy.

During the learning or training process, developers feed the numerical values of the training data into the input layer of nodes. Developers feed one feature, or variable, into each input node. For example, if developers are training an NN to predict house values, they might use the house's surface area, its age, the postal code, and the numbers of bedrooms and bathrooms. Each of those five variables is a feature, and there will be an input node for each feature. Therefore, the input layer will consist of five nodes. Because the NN's goal is to predict a home's value, the output layer will consist of a single node, the predicted price. The NN will consist of one or more hidden layers (a decision made by the developers), each of which has one or more nodes.

Input nodes apply the *bias* (a mathematical change) to the input data value, producing a new value. The input node then applies the *activation function* to this new value, producing another new value. The input node then sends this new value to the next layer of nodes; that is, the first hidden layer. Along the pathways to the next layer, additional adjustments, known as *weights*, are applied to the data values.

As the weight-adjusted data arrive at the hidden layer node from previous nodes, they are summed and the hidden layer node applies another bias and an activation function to the summed data, producing a new value. The node then sends this value along the pathways to the next layer of nodes. The process in which biases, activation functions, and weights change the data values continues through to the last layer of nodes, the output layer. In the nodes of the output layer, the data undergo their final adjustments from the bias and activation function, and a *loss function* compares the just-processed data to the expected output value.

The difference between the derived data value and the expected value—that is, the loss function—initiates the process of **backpropagation**. In this process, the values of the weights of each pathway and the bias values of each node are slightly changed in anticipation that the next iteration of data flowing through the neural network will result in a smaller error, or loss, upon output. After the adjustments by back-propagation, the next data values begin their journey through the NN.

This process—new data, vast numbers of slight adjustments, the systems adjustments by backpropagation—continues over and over until the training data are exhausted. At this point—if the loss function reveals that there are few or no required adjustments—developers consider the NN to be trained.

This chapter's Appendix shows an example of how neural networks function. While this example is highly simplified, it gives you a look at the steps that neural networks take to learn the patterns that may exist among the large amounts of data they process.

backpropagation A method of supervised learning to update the model's parameters to make its predictions more accurate.

recurrent neural network A type of neural network which uses sequential data or time series data and is used when the network's decision must be based on previous output.

convolutional neural network A type of neural network designed to separate areas of image inputs by extracting features to identify edges, curves, and colour density and then recombine these inputs for classification and prediction.

Neural Networks for Specific Applications

Recurrent Neural Networks (RNNs) A **recurrent neural network** is designed to access previous data such as sequential data or time series data during iterations of input. RNNs are used in applications where the network's decision must be based on previous output such as moving a robotic arm, reading a sentence, predicting time series, and composing music.

Convolutional Neural Networks (CNNs) A **convolutional neural network** is designed to separate areas of image inputs by extracting features to identify edges, curves, and colour density and then recombine these inputs for classification and prediction. CNNs are highly effective for image and pattern recognition applications such as facial recognition, video analysis, natural language processing, drug discovery, and anomaly detection. Let's take a closer look at how CNNs process images.

Each layer of the CNN manages a different level of abstraction such that, with each layer, the CNN identifies more of an image. To process an image, the first layer is fed with raw images. That layer notes aspects of the images such as the brightness and colours of individual pixels and how those properties are distributed across the image. The next layer takes the first layer's observations and places them into more abstract categories such as identifying edges, shadows, and so on. The next layer analyzes those edges and shadows, searching for

combinations that signify features such as eyes, lips, and ears. The final layer combines these observations into a representation of the intended object such as a face.

To train a CNN to learn facial recognition, developers will input millions of images. Some images will contain faces, and some will not. Each image will be labelled by a human. The images act as inputs to the neural network, and the labels—“face” or “not face”—are the outputs. The network’s task is to develop a statistical rule, operationalized through the weights between processors, that correlates inputs with correct outputs.

To accomplish this task, the network will search for those features that are common to the images that display faces. Once these correlations are strong enough—that is, the weights, or strength of the connections between processors, are high enough—the network will be able to reliably differentiate faces from not-faces in its training set. The next step is to feed the neural network with a fresh set of unlabelled images to determine whether the facial recognition algorithms that the network has developed actually function with the new data.

NNs can also make mistakes. For example, developers trained a CNN to differentiate between images of wolves and husky dogs. The researchers trained the CNN with numerous examples of photographs, and the CNN eventually achieved an accuracy rate of about 90 percent. The researchers then examined the inner workings of the CNN, focusing on which features contributed to correct classifications. They found that the CNN had learned based on the backgrounds of the training images—wolves were generally photographed on snow, and the dogs were photographed on grass. Therefore, the CNN tended to misclassify a photograph of a dog on a snowy background as being a wolf and to misclassify a wolf standing in a grassy field as a dog. The CNN’s excellent performance was misleading, and it was unreliable for the purpose for which it was trained.

Generative Adversarial Networks (GANs) A **generative adversarial network** consists of two neural networks that compete with each other in a zero-sum game in an effort to segregate real data from synthetic data. GANs separate real data from noise. To do that, one model (i.e., the generator model) is trained to generate new examples and the other model (i.e., the discriminator model) is trained to classify examples as either real or fake (i.e., generated). GANs perform well in applications where missing or incomplete data need to be filled in. For example, GANs are used to improve deep-space photography, for inpainting, and in other applications where missing digital data have to be completed. (Note: *inpainting* is a conservation process whereby damaged, deteriorating, or missing parts of an artwork are filled in to present a complete image). GANs can also be used to create deepfakes ranging from image manipulation to news embellishments.

generative adversarial network A type of neural network that has two parts: (a) The generator, which learns to generate plausible data, and (b) the discriminator, which learns to distinguish the generator’s fake data from real data.

Before you go on...

1. Describe the structure of a neural network.
2. Describe how a neural network operates. That is, describe how developers train neural networks.

14.4

Artificial Intelligence Applications

LEARNING OBJECTIVE

Provide use case examples of computer vision, natural language processing, robotics, image recognition, and intelligent agents.

The field of artificial intelligence has many applications. Note that these applications use machine learning, deep learning, and neural networks. In this section, we discuss computer vision, natural language processing, robotics, speech recognition, and chatbots. In Section 14.5, you will see numerous examples of these applications in use in all functional areas of

organizations. These examples will emphasize how important artificial intelligence is to you, regardless of your major.

Computer Vision

computer vision The ability of information systems to identify objects, scenes, and activities in images.

Computer vision refers to the ability of information systems to identify objects, scenes, and activities in images. Computer vision has diverse applications, including medical imaging to improve the prediction, diagnosis, and treatment of diseases; facial recognition; and autonomous vehicles. Let's take a closer look at examples of computer vision at Amazon, NanoSpeed Diagnostics, and eBay.

POM *Amazon.* Amazon has deployed an ML-based system in its fulfillment centres that enables workers to skip one manual item-scanning step per order. The system impacts Amazon's *stowing process*, which lets workers store items that have arrived from distributors and manufacturers anywhere on a warehouse's shelves, as long as each item's location is recorded in a computer so that it can be found again on the first try. This older method requires workers to take an item out of a box, scan its bar code, place it on a shelf, and then scan the bar code on the shelf. The two scans provide the exact location of the item.

Computer vision enables workers to pick up an item, slide it under a scanner mounted nearby, and place it on a shelf. Amazon has trained the system to recognize where the worker places the item, and it records that location for future reference. The worker no longer has to scan the shelf. Eliminating this step improves efficiency. Given the hundreds of millions of items stored in its fulfillment centres, the system is providing large cost savings for Amazon.

POM *NanoSpeed Diagnostics.* NanoSpeed Diagnostics (www.nanospeed.ca), an Edmonton-based start-up, has developed a new AI-based approach to blood tests. This approach is faster, less expensive, and able to do multiple assessments on a single drop of blood. Consider the test for Vitamin D. In the traditional approach, patients' samples are taken and mixed with certain compounds that react with elements in the blood and reveal information on what it contains. As a result of this process, the sample is changed and is therefore useless for further testing. So, if more tests are needed, more blood should be drawn.

However, in the new AI-based approach proposed by NanoSpeed, blood is analyzed by a spectrometer and a microscope, which read how light interacts with the sample. This information is then used to determine the exact elements that exist in the blood sample. The result is a snapshot of the blood: everything that is in it, and how much is present. This information is then fed into specialized software that is trained to find indicators of low Vitamin D.

MKT **POM** *eBay.* eBay's ML platform, Krylov, helps users locate items based on taking a picture of an object or an image. Users can take a photo of an item they are searching for and then upload the image to the eBay app. Within milliseconds, the platform presents items that match the image.

Natural Language Processing

natural language processing The ability of information systems to work with text the way that humans do.

Natural language processing refers to the ability of information systems to work with text the way that humans do. For example, these systems can extract the meaning from text, and they can generate text that is readable, stylistically natural, and grammatically correct.

Because context is critical, the practical applications of natural language processing typically address relatively narrow areas such as analyzing customer feedback about a particular product or service, automating discovery in civil litigation or government investigations (e-discovery), and automating the writing of formulaic stories on topics such as corporate earnings and sports. We take a closer look at two examples of natural language processing, at Google and eBay.

Google. In November 2020, Google open-sourced an ML model called MT5 that the company claims can achieve state-of-the-art results on a range of English natural language processing tasks. Google trained the model on a data set that includes 101 languages.

POM *eBay.* In addition to computer vision, eBay's ML platform, Krylov, provides ML-powered language translation services. The company has trained Krylov with vast amounts of data from its 1.4 billion listings for 183 million users in 190 markets.

Cross-border trade makes up nearly 60 percent of eBay's international revenue. Therefore, accurate, instantaneous translation is critical. eBay offered automatic translation before it developed Krylov. However, the platform has significantly improved eBay's translation accuracy, which in turn has helped to increase the company's international sales by 11 percent.

Robotics

Integrating computer vision with tiny, high-performance sensors and actuators, a new generation of robots can work alongside people and flexibly perform multiple tasks in unpredictable environments. Examples are unmanned aerial vehicles; cooperative robots, called *cobots*, that share jobs with humans on the factory floor; robotic vacuum cleaners; and so on.

POM Amazon Robotics—formerly Kiva Systems, acquired by Amazon in March 2012—is an excellent example of cobots working in distribution centres. Rather than human inventory pickers selecting items for order fulfillment, Amazon's cobots bring the items to a human who fills the orders.

Speech Recognition

Speech recognition focuses on automatically and accurately transcribing human speech. This technology must manage diverse accents, dialects, and background noise. Furthermore, it must distinguish between homophones and work at the speed of natural speech. A *homophone* is a word that is pronounced the same as another word but differs in meaning; for example, “break” and “brake.” Applications include medical dictation, hands-free writing, voice control of information systems, and telephone customer service applications. For example, popular voice-based digital assistants, such as Apple Siri, Microsoft Cortana, Google Assistant, Amazon Alexa, and Samsung Bixby, can understand our words, analyze our questions, and point us in the general direction of the right answer.

The Hospital for Sick Children (SickKids) in Toronto has started using a new version of a dictation solution from M*Modal (later acquired by 3M). The system is equipped with high-accuracy speech recognition functionality. Health care providers (e.g., physicians, nurses) can now open a patient's chart and dictate their notes, make edits, and even sign off and finalize their notes. These notes are immediately available to other clinicians who require access.

Using dictation tools with speech recognition functionality is not entirely new to SickKids, which had used such tools for 12 years. However, prior to the new version, clinicians had to dictate their notes into something like a voicemail message, then edit and sign off their notes before they could be included in their records. This process could take days or even weeks. However, the new tool with its high level of accuracy has expedited the process significantly.

speech recognition The ability of information systems to automatically and accurately transcribe human speech.

Chatbots

A **chatbot** is a computer program that uses artificial intelligence and natural language processing to simulate human conversation, either by voice or text communication. Organizations use chatbots, rather than a human, to solve a variety of problems such as the following.

- **MKT MIS** *Customer service and support:* Customers first interact with a chatbot, which can help with routine problems. If the customer query requires human intervention, the chatbot directs the customer to a customer-care agent. This process allows human agents to concentrate on more complex customer problems.

For example, TD Canada Trust (<https://www.td.com/ca/en/personal-banking>) has introduced its chatbot called TD Clari within its mobile app. TD Clari helps customers get quick answers to questions related to their TD bank accounts such as their purchases and transactions. TD Clari also helps customers to better understand their spending habits by breaking down transaction information into specific categories. In addition, the chatbot provides assistance with tasks in the app such as sending money, paying bills, and finding TD locations.

chatbot A computer program that uses artificial intelligence and natural language processing to simulate human conversation, either by voice or text communication.

- **HRM** **MIS** *Organizational support:* Chatbots can answer common employee questions regarding any part of the business. With additional training, chatbots can become employees' personal digital agents, improving their overall working experience.

For example, chatbots can search websites for updated information on topics of your choice, such as price changes on desired products (e.g., airline tickets). Chatbots can monitor internet sites, discussion groups, and mailing lists for stock manipulations, insider trading, and rumours that might affect stock prices.

- **MIS** *IT services support:* Chatbots can troubleshoot the most common problems employees face when using IT services. Such problems include outage alerts, password updates, periodic scans, and others.

IT's About Business 14.2 provides more detail on ChatGPT, a chatbot developed by OpenAI.

IT's About Business 14.2

ChatGPT

OpenAI (<https://openai.com>) is a non-profit artificial intelligence research company whose goal is to advance artificial intelligence to benefit humanity as a whole. OpenAI developed the language model, ChatGPT, to perform a wide variety of tasks very accurately and quickly. *Language models* are statistical models that predict the probability of a sequence of words in a language. They are a key component in various natural language processing (NLP) tasks such as text generation, machine translation, and text classification. *Natural language processing* enables computers to understand, interpret, and generate human language in a useful and meaningful way.

Developers train language models on large amounts of text data to learn the patterns and relationships among words, thus providing these models with a vast text knowledge base. Once trained, the models can be used to generate new text by sampling words based on their predicted probabilities or to perform other NLP tasks by making predictions based on the input text.

OpenAI believes that ChatGPT technology can transform numerous industries and improve the quality of life for people around the world. The development of ChatGPT was also motivated by an increasing demand for conversational AI systems and the need for more advanced language models that could be used to develop those systems.

A *conversational AI system* is a type of AI that allows people to interact with computers using NLP. The goal of these systems is to improve the user experience and automate tasks that would otherwise require human intervention. These systems use machine learning algorithms and NLP to understand and respond to user input, allowing for more intuitive and humanlike interactions.

OpenAI released ChatGPT-3 in prototype form on November 30, 2022. Amazingly, the system gained over 1 million users in five days! It was the largest and most advanced language model to date, with more than 175 billion parameters.

ChatGPT is designed to mimic human conversation and is quite versatile. The most common applications of ChatGPT are:

- Building conversational AI systems: ChatGPT can be used for customer service and support such as answering frequently asked questions; it can also help to build virtual assistants and other chatbots.
- Managing text:

- Text generation: ChatGPT can generate creative writing, such as articles, stories, blog entries, song lyrics, poetry, fairy tales, and student essays and papers. The tool can also generate business strategies, summaries, captions, headlines, gift ideas, blog topics and blog entries, and vacation ideas, among many others. Interestingly, it can also compose music.
- Text classification: ChatGPT can classify text into different categories such as spam, fake news, and social media posts.
- Text summarization: ChatGPT can reduce the length of a text while preserving its key information.
- Text completion: ChatGPT can predict the next word or sentence based on a text's content.
- Question answering: ChatGPT can answer questions by inferring context derived from a vast amount of text training data. For example, the system can answer test questions, including true-false and multiple-choice questions, short answer questions, and essay questions.
- Sentiment analysis: ChatGPT can classify reviews and social media posts into positive, negative, or neutral sentiments.
- Translation from one language to another.
- Technology: ChatGPT can write and debug computer programs.

ChatGPT gives users many advantages. Here are the most significant:

- ChatGPT can produce text whose coherence and fluency resemble those of human writing.
- ChatGPT can understand the context of a given question or prompt and generate text accordingly.
- With its large amount of training data, ChatGPT achieves high accuracy in various NLP tasks.
- ChatGPT is very flexible. Users are able to fine-tune their questions for specific tasks and domains, allowing for customization to fit specific needs.

ChatGPT does have some disadvantages and limitations. Here are the most notable:

- Bias: Like other AI models, ChatGPT may have biases in its training data that can affect the accuracy and fairness of its outputs.

- Lack of judgement: ChatGPT does not truly understand the world and therefore may generate nonsensical or inappropriate responses.
- Potential for misuse: ChatGPT's ability to produce human-like text can be used for malicious purposes, such as spreading misinformation or propaganda.
- Limitations in handling out-of-vocabulary words: ChatGPT may struggle to generate accurate responses for rare or never-before-seen words.
- Limitations in understanding sarcasm or irony: ChatGPT may struggle to recognize and generate sarcastic or ironic language.
- Ethical and societal implications: The development and use of large language models like ChatGPT have raised ethical and societal concerns, such as the potential for biased results, privacy issues, and the impact on employment.

Let's now take a look at areas where ChatGPT is making an impact.

Education

ChatGPT has raised difficult questions in education about the definition of plagiarism and academic integrity. *Plagiarism* is taking another person's ideas, writings, artistic designs, etc., and presenting them as one's own work, without attribution. More specifically, plagiarism includes taking parts of another's work and publishing them as one's own, either word for word or in substance. On the other hand, *academic integrity* means being honest when you research and use other people's work and contributions. Difficulties arise when the work is generated by *something* (such as ChatGPT) rather than *someone*.

Students may see ChatGPT as just another tool, like a spell-checker or calculator. Unfortunately, some students are using ChatGPT to answer test questions and generate entire works, such as essays and term papers, and presenting them as their own work.

ChatGPT is causing teachers at all levels to change their testing methods to keep up with the rapidly improving tool. For example, some teachers are requiring students to take exams in the classroom using e LockDown browsers (<https://web.respondus.com/he/lockdownbrowser>) to control students' computers. LockDown browser disables the use of other browsers, applications, and desktop functions such as search. Students can move out of LockDown browser once they complete the test and submit it.

Some public school systems, such as New York City's, have banned the use of ChatGPT on school devices and networks to diminish cheating. However, most universities have been reluctant to follow suit because it is not clear in all cases whether ChatGPT is a research tool or a plagiarism engine. The answer remains debatable.

Journalism

In January 2023, technology news outlet *CNET* admitted it used ChatGPT to write over 70 articles after experts discovered the site's three-month-long "experiment with automation." *CNET*'s use of ChatGPT was unveiled when a marketing expert called Gael Breton tweeted that he had found 75 finance articles on the site that had been generated by ChatGPT. The articles carried the "CNET Money Staff" byline even though they were generated by the chatbot. Another technology site, *Futurism*, found that some *CNET* stories contained some "very dumb errors." *The Washington*

Post noted that *CNET* only admitted to using ChatGPT after it was called out by Breton, other experts, and other sites.

CNET began adding lengthy corrections to some of its AI-generated articles. The problem here is twofold: First, *CNET* tried to use ChatGPT to write articles, but the quality and accuracy left much to be desired. Second, *CNET* did not inform its readers that the site was using ChatGPT to write some of its articles.

Search Engines

Shortly after ChatGPT was released, industry analysts stated that the tool would disrupt search engines because it can provide information in clear, simple sentences rather than just providing a list of internet links. That is, ChatGPT can explain concepts in ways that people can easily understand. The system can also save users time as they do not necessarily need to visit the sites listed by a search engine to obtain and then integrate the information for which they are searching. ChatGPT is designed to perform these two functions.

Software Engineering

ChatGPT can create simple software programs. Essentially, it can write the computer code, tailored to a user's request and parameters, to build websites and other computer programs. Not only that, it can also correct software errors.

ChatGPT-4

ChatGPT-4, released in March 2023, is the most advanced artificial intelligence system developed by OpenAI. The latest version of ChatGPT has advanced considerably from its earlier version in multiple ways. First, ChatGPT-4 can accept images as inputs. It can then analyze, interpret, classify, and generate captions for the input images. These images could be photographs, diagrams, and screenshots. An example from every day life would be to ask ChatGPT-4 what is funny about an image or provide it with a photo of several ingredients, so it generates a few possible recipes for you. In a more complex example, ChatGPT-4 can analyze the data shown in a graph.

ChatGPT-4 is superior to its earlier version with regard to creativity and collaborative tools. It can generate, edit, and iterate with users on creative and technical writing tasks, such as writing screenplays, composing songs, or learning a user's writing style. ChatGPT-4 can better synthesize existing ideas into novel combinations and help humans fill in the blanks between their different yet related ideas and pieces of work. Given that creativity is the capability to combine two or more seemingly unrelated concepts to generate a new idea or solution to a problem, the tool can help individuals to come up with new ideas better than ever before.

ChatGPT-4 can process significantly longer texts. Specifically, while the earlier version could process up to 3,125 words, this limit has increased to 25,000 words in the new version. So, while the previous version (ChatGPT-3.5) could read a 6-page text, ChatGPT-4 can now read the equivalent of a 50-page book to collect information and context. This allows its use for long-form content creation and document search and analysis, as well as extended conversations.

Overall, ChatGPT-4 is a more powerful tool than ChatGPT-3.5 for various reasons, including the ones described above and others such as the significantly larger training data set (100 trillion parameters, compared to 175 billion parameters used for the previous version). It is also able to produce various dialects and react

to emotions conveyed through text, and is better at answering difficult questions because of its ability to collect information from many sources, including scientific papers.

ChatGPT in Functional Areas of Business

ChatGPT can be used for various purposes in business. Below, we discuss some of these uses.

Automation of routine tasks: ChatGPT can be trained to perform various routine tasks. For instance, it can complete data entry tasks, generate reports, generate written content (e.g., content for marketing purposes), prepare financial statements, screen resumés for hiring, and much more. This helps free up time for professionals in different areas so that they can focus on higher-value tasks. In many cases, such automation can also improve the accuracy and efficiency of these tasks.

Enhanced data analysis: ChatGPT can assist employees with analyzing large amounts of data including financial data (e.g., cash flow), marketing data (e.g., customer behaviour), supply chain data (e.g., vendor fulfillment time, inventory data), and HR data (e.g., employees' absenteeism). Such analysis gives experts insights into various areas of a business, enabling them to make timely and better informed decisions. In some cases, ChatGPT can also provide suggestions for improvement and optimization in different areas (e.g., marketing campaigns, inventory optimization).

Fraud detection: ChatGPT can be used to detect anomalies and patterns in data, especially financial data, that may indicate fraud.

Improved customer service: ChatGPT can be used to respond to customer inquiries and provide advice and support. This will free up employees' time to focus on more complex tasks. In addition, it can standardize customers' experience when interacting with a business.

ChatGPT Detectors

Edward Tian, a senior at Princeton University, designed GPTZero (<https://gptzero.me>), a tool to help educators detect writing generated by ChatGPT. In early February 2023, the tool had a false positive rate of less than 2 percent. (False positive means that the tool would claim that a portion of text was written by ChatGPT when it was not.) Educators can sign up to be on an email list for updates about the next version of the technology.

If a detector tool flags a student's writing as produced by ChatGPT, many teachers see that as a starting point for a conversation, rather than a clear case of academic dishonesty. For example, students may have used ChatGPT as a starting point for generating ideas in much the same way that they may use a tool such as Grammarly, which can rewrite sentences to make them more coherent and/or grammatically correct.

Questions

1. As a student, do you consider that ChatGPT enables research or enables plagiarism?

2. Do you think that ChatGPT might cause you to reconsider your choice of major? Why or why not?
3. Do you think that ChatGPT will disrupt your choice of profession? Why or why not?
4. Which professions do you think that ChatGPT is least likely to disrupt? Support your answer.

(Hint: For questions 2, 3, and 4: Take a look at [Section 14.5](#).)

Sources: Compiled from S. Conroy, "GPT 4 Image Input: Can You Use Images with ChatGPT?," *Silent Preview*, May 14, 2023, <https://silentpreview.com/gpt-4-image-input-chatgpt/>, accessed June 9, 2023; D. Owasi, "6 Little Known Ways Chat GPT-4 Absolutely Crushes Chat GPT-3.5," *Medium*, April 14, 2023; Folio 3 AI Editorial Team, "ChatGPT 4 vs ChatGPT 3: What's New?," April 11, 2023, <https://www.folio3.ai/blog/chat-gpt-4-vs-chat-gpt-3>, accessed June 9, 2023; A. Truly, "GPT-4: How to Use, New Features, Availability, and More," *Digital Trends*, April 6, 2023; K. Steinbrinck, "Pure Imagination: Could ChatGPT Be More Creative Than You?," March 28, 2023, <https://www.emailonacid.com/blog/article/industry-news/chatgpt-more-creative/>, accessed on June 9, 2023; S. Brodsky, "GPT-4 Is Here, and Experts Say It Can Make You More Creative," *Lifewire*, March 20, 2023; B. Nolan, "ChatGPT Has Been Around for 2 Months and Is Causing Untold Chaos," *Business Insider*, January 28, 2023; J. Jolly, "What Is ChatGPT? Everything to Know about OpenAI's Free A.I. Essay Writer and How It Works," <https://www.usatoday.com/story/tech/2023/01/27/chatgpt-buzzfeed-ai/11129947002/>, January 28, 2023; E. Ofgang, "What Is GPTZero? The ChatGPT Detection Tool Explained by Its Creator," <https://www.techlearning.com/news/what-is-gptzero-the-chatgpt-detection-tool-explained>, January 27, 2023; J. Bongiorno, "New AI Chatbot Can Do Students' Homework for Them," *CBC News*, January 27, 2023; A. Klein, "Can Digital Tools Detect ChatGPT-Inspired Cheating?" *EducationWeek*, January 27, 2023; L. Tung, "ChatGPT Can Write Code. Now Researchers Say It's Good at Fixing Bugs Too," *ZDNet*, January 26, 2023; S. Kelly, "ChatGPT Passes Exams from Law and Business Schools," *CNN Business*, January 26, 2023; A. Mitchell, "ChatGPT Could Make These Jobs Obsolete: 'The Wolf Is at the Door,'" <https://nypost.com/2023/01/25/chat-gpt-could-make-these-jobs-obsolete/>, January 25, 2023; M. Milano, "CNET Uses ChatGPT to Write Articles, Runs into Major Issues," *WebProNews*, January 19, 2023; D. Gewirtz, "Can AI Detectors Save Us from ChatGPT?," *ZDNet*, January 13, 2023; S. Svruga, "Was That Essay Written by AI? A Student Made an App that Might Tell You," *Washington Post*, January 12, 2023; T. Barrabi, "NYC Schools Block Access to ChatGPT over Cheating Concerns," *New York Post*, January 5, 2023; L. Ocelot, "ChatGPT-4, the Newest and Most Advanced AI System, Might Prompt a Major Shift in the Way We Communicate," <https://medium.com/inkwater-atlas/chatgpt-4-the-newest-and-most-advanced-ai-system-might-prompt-a-major-shift-in-the-way-we-fd764f97212c>, January 1, 2023; I. Khan, "ChatGPT Caused 'Code Red' at Google, Report Says," *CNET*, December 22, 2022; K. Rosenblatt, "An AI Chatbot Went Viral. Some Say It's Better than Google; Others Worry It's Problematic," *NBC News*, December 2, 2022; <https://www.nbcnews.com/tech/tech-news/chatgpt-ai-chatbot-viral-rcna59628>, accessed February 2, 2023.

Before you go on...

1. Describe the advantages of computer vision, natural language processing, speech recognition, and chatbots.
2. What are cobots?

14.5

Artificial Intelligence in the Functional Areas

LEARNING OBJECTIVE

Provide use case examples of artificial intelligence applications in accounting, finance, marketing, production and operations management, human resource management, and management information systems.

ACCT AI in Accounting

By the end of 2020, **machine learning systems** were performing routine functions, freeing accountants to focus on performing judgement-intensive tasks and communicating with clients. Machine learning requires huge amounts of data to provide accurate results. Not surprisingly, then, the largest accounting firms are leading the industry in developing ML applications. The Big Four firms are EY (www.ey.com), PwC (www.pwc.com), Deloitte (www.deloitte.com), and KPMG (www.kpmg.com). Consider these examples:

- KPMG uses IBM Watson, an ML system, to help leasing companies comply with the International Financial Reporting Standards (IFRS) 16 lease accounting rules.
- Argus, an ML tool developed by Deloitte, reviews documents for key accounting information. The tool works with many types of documents, including but not limited to: sales, leasing and derivatives contracts, employment agreements, invoices, client meeting minutes, legal letters, and financial statements. Deloitte has also deployed a service that monitors risk associated with ML algorithms. This service can help early adopters use machine learning tools with reduced fear of adverse effects.
- Suppose an accounting clerk is processing a transaction but is unsure whether to post the expense in this month's financials or the next month. Without an ML system, the clerk decides how to record that transaction. However, this decision might not be correct. If the entry is incorrect, it might go unchecked and uncorrected. This problem is one of the reasons why many companies are not confident in the accuracy of their most recent close and have had to reopen their books after close to correct errors.

To help with such problems, Flexi (www.flexi.com), a provider of enterprise financial management software, has deployed an ML system that helps organizations avoid errors and accelerate the financial closing process. Specifically, the system offers suggestions on how to correctly record transactions based on accounting rules.

Taxes ML systems use knowledge of the tax code to process clients' tax information through a set of rules and calculate the amount of taxes they owe. In 2017, for example, H&R Block (www.hrblock.ca) incorporated IBM Watson to help deliver the best outcome for each unique tax situation.

Tax preparation involves massive volumes of data, encompassing thousands of pages of the federal tax code as well as provincial tax codes, all of which impact a client's tax outcome. H&R Block and IBM trained Watson using data from millions of returns that H&R Block had filed since 1955. H&R Block tax experts then validated Watson's conclusions and first applied it to the thousands of client questions and topics discussed with clients during the return filing process.

H&R Block uses Watson to understand context, interpret client intent, and draw connections between clients' statements and relevant areas of their returns. H&R Block professionals can then identify additional areas of possible tax implications to maximize client refunds or reduce their tax liabilities. The client can also follow along with the tax preparation process on a dedicated client companion screen that highlights areas for deductions, making the preparation process more transparent and understandable.

Here is how the process works. A customer enters an H&R Block office and sits down in front of a screen. A tax professional begins the usual interview, asking about life events,

machine learning

systems The ability of information systems to accurately perform new, unseen tasks, built on known properties learned from training or historical data that are labelled.

potential deductions, and possible credits, entering data as the client watches the screen. Throughout the process, Watson references millions of data points and the entire federal and provincial tax codes, to outline areas with potential savings. After the customer interview, Watson displays a chart of all possible deductions and credits. The tax professional then goes through the chart with the customer, explaining all the different ways to increase a refund or reduce liabilities.

Auditing An *audit* is an independent examination of an organization's financial information to determine whether its financial statements are accurate. Let's look at examples where organizations use ML systems in auditing and compliance.

- **Problem:** Most enterprises audit only a fraction of their invoices, meaning they could miss errors, fraud, and contract violations. Machine learning systems validate all invoices against contract terms and assign a risk score based on errors, anomalies, and non-compliance with contract terms.

Requirement: Automatically audit all invoices and flag high-risk invoices for manual review.

Solution: ML systems will enable auditors to examine 100 percent of companies' financial transactions. ML algorithms will process and review the data, recognize anomalies, and compile a list of outliers for auditors to check. Instead of spending most of their time checking data, auditors can focus specifically on the reasons behind a pattern or anomaly. If auditors can check every transaction, then their financial information will be more accurate, and they can better advise their clients. ML systems automatically approve low-risk invoices so they can proceed to payment and flag high-risk invoices for manual review.

- **Problem:** Accounting teams typically audit invoices after they have been paid. As time passes, it can become increasingly difficult for companies to recover money spent erroneously or fraudulently. Even if a company can eventually recover the spend, there is a cost to not having that cash on hand.

Requirement: Streamline the audit process to ensure that all spending is reviewed prior to payment.

Solution: ML systems streamline the manual review process to efficiently audit all spending prior to payment.

- **Problem:** Procurement teams may spend large amounts of time negotiating contract terms only to have vendor invoices violate them. Contract violations may relate to payment terms, volume discounts, and pricing mismatches.

Requirement: Make sense of all contract terms and validate invoices against them to ensure that the invoice adheres to the contract.

Solution: ML systems integrate with contract management systems and repositories to extract all contract terms. ML systems use semantic analysis to make sense of those terms in business contexts. Furthermore, they are trained to identify invoices whose details do not comply. *Semantic analysis* is the process of deriving meaning from text; it is related to natural language processing.

- **Problem:** With thousands of invoices being processed every month, it is very difficult to examine each one. Fake invoices, shell companies, and vendor impersonation are only some of the methods that criminals use to target companies.

Requirement: Identify suspected fraud in invoices.

Solution: ML systems review invoices in relation to data in contracts, business systems, online sources, and other invoices to identify suspected fraud.

- **Problem:** Companies could be paying the same bill twice—once via expense reimbursement and again via invoice. If invoice and expense automation systems do not communicate, then duplicate spending can go unnoticed.

Requirement: Detect duplicate spending across both invoice and expense automation systems.

Solution: ML systems remember all of the invoice- and expense-based spending that they process, regardless of when it occurs and what the receipts and invoices look like. These systems can then detect duplicate spends based on various attributes such as

words, phrases, images, amounts, dates, prices, etc. Therefore, ML systems ensure that companies do not pay an invoice if they have already reimbursed the employee for the same amount, or vice versa.

- **Problem:** Duplicate invoices can occur. In rare cases, vendors send duplicate invoices on purpose. In the majority of cases, however, they are a mistake. They can also be the result of fraud by an employee. Invoice automation systems can catch duplicates, generally when those invoices have the same invoice number. If a vendor is sending a separate monthly or quarterly summary invoice, then duplicates can be even more difficult to catch.

Requirement: Identify all duplicate invoices, regardless of when they are received, how they are grouped, and whether they have the same invoice number.

Solution: ML systems do not forget data that they have ingested. They catch duplicate invoices—even ones sent at different times, broken up into smaller pieces, or having different invoice numbers—by matching individual line items and other data, and flag them for review prior to payment.

- **Problem:** An organization's reputation can be damaged by its vendor associations. Therefore, firms should consider reputation risks and monetary penalties arising from vendor misconduct, such as violation of Canada's Corruption of Foreign Public Officials Act (CFPOA), the United Kingdom Bribery Act, and payments to companies with which a board member has a relationship.

Requirement: Limit organizations' exposure to vendor misconduct such as regulatory violations and conflicts of interest.

Solution: ML systems check the names of vendors, politically exposed employees, and board members and their associations against online databases, flagging high-risk organizations and people.

- **Problem:** Companies receive thousands of invoices every month, making it very difficult to keep abreast of associated discount opportunities.

Requirement: Validate invoice amounts against early payment contract terms, and flag those that do not include these savings.

Solution: ML systems extract and understand contract terms related to early payment. When an invoice payment deadline approaches, these systems flag savings opportunities associated with early payments.

- **Problem:** Most companies employ contractors in a variety of departments such as janitorial services, temporary workers, systems integrators, and consultants. Firms generally trust their contractors to bill them for the hours they actually work. But how can the firms verify that they were billed correctly?

Requirement: Ensure that contractors are working the hours they claim in their invoices.

Solution: ML systems integrate with relevant business systems such as time tracking, card access, and email and messaging. ML systems also gather information from digital sensors such as an office key fob system (a key fob is a small, programmable device that provides access to a physical object). Fobs can be used to provide one-device, one-factor authentication to objects such as doors or automobiles. The systems build a profile of access and work activity for different types of contractors. When the system audits an invoice for a contractor who is inconsistent with the profile, it will flag that invoice as high-risk.

- **Problem:** A three-way match refers to the three components—purchase order, receipt of goods, and supplier invoice—that must match within agreed-upon tolerance levels to ensure a proper and timely payment. This method is limited to price and units across invoices, receipts, and purchase orders. As a business becomes more sophisticated, it needs to validate not just price and units, but also volume discounts, payment terms, delivery times, transport conditions, chain of custody, service level agreements, and whatever else is meaningful to the business, based on data from any of the business systems.

Requirement: Automatically match data elements from any business systems.

Solution: ML systems recognize the content of invoices and match those data with data from enterprise systems such as contract management and enterprise resource planning to ensure that transactions are accurate.

- **Problem:** Businesses might have to make a conscious choice to pay more to ensure quality and timeliness in a supply chain. At the same time, however, they might want the lowest price, or at least the market rate, for goods and services. It is important for a firm to know how much it is paying and what the market rate is when it renegotiates contracts or chooses future business partners.

Requirement: Have visibility into what the organization pays for goods and services versus market rate.

Solution: ML systems gather information from thousands of online sources to understand market pricing and other details for goods and services. When an invoice price exceeds a certain threshold over the market price, the system will flag the invoice for review. By keeping track of overcharges over time, the firm will have improved insights into what suppliers are doing. These insights empower the company to negotiate better later on.

- **Problem:** When a company renegotiates a contract for volume discounts, it should review vendors' invoices to ensure that they follow agreed-upon terms.

Requirement: Ensure that invoices reflect the volume discounts specified in your contracts.

Solution: ML systems make sense of the volume discounts in the firm's contracts and keep track of the firm's purchase volume. When the system audits an invoice that does not comply with the price for the firm's current volume, it will flag it for review.

- **Problem:** A small percentage of vendors might try to cheat a company's system. For example, they might send the firm a stream of fraudulent invoices that fall just below the review threshold, break up large invoices into smaller amounts, or slowly add extras and surcharges to each new invoice in hopes that the company will not notice. These anomalies can go unnoticed in many business systems.

Requirement: Firm must be alerted to suspicious invoice activity before they make payments.

Solution: ML systems use a combination of computer vision and semantic analysis to build a profile of what "good" invoices look like and uncover unusual patterns that humans might not notice.

FIN AI in Finance

Machine learning systems have been in use for years in the financial sector. Here we look at four areas where these systems are widely used: process automation, security, insurance and risk management, and algorithmic trading.

Process Automation ML systems enable organizations to replace manual work, automate repetitive tasks, and increase productivity.

- **Chatbots.** ML-driven chatbots provide access to all of a customer's data. They communicate with customers to provide account information, send notifications to customers, track spending habits, provide credit scores, set and manage budgets, suggest how to save money, pay bills, and help them reset their passwords. Chatbots can also enable customers to search their account history for a specific transaction with a specific merchant, avoiding the hassle of searching their bank statements. The bots can also compute total amounts of credit and debt, a task that customers previously had to perform manually.

Chatbots also assist in call centres. Organizations train the chatbots with data from previous customer interactions. The chatbots then interact directly with customers. If a chatbot cannot answer a query, it refers the customer to a human. For instance, Privatbank, a Ukrainian bank, has deployed chatbots across its mobile and Web platforms. The chatbots resolve general customer queries quickly, thereby enabling the bank to decrease the number of human assistants. Examples of chatbots are TD Bank's Clari, Bank of Montreal's BMO Bolt, Capital One's Eno, HSBC's Amy, CIBC's virtual assistant, and Scotiabank's chatbot.

Robo-advisers are a special type of chatbot that analyze each customer's portfolio, risk tolerance, and previous investment decisions to offer advice on financial planning, portfolio management and investment decisions. For example, ForwardLane (www.forwardlane.com).

forwardlane.com) provides advisers with personalized investment advice and quantitative modelling that used to be available only to extremely wealthy clients. The advisers can then pass along the information to their clients.

Traditionally, human investment advisers have been responsible for managing financial portfolios. Today, financial institutions use ML to manage client portfolios and optimize clients' assets. Customers enter their present financial assets and goals. A robo-adviser then allocates the current assets across investment opportunities based on the customer's risk preferences and goals, taking into account real-time market dynamics.

- *Paperwork automation.* In 2020, Google introduced its new Document AI (DocAI; <https://cloud.google.com/document-ai>) platform, which employs ML to transform unstructured data from documents into structured data, thereby making it easier to understand, analyze, and use documents. Specifically, DocAI uses computer vision, optical character recognition, and natural language processing, to create trained ML models that extract information from documents. One product in the DocAI platform is *Lending DocAI*, which is a set of pre-trained ML models developed for the mortgage industry. Lending DocAI enables financial institutions to process borrowers' income and asset documents faster, saving thousands of hours. HSBC Canada (www.hsbc.ca) is one of the users of Lending DocAI.

Security Banks are introducing ML systems into their fraud detection systems. The banks have two objectives: (a) to detect real incidents of fraud quickly and accurately, and (b) to prevent false positives (i.e., incorrectly flagging legitimate transactions as fraudulent). Banks do not want to abolish existing fraud detection rules, many of which were implemented to comply with government regulations. Rather, they want to augment their existing systems with new ML systems. Consider the following examples.

- *Monitoring.* Banks use ML systems to monitor thousands of transaction variables for every account in real time. These systems examine each action that a cardholder takes and then determine whether an attempted activity is characteristic of that individual. Significantly, they identify fraudulent behaviour very accurately in real time. When they identify suspicious account behaviour, they can request additional identification from the customer to validate the transaction. Alternatively, they can block the transaction.

Consider rogue trading, which is a serious problem for banks around the world. Losses and fines for the top 13 global banks have totalled more than \$10 billion since 2010.

In an attempt to stop rogue trading, banks have deployed ML systems that attempt to predict which traders are likely to go rogue. They monitor traders and their communications. For example, they search for obvious phrases and keywords such as "Let's take this conversation off-line." They also monitor traders' credit scores, human resources reviews, court convictions, sizable divorce settlements, and many other variables to make their predictions more accurate.

These ML systems make it more difficult for a trader to make the kind of enormous bets that led to one-off losses of as much as US \$6 billion in JPMorgan Chase and Co.'s "London Whale" scandal. In April and May 2012, US \$2 billion in trading losses occurred at the firm, based on transactions booked through its London branch.

- *Finding false positives.* False positives, which are legitimate transactions that are wrongly rejected due to suspected fraud, account for more than \$100 billion in annual losses for global retailers, in addition to lost customers. ML systems, such as Mastercard's Decision Intelligence technology, analyze various data points to identify fraudulent transactions that human analysts might miss, while improving real-time approval accuracy and reducing false positives. Using ML to spot unusual patterns and improve general regulatory compliance workflows helps financial organizations to be more efficient and accurate in their processes.

The Nasdaq stock market is an attractive target for criminals. As the world's largest stock exchange by volume, it must be constantly monitored for attempts to illicitly beat the system. These attempts can include manipulations to inflate a stock's closing price; rapidly buying and selling stocks to give the false impression that a lot of activity has occurred; and spoofing, which is placing a large buy or sell order with no intention of actually executing it to create artificially high demand.

The legacy Nasdaq surveillance system issued around 1,000 alerts per day for human analysts to investigate. Only a fraction of those cases were subsequently confirmed as

fraud and resulted in heavy fines. An ML system is now helping to monitor Nasdaq, augmenting the existing system to flag any signs of market abuse. The ML system also works with human analysts to monitor more than 17.5 million trades per day.

The ML system was trained to detect particular types of abuse by learning from historical examples. Every time it detects similar suspicious activity, it alerts a human analyst, who possesses the appropriate expertise. After investigating the case, the analyst enters the outcome back into the ML system. In that way, the system learns and becomes better at catching instances of attempted abuse.

Insurance and Risk Management Consider usage-based insurance models, which are based on ML systems that utilize data from telematics and IoT sensors. The transformation from legacy fixed premium insurance models to modern pay-as-you-go models is the result of leveraging ML systems and driving data to more accurately profile driver and trip specifics in order to offer accurate micro-insurance premiums.

- *Driving behaviour modelling.* Consider this hypothetical scenario from the near future. Suppose that a customer is driving a car on the highway on a long and tiring trip. The ML system in the car uses computer vision to note that his eyes are getting droopy. The system's sensors gather data that shows that the way he is driving—for example, speed, handling, and braking—is different from the way he normally operates his car. The system then uses natural language processing over the car's speakers to tell him to park his car and get some rest. He resists, thinking that he does not need a break. The system tells him that, after analyzing the number of hours that he has been driving, the speed at which the car is running, and his head movements, it feels that he must take at least a small break. On the automobile's digital screen, the system then offers to buy a coffee for him from the next coffee shop on the highway. He accepts the offer. In the near future, if he does not accept the offer, then the system will be able to slow the car and pull it gently off the highway.
- *Claim settlement.* ML systems are also impacting claim settlement. By leveraging computer vision and natural language processing in ML systems, insurance assessors can gather real-time information related to accidents and settle claims faster.

The system takes charge of the entire process, walking the customer through it, step by step, in a conversational format. It gathers all the information required to process the claim, including videos or photos of the damage, and uploads that information into a database. Next, the system examines the application for fraud, searching for anomalies and non-compliant data. It then accesses the insurer's adjustment model, where it examines a range of values for payout. Finally, it calculates and proposes payout amounts, based on a payout predictor model it has been trained on.

- *Compliance issues, regulatory issues, and risk management.* ML-powered systems help lenders lower compliance and regulatory costs by providing robust credit scoring and lending applications. These applications help lenders achieve faster and more accurate risk assessment by factoring in the applicant's character and repayment capacity. For example, [Underwrite.ai](#) applies ML to provide lenders with dynamic models of credit risk.

To remain compliant and identify fraud, banks use ML systems like Amelia ([www.amelia.ai](#)) that employ natural language processing to scan legal and regulatory text for compliance issues.

Algorithmic Trading ML systems help to make better algorithmic trading decisions. ML algorithms monitor thousands of data sources in real time, including the news and trading results, to detect patterns that could force stock prices to go up or down. These systems can then advise or even act to sell, hold, or buy stocks according to their predictions.

MKT AI in Marketing

Improved Lead Scoring Accuracy Lead scoring helps enterprises rank prospective customers on a scale that represents their value to the firm. Improving lead scoring accuracy helps the company prioritize its lead generation strategies.

Marketing managers use ML systems to monitor customer behaviour in order to obtain data for these calculations. For example, these systems track websites visited, emails opened, downloads, clicks, and many other variables. They also consider a customer's behaviour on social media platforms, such as accounts they follow, posts they like and dislike, ads they engage with, and many other variables.

Easier Customer Churn Prediction *Customer churn*, also known as customer turnover, is the number of customers who end their relationship with a business. *Churn rate* is the percentage of customers who leave a business within a specific period of time.

Companies want to know how customers engage with a product, service, or mobile app. Churn rates are an indicator of customer satisfaction with firms' products and services. Firms need to be able to predict their churn rate in order to minimize it.

To predict churn rates, companies are using ML systems to monitor customer behaviour. For example, they consider the last time a customer signed into their profile on the firm's website, how long they stayed on the website, and when their last purchase was. The answers to such questions, and many others, can predict that a customer will end their relationship with this company. ML systems can analyze such customer behaviour at a huge scale, enabling firms to better predict that certain customers might leave.

Profitable Dynamic Pricing Models A *dynamic pricing* strategy allows businesses to offer variable prices for the product and services they offer based on changing market demands. This is common in the hospitality, travel, and entertainment industries. The retail industry is now employing ML systems to implement this strategy as well.

Dynamic pricing is related to *real-time pricing*, which occurs when the value of goods is based on specific market conditions. For example, the price of an airline ticket depends on how far in advance the customer purchases it, the number of tickets already purchased on that particular flight, and the location of the seat on the aircraft. Another example of real-time pricing is surge pricing on Uber and Lyft.

ML systems make it easier for companies to implement and improve their dynamic pricing models by analyzing vast amounts of data. These data include historical prices for each service or product, customer demand, and external factors such as industry trends, seasonality, weather, and location. ML systems also analyze customer information such as search and/or booking history, demographic features, income, and many other variables.

Sentiment Analysis Companies that implement e-commerce often do not have face-to-face relationships with their customers. As a result, they find it difficult to understand customers' feelings. For instance, with face-to-face conversations, you can make judgements based on facial expressions, tone, and body language. You can then use these judgements to determine whether the person with whom you are speaking is happy, satisfied, or excited.

Companies that employ e-commerce need to know how their customers feel in order to respond properly. ML systems can help in this area by analyzing text to determine whether the sentiment expressed by customers is positive or negative, a process called *sentiment analysis*. ML systems read all digital communications and classify them as positive or negative. They then alert marketing managers, who can respond to negative comments and trends. ML systems can also identify happy and satisfied customers to help companies find social influencers and brand ambassadors.

Improved Website Experiments A/B testing is an excellent method to improve the features of a company's website, mobile app, and email marketing content. *A/B testing* is the process of showing two versions of, for example, the same Web page to different segments of website visitors at the same time and comparing which version drives more purchases or sign-ups. ML systems analyze the results of thousands of A/B tests every day. Companies then use these data to improve their content to increase visitor engagement.

Consider Google RankBrain, an ML-based search engine algorithm that helps Google learn from users' search results to provide more relevant search results in the future. For example, if two people search for the same term on Google at the same time, they will likely see different search results based on the outcome of Google's A/B testing.

Focus on Ad Targeting and Customer Personalization ML systems are helping marketing managers target their ads more effectively. A company might produce excellent ads, but they will not be effective if the correct audiences are not viewing them. ML systems can help ensure that companies reach their target audience.

ML systems can also help personalize the customer experience. ML algorithms can predict which type of content will be the most popular with each unique visitor. ML systems can:

- Recommend content on a company's website based on users' history and preferences
- Remarket company's content across desktop, laptop, mobile, and social interfaces
- Personalize branded content in emails based on users' history across other channels
- Drive new, targeted users to relevant content

Machine learning helps online retailers improve their customers' *product discovery* on their website and improve the efficiency of *product categorization*.

Product discovery is the first, and, arguably, the most important component of the shopping process. Retailers employ visual and voice search to help customers find what they are looking for.

ML-powered *visual search* systems enable customers to upload images and look for similar items based on their colours, shapes, and patterns. For example, The British online fashion and cosmetics retailer ASOS (www.asos.com) has a "Style Match" feature on its mobile app that lets customers take or upload pictures to search for similar clothes. So, if a customer uploads a picture of someone wearing a blue shirt, they can search for similar blue shirts on the website. Style Match does not limit users to searching for one item only. So, if a user uploads a picture of someone wearing a pink top with a white skirt, they will receive results related to both of these items. Amazon's "Style Snap" does a similar job, enabling customers to look for multiple items to complete a look using an image. Walmart, Tesco, Kohl's, Costco, and many other companies use Google or Amazon ML-powered voice recognition technology and natural language processing to provide customers with quick, simple *voice search* capacity. For instance, customers can ask Amazon's Alexa for a desired item and its delivery status without typing anything.

Alibaba (www.alibaba.com) is a Chinese multinational company that specializes in e-commerce. Alibaba's ML system chooses which items customers will see when they visit the website and search for products. The system builds a customized page view for each visitor, displaying items they will be interested in. Significantly, the system also dynamically prices items based on its knowledge of the customer's past spending habits. By monitoring customer actions—whether they make a purchase, browse to a different item, or leave the site—the system learns in real time to adjust these page views to increase the probability that the visit will end with the customer making a purchase.

Alibaba has deployed automated content generation to make it easier to write descriptions for items it sells. Its ML-driven copywriter uses NLP algorithms to produce 20,000 lines of copy in one second. The copywriter creates multiple versions of advertisements and runs them through algorithms trained on customer behaviour data. The system finds which combination of words is most likely to result in customers clicking on them. It then uses those words to create its copy.

Product categorization. Love the Sales (www.lovethe-sales.com) is a fashion e-commerce aggregator that allows consumers to shop all sale items from multiple brands and retailers in a single online destination. The website uses ML systems to classify more than 1 million items from more than 500 brands and retailers. These systems tag items and sort them in different categories for customers.

Computer Vision for Product Recognition ML systems help brands recognize their products in online images and videos. For instance, Miller Lite (www.millerlite.com) used an ML system to scan through user-generated content on social media. ML algorithms searched for images to find posts related to the brand. The system also tracked information about competing brands and influencers. In addition, it collected data about users who posted on social media about Miller Lite. The ML system found 1.1 million posts associated with the brand and identified 575 Miller Lite promoters.

Amazon's Just Walk Out technology integrates machine learning with cameras and sensors in its Amazon Go cashierless stores. This technology automatically detects when products are taken from or returned to shelves. In addition, it keeps track of the items in a customer's cart. When customers are finished shopping, they simply leave the store. Amazon then sends them a digital receipt and charges their Amazon accounts.

Other physical stores can use Amazon's Dash Cart, which is an ML-powered shopping cart that allows shoppers to skip the checkout line. Shoppers use a QR code in the Amazon app that enables them to easily sign in and begin using the cart. The cart has a screen where shoppers can access their Alexa Shopping Lists to check off items and view their subtotals and coupon scanners, where shoppers can apply store coupons as they shop.

The smart cart uses computer vision and sensors to identify the things shoppers place in it. When a shopper exits through the store's Amazon Dash Cart line, sensors automatically identify the cart, and their payment is processed using the credit card on their Amazon account.

Relevant Recommendation Systems ML systems in the form of intelligent personalization software can identify user preferences as well as people who know them best. For example, if users have multiple profiles on their Netflix account, they know that each time they launch the platform, it asks "Who is watching?" Then it provides "recommendations for you" based on shows, movies, and documentaries the user has already watched. These recommendations improve the customer experience.

ML systems help marketing managers discover which types of products consumers want based on their browsing histories and shopping behaviours. Relevant product suggestions increase conversions.

Monitoring Customer Satisfaction ML systems such as facial recognition can detect customers' moods while they are shopping. Walmart has installed cameras at each checkout lane. If a customer looks annoyed, then a store representative will talk to them to resolve any potential problems.

Chatbots Live chat enjoys a very high customer satisfaction rating. In fact, industry analysts assert that more than 60 percent of customers are more likely to return to a website if it offers a live chat feature.

Chatbots can help firms improve their live chat feature because ML systems improve chatbots' capabilities. For example, these systems use sentiment analysis to judge the mood of a customer message. When paired with social media, ML systems can gather more information about customers to apply when a chatbot receives a new message. That is, ML systems enable chatbots to personalize the customer experience. As a result, chatbots keep customers on pages for longer periods of time. They also decrease wait times for customers because they can handle simple, routine queries without human assistance.

Improved Audience Insights With ML systems, companies can learn valuable information about their customers. This information provides more accurate data that firms can use to build more comprehensive, targeted customer profiles to increase customer engagement. For example, Affinio (www.affinio.com) helps companies discover various aspects of customer behaviour, such as which customers are foodies, which ones watch a particular television show, and which ones have travelled to similar places.

Discover Trends ML systems are capable of monitoring social media to inspire fresh product and content ideas that directly respond to customers' preferences. As one example, ice cream giant Ben & Jerry's (www.benjerry.com) launched a range of breakfast-flavoured ice creams, including Fruit Loot, Frozen Flakes, and Cocoa Loco. The company introduced these products after it had employed ML systems to help its Insight division listen to what was being talked about in the public sphere. For instance, at least 50 songs within the public domain had mentioned "ice cream for breakfast" at one point. Discovering the popularity of this phrase across various platforms revealed the value of ML systems in identifying emerging trends.

Intelligent Marketing Campaigns AdGreetz (www.adgreetz.com) is a marketing services company that has developed an ML-based advertising platform that can quickly generate thousands or millions of personalized ads.

The first campaign that AdGreetz conducted for Flipkart, a giant Indian e-commerce vendor, reached 200 million people across multiple social media platforms. The audience, spread across different regions of India, was extremely diverse, consisting of people who live in different cities, speak different languages, and have different motivations and different relationships with Flipkart.

To give the ads a more significant impact, AdGreetz and Flipkart created about a million *creatives*, or ad banners and other forms of online advertising. Each creative targeted different groups based on data collected from social media and Flipkart's e-commerce platform. These ads varied dramatically, including different colours, voices, and languages, depending on the target audience. Flipkart has subsequently used AdGreetz to produce an additional 40 campaigns.

POM AI in Production/Operations Management

In the Factory The *smart factory* is a highly digitized operation that continuously collects and shares data through connected machines, devices, and production systems. Smart factories use Big Data analytics (see Chapter 12), the industrial Internet of Things (see Chapter 8), machine learning, and robotics.

- **Production.** Volkswagen (www.volkswagen.com) is using computer vision to increase its production by 30 percent by 2025. The automaker deployed its first application in its Leipzig Porsche plant. Workers attach several labels containing vehicle information to each vehicle they produce. Many of the labels contain country-specific information and are written in the customer's language. The computer vision system ensures that the labels are applied properly.

At the Leipzig plant, an employee on the production line now scans the vehicle identification number to ensure that the vehicle is identified correctly. The employee also takes photos of each label attached to each car. The computer vision app checks the images in real time to ensure that the labels have the correct content and are written in the appropriate language. This process saves several minutes per vehicle.

- **Quality control.** Quality control is critical because customers expect products with zero defects. Defects damage the reputation of the manufacturer and its brand.

Industry analysts have noted that ML systems increase defect detection rates by up to 90 percent. These systems can also check for defects on all products in a production process rather than simply examining samples.

For instance, Audi, a Volkswagen brand, uses ML and computer vision at its plant located in Ingolstadt, Germany, to conduct its quality testing operations. The system detects the smallest cracks on the vehicle as well as defects in vehicle components.

- **Predictive maintenance.** Equipment maintenance is a critical feature of every asset-reliant production operation. Unplanned downtime is expensive. Predictive maintenance techniques help determine the condition of in-service equipment to estimate when maintenance should be performed. This approach saves money and time over routine or time-based preventive maintenance because maintenance is done only when needed.

ML-based predictive maintenance systems are trained with data from sensors on the equipment. These systems search for patterns and anomalies in various equipment. They can help to reduce costs, enhance predictability, and make certain that equipment is available when needed. As an additional benefit, they can increase the length of the equipment's remaining useful life.

Consider the smart locomotives manufactured by General Electric (GE; www.ge.com). GE has equipped its locomotives with sensors and cameras that gather data for the ML system. GE improved its speed and accuracy in detecting problems in these giant, complex machines, which in turn reduced locomotive failure by 25 percent.

- **Robotics.** Smart factories are deploying increasing numbers of robots, which are driven by ML systems. An excellent example is Amazon's Kiva robots in its distribution centres (see the chapter opening case).

In Transportation An *autonomous vehicle* (automobile, bus, tractor, combine, boat, forklift, etc.) is a vehicle capable of sensing its environment and moving safely with little or no human input. These vehicles are powered by ML systems.

An early application of autonomous vehicles is in public transportation. For instance, Olli is an autonomous electric shuttle bus that operates around the world.

Another application involves autonomous delivery robots. For instance, Pizza Hut uses robots to deliver pizza in Vancouver. These robots have four wheels, two eye-like rings of light in front, a strip of lights around the top, and a yellow flag to help make them more visible. These delivery robots can even cross the street on their own.

Another transportation-related application of ML systems is to resolve traffic control and optimization problems using traffic sensors and cameras. Sydney Coordinated Adaptive Traffic System (SCATS; www.scats.nsw.gov.au) is an intelligent traffic management platform developed in Sydney, Australia. SCATS uses real-time data and ML algorithms to make intelligent decisions that adapt to changing traffic conditions. This system can optimize traffic signals in real time across single intersections or entire networks. This helps save time and money for commuters and municipalities while also increasing productivity and reducing emissions. SCATS also gives priority to transit and emergency vehicles. The system has been used in Toronto since 2018. As of December 2022, 59 intersections in Toronto are equipped with this system and the city plans to increase this number to 89 by the end of 2023.

Along Supply Chains AI in supply chains helps to deliver the optimization capabilities required for more accurate capacity planning, improved productivity, higher quality, lower costs, and greater output, while promoting safer working conditions.

Supply chain optimization. ML systems contribute to solving the complex constraint, cost, and delivery problems that companies face today. ML systems can provide supply chain managers with significant insights into how they can improve supply chain performance, by anticipating anomalies in logistics costs and performance before they occur. Here are some of the ways in which ML systems help optimize supply chains:

- ML systems use data from Internet of Things sensors, telematics, intelligent transport systems, and traffic data.
- They can improve the accuracy of demand forecasting.
- They can reduce logistics costs by identifying patterns in track-and-trace data captured by IoT sensors. Track-and-trace apps provide real-time data on the location and status of items as they move through a supply chain.
- ML-based planning and optimization systems can reduce lost sales as a result of products not being available. These systems can also reduce inventory along the supply chain.
- ML systems can optimize capacity utilization along the supply chain.
- They can detect and act on inconsistent supplier quality levels and deliveries. These systems provide visibility into inbound deliveries and delays, and they enable firms to monitor the status of critical orders, including multicomponent orders, in near-real time. They also alert companies when a late delivery will impact a customer order.

When a supply chain disruption does occur, an ML system generates an alert and automatically brings together the right members of the supply chain team to resolve the issue. The system gives the team the most relevant information, including data on the orders that are being affected and the potential financial impacts. The system learns from each resolution, thereby improving its performance for the next disruption.

- ML systems use data from automated inspections to reduce the risk and the potential for fraud, while improving product and process quality. Inspectorio (<https://inspectorio.com>), an ML company, is addressing the many problems that a lack of inspection and supply chain visibility creates. Because there can be a time lag to receive handwritten factory inspections, Inspectorio digitizes those inspections and uses machine learning that

enables retailers to monitor their supply chains in real time. This process allows them to quickly find and address quality and compliance problems.

- ML systems provide end-to-end supply chain visibility as well as predictive and prescriptive information on supply chain operations.
- They can help companies find and stop privileged credential abuse, which is the leading cause of security breaches across global supply chains. By using the least privilege access approach (see Chapter 4), firms can minimize attacks. They know that, if a privileged user has entered the correct credentials but the request comes from a risky context, then stronger verification is needed to permit access. Zero Trust Privilege is a framework for verifying who is requesting access, the context of the request, and the risk of the access environment (see O'Reilly Media; www.oreilly.com). Delinea's Centrify (www.delinea.com/centrify) is a leader in this area.

Security There are numerous examples of organizations applying ML systems to various aspects of security.

- In 2020, Facebook took down almost 6 billion fake accounts. Criminals use such accounts to spread spam, phishing links, and malware.

Facebook distinguishes between two types of fake accounts: user-misclassified accounts and violating accounts. User-misclassified accounts are personal profiles for businesses that are meant to be Pages. Facebook simply converts these accounts to Pages.

Violating accounts are more serious. These are personal profiles that engage in nefarious activities and violate the platform's terms of service. These activities can include using a fake name, impersonating someone, contacting other people to harass them, and many others. Facebook wants to remove violating accounts as quickly as possible without involving legitimate accounts (false positives).

Facebook uses hand-coded rules and ML to block a fake account either before it is created or before it becomes active. After a fake account has gone live, detection is more difficult. At this point, Facebook's ML system, called Deep Entity Classification (DEC), becomes involved.

Facebook has trained DEC to differentiate between fake and real users by their connection patterns across the network. The company calls these patterns *deep features*. They include average age or gender distribution of the user's friends, among thousands of other factors. In fact, Facebook uses more than 20,000 deep features to characterize each account, providing a snapshot of how each profile behaves.

DEC can identify four types of fake profiles:

- Illegitimate accounts that are not representative of the person
- Compromised accounts of real users that attackers have taken over
- Spammers who repeatedly send revenue-generating messages
- Scammers who manipulate users into divulging personal information

Since Facebook implemented DEC, it has limited the volume of fake accounts on the platform to roughly 5 percent of monthly active users. Unfortunately, the platform has approximately 2.7 billion monthly active users, meaning that 135 million Facebook accounts are still fake!

- Amazon, which has long tried to eliminate counterfeit products from its site, is using machine learning to automatically monitor its website for fake items. The system uses data from Amazon sellers, which give Amazon their logos, trademarks, and other important data about their brands. Amazon's system then scans product listings every day searching for fake items before they are purchased.

Previously, brands had to report counterfeit items to Amazon. In 2019, Amazon deployed its ML-powered Project Zero, which allows brands to take down counterfeit items on their own without Amazon's help.

- In 2018, Walmart began using ML-powered computer vision from Irish startup Everseen (www.everseen.com) to deter theft and losses at its checkouts and self-checkouts in more than 1,000 of its stores. The system, called Missed Scan Detection, notifies

attendants if an item moves past a scanner without being scanned, giving them a chance to correct the situation. Walmart maintains that *shrinkage rates*—the loss of goods to theft and accidents—have decreased at stores that employ the system.

However, a group of Walmart employees who call themselves the Concerned Home Office Associates have claimed that the computer vision system often misidentifies innocuous behaviour as theft (false positives) and often fails to stop actual instances of stealing. The group created a video that purports to show the technology failing to flag items that not being scanned in three Walmart stores. Their primary concern is false positives at self-checkouts, which frustrate customers and store associates and lead to longer check-out lines.

HRM AI in Human Resources

Recruiting Recruiting refers to the overall process of identifying, screening, and interviewing suitable candidates for available positions within an organization.

- *Candidate identification and screening.* Finding the right talent is a major problem for virtually all organizations. To assist with this process, AI companies are developing tools to scan resumés, online job profiles, and job queries much more quickly than humans can. These tools automate the candidate search process and move the best candidates to the top of the list.

Consider DBS Bank (www.dbs.com). The DBS Talent Acquisition team created Jobs Intelligence Maestro (JIM), a virtual recruitment bot powered by artificial intelligence. The consumer bank uses JIM to screen candidates applying to be wealth planning managers, a high-value job.

After DBS introduced JIM in 2018, the firm was able to shorten the screening time from 32 minutes per candidate to 8 minutes, improve the completion rate of job applications from 85 percent to 97 percent, and respond to 96 percent of all candidate queries through JIM. As a result, recruiters were able to spend more time personally sharing DBS's culture and values with candidates.

CareerBuilder (www.careerbuilder.ca) is an employment website founded in 1995. In 2019, the company launched its Talent Discovery platform. CareerBuilder claims that the machine-learning tool finds potential employees faster and increases job applications. The company trained the tool with data that include 2.3 million job postings, 680 million unique profiles, 310 million unique resumés, 10 million job titles, and 1.3 billion skills.

Talent Discovery provides a candidate appeal score that helps companies understand how effective a job posting will be at attracting candidates. It also offers recommendations to increase the posting's appeal. Furthermore, it provides a map that displays similar competing jobs in a geographic area and the salaries those jobs are offering. Talent Discovery uses machine learning to help companies create job descriptions that are gender-neutral and tone-neutral to save time and help increase diversity.

- *Promoting diversity and inclusion.* Job descriptions can contain subtle messages about company culture, including its inclusiveness or lack thereof. An AI tool that helps identify problems with the language employed in job descriptions is Textio (www.textio.com). The tool analyzes writing for gender bias and other unintentional messages. It suggests alternative wording, serving as a writing coach on diversity and inclusion. Textio's customers include Fraser Health (www.fraserhealth.ca) and Zillow (www.zillow.com). Interestingly, Zillow has seen an 11-percent increase in female applicants since it began to use the tool.
- *Video interview analysis.* Because companies want to spend less time on the interviewing process, video interviewing software is becoming increasingly popular. For example, HireVue's video interviewing system employs voice and facial recognition technology, along with an ML ranking algorithm, to evaluate candidates.

Onboarding *Onboarding* is the process by which new employees acquire the knowledge, skills, and behaviours they need to become effective organizational members.

As companies strive to retain talented employees, mentoring is becoming increasingly important. Consider the AI-driven app Ellen from Next Play. Ellen helps to (a) connect mentees with mentors at their company, (b) expand the mentee's network within the company, and (c) foster a sense of belonging at the workplace. Ellen also nudges mentors and mentees to engage in high-quality conversations. Interestingly, more than 90 percent of Ellen matches stay in contact after their first three mentor/mentee meetings.

IBM is creating a system that answers new employees' most pressing or job-critical questions to help get them up to speed quickly. The system offers training suggestions and provides the names, locations, and contact information for people the employee should connect with very early in their employment.

Career Pathing AI technology is helping HR professionals with career pathing to enhance employee satisfaction and retention, succession planning, workforce planning, and overall company productivity and profitability. AI systems can efficiently match employees with suitable next-step positions based on their profiles and experience. This process is similar to the way these systems align external candidates to recommended positions within the company.

It should be noted that, if an employee wants a complete career overhaul or change, AI systems are not independently creative enough to design an entirely unique career path.

Identifying Employees Who Might Be Leaving the Organization People analytics platforms employing ML algorithms can help identify employees who might be considering leaving the organization. ML algorithms consider various factors for every employee, including those collected through surveys such as their engagement score, loyalty score, and growth score, as well as their participation in surveys, and tenure in the firm. With these data, attrition risk levels (e.g., severe, high, low, etc.) can be computed for each employee.

Monitoring Employees Consider employee monitoring at Outback Steakhouse (www.outback.com). Casual dining chains are experimenting with surveillance technology designed to maximize employee efficiency and performance. One Outback location is testing a computer vision tool called Presto Vision (www.presto.com).

These kinds of tools use surveillance cameras to monitor employees such as servers at restaurants. The system uses machine learning to analyze video footage of restaurant staff at work, particularly their interactions with guests. It provides metrics such as how often servers tend to their tables and how long it takes for food to come out of the kitchen and reach each table. At the end of a shift, managers receive an email containing the compiled statistics. They can then use these data to identify problems and determine whether servers, hosts, and kitchen staff are doing their jobs adequately.

These systems can also be used to correct employee performance in near-real time. For instance, managers could be sent text messages when the number of people waiting for a table reaches a certain threshold. In another example, the system could detect when a guest's drink is almost empty and prompt servers to offer them a refill.

Such employee monitoring is a double-edged sword. Industry analysts note that workplace surveillance can have negative effects on employees, such as increased stress and lower job satisfaction.

Monitoring and Improving Employees' Health Physically or mentally toxic work environments can negatively impact employees' health, which can in turn result in organizational losses. According to Statistics Canada, 27 percent of Canadian workers claim to have high to extreme levels of stress on a daily basis. An additional 46 percent of Canadian workers have reported feeling "a bit" of stress on a day-to-day basis. Moreover, 62 percent of Canadian workers say work is their main source of stress.

To deal with these problems, many firms are asking their employees to opt in to company exercise and diet plans. For example, companies provide their employees with wearables such as a Fitbit or Apple Watch. Employees can agree to share the data from their wearables with the company in return for a reduction in their health-care premiums. Let's look at how the National Football League (NFL; www.nfl.com) in the United States is using sensors to improve the health of players.

Research has highlighted the health risks associated with playing American football including neurological issues. To help with this problem, the NFL has adopted Amazon Web Services (AWS; www.aws.amazon.com) and Amazon's ML products and services to better simulate and predict player injuries, with the goal of improving players' health and safety. The partnership uses Next Gen Stats (www.nextgenstats.nfl.com), an existing NFL and AWS agreement that enables the NFL to capture and process data on its players.

Sensors on players' equipment and the football itself capture real-time location, speed, and acceleration data on players and the football. The data are then fed into AWS data analytics and machine learning tools to provide fans, broadcasters, and NFL teams with live and on-screen statistics and predictions, such as expected catch rates and pass completion probabilities. Using those data, as well as data from other sources such as video footage; equipment choice; playing surfaces; player injury data; type of play (run or pass); type, frequency, and angle of impact; the speed the players are running; and environmental factors (temperature, rain, wind, etc.), the NFL and AWS partnership creates a digital twin of each player.

Typically used in manufacturing to predict machine outputs and potential breakdowns, a *digital twin* is a virtual, digital model of a machine or a person created from real-time and historical data. Using machine learning and predictive analytics, a digital twin can be placed in any number of virtual scenarios, enabling data scientists to see how the digital twin's real-life counterpart would react. These scenarios do not risk the health and safety of real players but they can provide insights into changes to game rules, player equipment, and other factors that could make football a safer game.

MIS AI in Management Information Systems

Organizational information technology groups use machine learning in many areas. We consider several examples here.

Security Organizations store vast amounts of customer, strategic, and other forms of data, which must be secured at all times. ML algorithms help identify potential threats and data breaches while also providing solutions to eliminate or mitigate such threats.

Server Optimization Firms' servers frequently receive millions of requests per day. They are then required to open Web pages requested by users. Servers can become unresponsive if the number of requests exceeds their processing capacity. ML algorithms can optimize server processing to help meet this demand. In a server farm, ML algorithms allocate user requests among multiple servers to optimally meet demand.

Service Management IT service management encompasses the activities performed by an IT team to design, deliver, operate, and control information technology services offered to organizational users. ML systems can assist the IT service team in several ways.

- Chatbots can recognize, categorize, and prioritize underlying problems in employee requests. In live chat, chatbots can use natural language processing to answer common questions without human intervention.
- Service desk teams have different skill sets. Some are better at resolving certain requests than others. ML algorithms can automatically send requests to the appropriate employees.
- Many IT requests require humans to perform a complex set of steps to fulfill them. In the case of employee onboarding, ML algorithms learn from a historical database of requests that cover a range of actions taken based on the type of employment and the employee's role and department. The algorithms can suggest what types of hardware and software an employee needs as well as the amount of access to organizational applications the employee should receive.
- Based on the historical database of requests and current user behaviour patterns, ML algorithms can forecast and fulfill users' requests.

Software Development Software development is the process of conceiving, specifying, designing, programming, documenting, testing, and error correcting involved in creating and maintaining applications.

- *DevOps* is the combination of cultural philosophies, practices, and tools that increase an organization's ability to quickly develop and deliver applications. Key functions within DevOps projects include continuous integration and continuous delivery. *Continuous integration* is the practice of combining computer code from multiple contributors on a single software project. *Continuous delivery* refers to a situation in which a version of the final software package is always ready to be released but is not sent to production before the decision is made to release it. *DevOps bots*, which are still under development, will be ML-powered bots that assist in all stages of the software development process. Let's take a closer look at bots' potential contributions to the process.

Requirements gathering. Gathering user requirements remains an art form. DevOps bots will listen in on stakeholder interviews. As stakeholders define their requirements, the bots could conduct a real-time sentiment analysis. They could then determine which requirements the stakeholders considered important and which ones they were uncertain about. The bots could also flag any requirement with a history of negative project outcomes, proactively alert the project manager, and suggest improvements and alternative approaches.

Users often do not comprehend the risk and cost implications of requested features. The bots will make the DevOps process more transparent to these users. This feature would help business users make more informed choices, particularly if they have a limited software development budget.

The bots will also make the users aware of the different cost/risk profiles of alternative technologies. For example, if a development team proposes to introduce NoSQL databases into the existing IT environment, stakeholders need to know the operational impact of adding this type of database and the financial return they might expect.

In the end, the bots could provide a list of prioritized project requirements, risk elements, and technology alternatives. Finally, the bots could provide a list of development project resources, including the appropriate developer skills, business experience, and availability.

Writing the code. If developers are writing new computer code, then ML algorithms could examine its structure and syntax to help programmers write better code, find and repair software errors, save time, and improve productivity.

If the developers are working with legacy (existing) code, they might find that this code is poorly documented. If the code was not fully documented, then developers typically begin their improvement efforts somewhere in the legacy code without being certain of the proper entry point. DevOps bots should automatically document the legacy code as well as the code developed by the new team. The bots should also assist the developers in finding the right entry points for enhancing the legacy code.

Software testing and quality assurance. Software developers use ML algorithms to automatically find and repair errors and other issues within applications during development cycles. For example, tools such as Bugspots can be used to ensure that all software bugs are eliminated without human intervention. Bugspots is a Python implementation of the bug prediction algorithm used at Google.

Application deployment. *Software versioning*, a form of continuous deployment, is a strategy to categorize the unique states of computer software as it is developed and released. For example, Apple's iOS 14 is a version of its mobile operating system. Software versioning is a critical component of application development and deployment. ML algorithms are useful in predicting problems that can occur in deployment.

AIOps AIOps, the application of artificial intelligence to IT operations, gives IT professionals a real-time understanding of the issues that affect the availability and performance of the organization's information systems. AIOps learns from data sources such as traditional IT monitoring, logs, application and performance anomalies, and many others.

AIOps provides organizations with an overview of the entire IT environment—computation, network, storage, physical, virtual, and cloud. Specialized algorithms focus on specific tasks. For example, algorithms can pick out significant alerts from an event stream, identify correlations between alerts from different sources, assemble the correct team of human specialists to diagnose and resolve a situation, propose probable root causes and possible solutions based on past experiences, and learn from feedback to improve continuously over time.

Common uses of AIOps include:

- Predictive analytics to prevent system failure or disruption
- Event correlation and root cause analysis
- Optimization of infrastructure utilization
- Capacity planning and forecasting
- IT service management

Before you go on...

1. Look at the functional area that corresponds to your major.
 - a. Discuss potential impacts of ML applications on your profession.
 - b. Describe additional ML applications not discussed in the text.

14.6

Appendix

LEARNING OBJECTIVE

Understand the process by which a neural network transforms data values from the input node to the output node, and then calculates the loss function to initiate the backpropagation process.

A neural network is basically a network of mathematical equations, which takes one or more input variables, and by going through a network of equations, results in one or more output variables. In a neural network, there is an input layer, one or more hidden layers, and an output layer. The input layer is composed of one or more nodes or input variables. Hidden layer(s) consist of one or more hidden nodes, and the output layer consists of one or more output nodes. We will now use an example to explain how an NN works in simple terms. Before continuing with this example, make sure that you have read Section 14.3.

Consider a neural network designed to predict salaries based on the GPA of graduating seniors. We have data from four recent graduates and will use three of them to train the NN (see below). We have an input node for the GPA, two nodes in the hidden layer and an output node for predicting salaries. The output salaries are in thousands of dollars. We randomly select 3.42, 2.63, and 4.00 as our training data and we use the 3.70 GPA to test our NN.

GPA	Starting Salary (000)
3.42	\$78.250
2.63	\$49.200
4.00	\$83.250
3.70	\$79.800

For simplicity in our NN, we use Google's Swish activation function for all nodes (see Figure 14.4). Keep in mind that today's NNs typically use the same activation function for each layer of nodes, although different layers can have different activation functions.

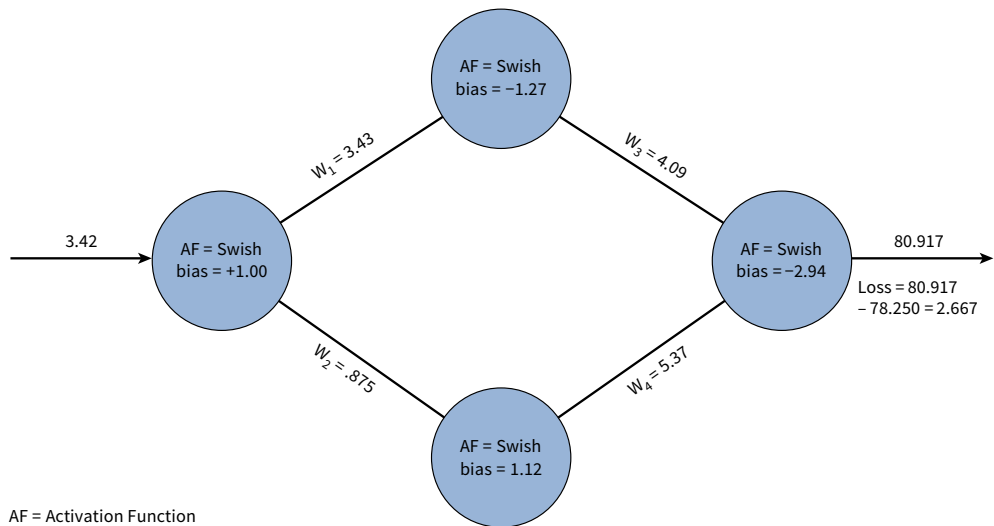


FIGURE 14.5 First iteration of neural network.

In [Figure 14.5](#), the first GA value, 3.42, enters the neural network at its input node. The input node bias (+1.00) shifts the GPA to 4.42. Subsequently, the activation function of the input node shifts the 4.42 GPA to a value of 4.432. To understand how the activation function generates the value of 4.432 by receiving 4.42, look back to [Figure 14.4](#), where you will see the Swish activation function shifting the value of 4.42 on the X-axis to the value of 4.432 on the Y-axis. The value of 4.432 now moves to the hidden layer nodes.

Along the way from the input node to the hidden layer, the data value of 4.432 is shifted by the weight of the upper pathway ($w_1 = 3.43$) to 15.202 and the weight of the lower pathway ($w_2 = 0.875$) to 3.878. Note: for the upper pathway, $4.432 \times 3.43 = 15.202$. For the lower pathway, $4.432 \times 0.875 = 3.878$.

When the input value arrives at the nodes in the hidden layer, each node first applies its bias and then uses its activation function to shift the input value to an output value. Therefore, the upper pathway node bias ($b_1 = -1.27$) shifts the data value to 13.932 ($15.202 - 1.27$), while the lower pathway bias ($b_2 = 1.12$) shifts the data value to 4.998 ($3.878 + 1.12$).

Then, the hidden layer activation functions model the respective values from 13.932 to 13.932 (upper pathway) and from 4.998 to 5.005 (lower pathway). Please note that, for X values larger than 5, the slope of the activation function, as depicted in [Figure 14.4](#), approaches 1. Therefore, an input value of 4.998 is slightly shifted by this function to 5.005; while an input value of 13.932 remains the same.

Next, these values move from the hidden layer to the next layer (in this example, the final node). Along the way, weights ($w_3 = 4.09$, upper; $w_4 = 5.37$, lower) shift the data values to 56.981 and 26.876. Note: for the upper pathway, $13.932 \times 4.09 = 56.981$. For the lower pathway, $5.005 \times 5.37 = 26.876$.

Then, at the final node, those two values are summed ($56.981 + 26.876$) to yield a value of 83.857 and then the last bias, b_4 (-2.94), shifts the value to 80.917 ($83.857 - 2.94 = 80.917$). The output node activation function performs the final calculation and produces an output value of 80.917. The NN's loss function compares the output value, 80.917, to the input salary value associated with the 3.42 GPA, 78.250, and determines a difference—a loss value—of 2.667.

The loss function uses the difference of 2.667 to recalculate the weights and biases throughout the neural network in the backpropagation process. These weights and biases will be applied during the second iteration. See [Figure 14.6](#).

The next GPA, 2.63, enters the neural network at the input node. The input node bias (+1.00) shifts the GPA to 3.63 and the input node activation function shifts the 3.63 GPA to a value of 3.657, which then moves to the hidden layer nodes.

Along the way, the data value of 3.657 is shifted by the upper pathway weight ($w_1 = 2.27$) to 8.300 and the lower pathway weight ($w_2 = 0.908$) to 3.320. Note: for the upper pathway, $3.657 \times 2.27 = 8.300$. For the lower pathway, $3.657 \times 0.908 = 3.320$.

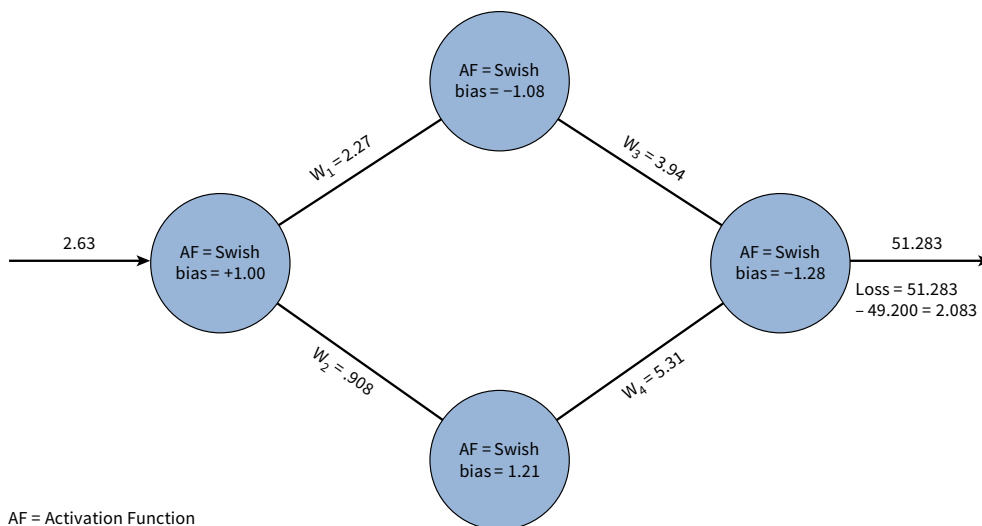


FIGURE 14.6 Second iteration of neural network.

The upper pathway node bias ($b_1 = -1.08$) shifts the data value to 7.220 ($8.300 - 1.08$), while the lower pathway bias ($b_2 = 1.21$) shifts the data value to 4.530 ($3.320 + 1.21$).

Then, the hidden layer activation functions model the respective values to 7.221 (upper pathway) and 4.541 (lower pathway).

Next, weights ($w_3 = 3.94$, upper; $w_4 = 5.31$, lower) shift the data values to 28.451 and 24.112. Note 1: for the upper pathway, $7.221 \times 3.94 = 28.451$. For the lower pathway, $4.541 \times 5.31 = 24.112$. Note 2: the weights and biases in this iteration are different from the previous iteration as they have been adjusted in the backpropagation process.

Those two values are summed ($28.451 + 24.112$) to yield a value of 52.563 and then the last bias, $b_4 (-1.28)$, shifts the value to 51.283 ($52.563 - 1.28 = 51.283$). The output node activation function performs the final calculation and produces an output value of 51.283. The NN's loss function compares the output value, 51.283, to the input salary value associated with the 2.63 GPA, 49.200, and determines a difference—a loss value—of 2.083.

The loss function uses that difference, 2.083, to recalculate the weights and biases throughout the neural network in the backpropagation process. These weights and biases will be applied during the third iteration. See [Figure 14.7](#).

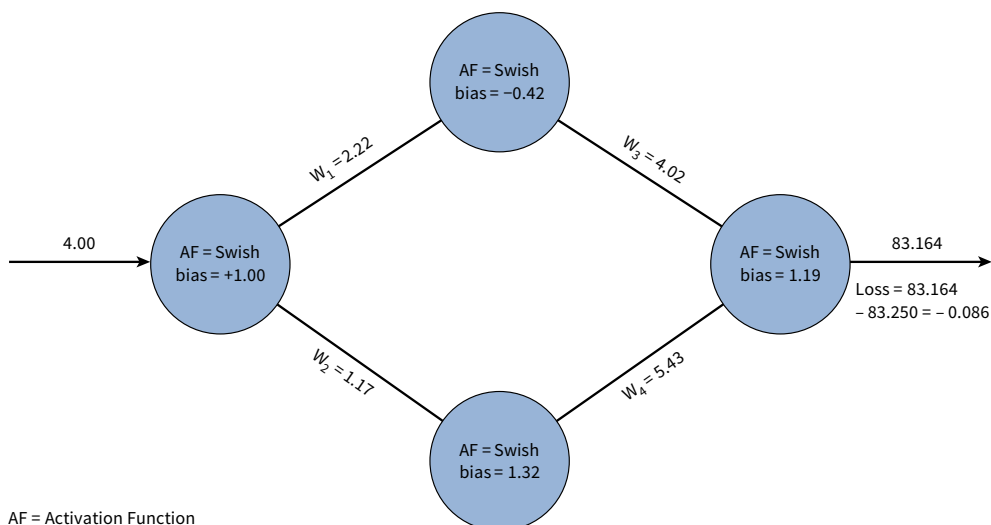


FIGURE 14.7 Third iteration of neural network.

The next GPA, 4.00, enters the neural network at the input node. The input node bias (+1.00) shifts the GPA to 5.00 and the input node activation function shifts the 5.00 GPA to a value of 5.007, which then moves to the hidden layer nodes.

Along the way, the data value of 5.007 is shifted by the upper pathway weight ($w_1 = 2.22$) to 11.115 and the lower pathway weight ($w_2 = 1.17$) to 5.858. Note: for the upper pathway, $5.007 \times 2.22 = 11.115$. For the lower pathway, $5.007 \times 1.17 = 5.858$.

The upper pathway node bias ($b_1 = -0.42$) shifts the data value to 10.695 ($11.115 - 0.42$), while the lower pathway bias ($b_2 = 1.32$) shifts the data value to 7.178 ($5.858 + 1.32$).

Then, the hidden layer activation functions model the respective values to 10.695 (upper pathway) and 7.179 (lower pathway).

Next, weights ($w_3 = 4.02$, upper; $w_4 = 5.43$, lower) shift the data values to 42.994 and 38.980. Note: for the upper pathway, $10.695 \times 4.02 = 42.994$. For the lower pathway, $7.179 \times 5.43 = 38.980$.

Those two values are summed ($42.994 + 38.980$) to yield a value of 81.974 and then the last bias, $b_4 (1.19)$, shifts the value to 83.164 ($81.974 + 1.19 = 83.164$). The output node activation function performs the final calculation and produces an output value of 83.164. The NN's loss function compares the output value, 83.164, to the input salary value associated with the 4.00 GPA, 83.250, and determines a difference—a loss value—of -0.086 .

The loss function uses that difference, -0.086 , to recalculate the weights and biases throughout the neural network in the backpropagation process. These weights and biases will be applied during the fourth iteration. See [Figure 14.8](#).

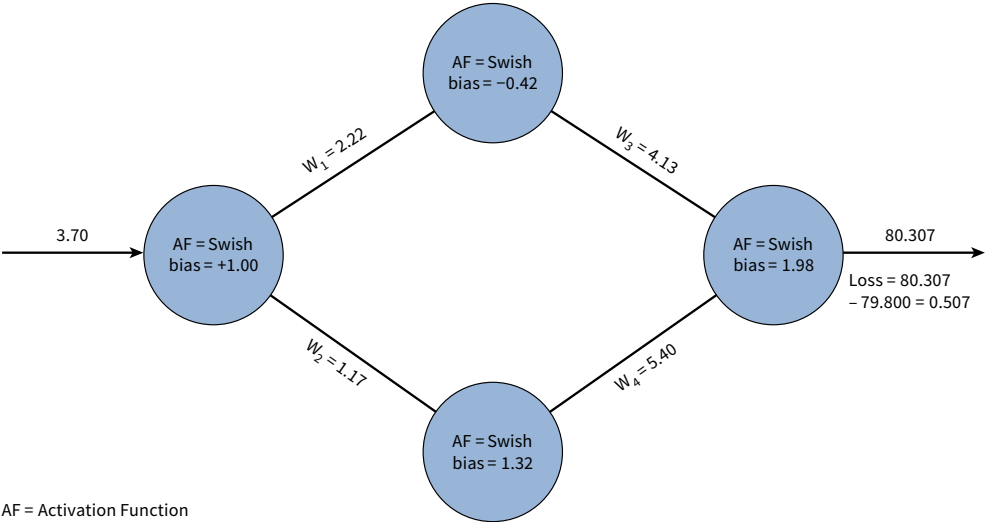
Now we check to see if the neural network is performing accurately for test data. Therefore, we enter the GPA of 3.70.

The GPA 3.70 enters the neural network at the input node. The input node bias (+1.00) shifts the GPA to 4.70 and the input node activation function shifts the 4.70 GPA to a value of 4.709, which then moves to the hidden layer nodes.

Along the way, the data value of 4.709 is shifted by the upper pathway weight ($w_1 = 2.22$) to 10.454 and the lower pathway weight ($w_2 = 1.17$) to 5.510. Note: for the upper pathway, $4.709 \times 2.22 = 10.454$. For the lower pathway, $4.709 \times 1.17 = 5.510$.

The upper pathway node bias ($b_1 = -0.42$) shifts the data value to 10.034 ($10.454 - 0.42$), while the lower pathway bias ($b_2 = 1.32$) shifts that value to 6.830 ($5.510 + 1.32$).

Then, the hidden layer activation functions model the values to 10.034 (upper pathway) and 6.831 (lower pathway).



AF = Activation Function

FIGURE 14.8 Fourth iteration of neural network.

Next, weights ($w_3 = 4.13$, upper; $w_4 = 5.40$, lower) shift the data values to 41.441 and 36.886. Note: for the upper pathway, $10.034 \times 4.13 = 41.441$. For the lower pathway, $6.831 \times 5.40 = 36.886$.

Those two values are summed ($41.441 + 36.886$) to yield a value of 78.327 and then the last bias, b_4 (1.98), shifts the value to 80.307 ($78.327 + 1.98$). The output node activation function performs the final calculation and produces an output value of 80.307. The NN's loss function compares the output value, 80.307, to the input salary value associated with the 3.70 GPA, 79,800, and determines a difference—a loss value—of .507.

Our neural network predicted a salary of 80,307, or \$80,307. The actual salary of the individual who had the 3.70 GPA was \$79,800. Our network is off by \$507 (approximately 99.3 percent accurate), an excellent result.

As you see in this example, the neural network continually shifts the system's weights and biases based on the magnitude of the difference between the computed salary and the actual salary (the loss) in an effort to match the pattern between GPAs and starting salaries of graduates from the sample data. The shifts in these values are usually small and occur over thousands of input values and iterations of the neural network.

Our example is very simplified because it involves only three sample values for training. However, it should convey how a neural network is trained by this continual shifting of parameters. When the differences between computed and actual salaries minimize over large amounts of data, the system is said to be trained.

Now imagine entering millions of data points into hundreds of input nodes that feed more than a dozen hidden layers with hundreds of nodes each, and outputting dozens of discrete, computed data points to be compared to the actual data values. Then imagine the thousands of adjustments to the weights and biases throughout the network to accommodate the next data inputs. This is how complex and sophisticated machine learning can be.

What's in IT for me?

The sections below provide a quick summary of artificial intelligent applications in each functional area of the organization. You will find detailed discussions of AI systems in the functional areas in Section 14.5.

ACCT For the Accounting Major

AI systems are used extensively in auditing to uncover irregularities. They are also used to uncover and prevent fraud. Today's CPAs use AI systems for many of their duties, ranging from risk analysis to cost control. Accounting personnel also use intelligent agents for mundane tasks such as managing accounts.

FIN For the Finance Major

People have been using computers for decades to solve financial problems. Innovative AI systems have been developed for activities such as making stock market decisions, refinancing bonds, assessing debt risks, analyzing financial conditions, predicting business failures, forecasting financial trends, and investing in global markets. AI systems can often facilitate the use of spreadsheets and other computerized systems used in finance. Finally, AI systems can help reduce fraud in credit cards, shares, and other financial services.

MKT For the Marketing Major

Marketing personnel use AI systems in many applications, from allocating advertising budgets to evaluating alternative routings of salespeople. New marketing approaches such as targeted marketing and

marketing transaction databases are heavily dependent on IT in general and on AI systems in particular. AI systems are especially useful for mining customer databases and predicting customer behaviour. Successful AI applications appear in almost every area of marketing and sales, from analyzing the success of one-to-one advertising to supporting customer help desks. With customer service becoming increasingly important, the use of intelligent agents is critical for providing fast response.

POM For the Production/Operations Management Major

AI systems support complex operations and production decisions, from inventory to production planning. AI systems in the production/operations management field manage tasks ranging from diagnosing machine failures and prescribing repairs to complex production scheduling and inventory control.

HRM For the Human Resource Management Major

Human resources personnel employ AI systems for many applications. For example, recruiters use these systems to find applicants' resumés on the Web and sort them to match needed skills. HR managers also use AI systems to evaluate candidates (e.g., tests, interviews). HR personnel use AI systems to train and support employees in managing their benefits and to predict employees' job performance and future labour needs.

MIS For the MIS Major

The MIS function develops (or acquires) and maintains the organization’s various AI systems, as well as the data and models that these

systems use. MIS staffers also interact frequently with subject area experts to capture the expertise used in AI systems.

Summary

14.1 Explain the potential value and the potential limitations of artificial intelligence.

Table 14.1 differentiates between artificial and human intelligence on a number of characteristics.

14.2 Differentiate among supervised, semi-supervised, unsupervised, reinforcement, and deep learning.

- *Supervised learning* is a type of machine learning in which the system is given labelled input data and the expected output results.
- *Semi-supervised learning* is a type of machine learning that combines a small amount of labelled data with a large amount of unlabelled data during training.
- *Unsupervised learning* is a type of machine learning that looks for previously undetected patterns in a data set with no pre-existing labels and with minimal human supervision.
- *Reinforcement learning* is a type of machine learning in which the system learns to achieve a goal in an uncertain, potentially complex environment.
- *Deep learning* is a subset of machine learning in which artificial neural networks learn from large amounts of data.

14.3 Describe the structure of a neural network, and discuss how that structure contributes to the purpose of neural networks in machine learning.

A neural network is a set of nodes, or virtual neurons, that work in parallel in an attempt to simulate the way the human brain works,

although in a greatly simplified form. Neural networks consist of several layers of nodes, called the input layer, hidden layers, and output layer. Current neural networks are able to simulate billions of neurons. In this way, developers can train a neural network to learn, recognize patterns, and make decisions in a humanlike way.

14.4 Provide use case examples of computer vision, natural language processing, robotics, image recognition, and intelligent agents.

We leave the additional examples to you. You can search the Web to find numerous examples of each machine learning application.

14.5 Provide use case examples of artificial intelligence applications in accounting, finance, marketing, production and operations management, human resource management, and management information systems.

We leave the additional examples to you. You can search the Web to find numerous examples of numerous examples of machine learning applications in each functional area.

14.6 Understand the process by which a neural network transforms data values from the input node to the output node and then calculates the loss function to initiate the backpropagation process.

This process is explained in detail in the Appendix.

Key Terms

algorithm 419	machine learning (ML) 419	reinforcement learning 423
artificial intelligence (AI) 417	machine learning systems 435	semi-supervised learning 423
backpropagation 428	narrow AI 418	speech recognition 431
chatbot 431	natural language processing 430	strong AI 418
computer vision 430	neural network (NN) 426	supervised learning 422
convolutional neural network 428	node 426	unsupervised learning 423
deep learning 424	recurrent neural network 428	weak AI (also called <i>narrow AI</i>) 418
generative adversarial network 429		

Discussion Questions

1. What are the pros and cons of facial recognition as a business policy? As a public policy?
2. Consider your health care provider's data.
 - Who owns those data?
 - Who profits from analyzing them?
 - What are they used for?
 - Provide an example of an ML system that uses your data.
3. You are a passenger in a rented, autonomous vehicle that hits a pedestrian. Who or what is liable for the accident? Support your conclusions.
4. You are a passenger in an autonomous vehicle that you own. While you are riding in the vehicle and reading a report for a business meeting, your vehicle hits a pedestrian. Who or what is liable for the accident? Support your conclusions.
5. Suppose that your insurance company decides to price your car insurance premium based on data about your driving habits collected by sensors in your car that the firm inputs into an ML system.
 - a. Would you be in favour of this new process? Why or why not?
 - b. Would the cost of your new policy be in your favour? Why or why not? For example, what if you were speeding?
6. Suppose that your health care company decides to price your insurance premiums based on data about your health (e.g., blood pressure, blood glucose) and health habits (eating, exercising, sleeping, etc.) obtained from Fitbit sensors, smart watches, and intelligent scales in your bathroom.
 - a. Would you be in favour of this new process? Why or why not?
 - b. Would the cost of your new policy be in your favour? Why or why not? For example, what if you were under stress at your job and your blood pressure increased?

Problem-Solving Activities

1. Which machine learning algorithm would you use to predict admittance to your university's freshman class? Describe your algorithm by including your input data and output data.
2. Which machine learning algorithm would you use to identify an image as a dog or a cat? Describe your algorithm by including your input data and output data.
3. Which machine learning algorithm would you use to forecast the weather? Hint: First define what "forecasting the weather" means. Describe your algorithm by including your input data and output data.
4. Ask ChatGPT to write a letter to your professor convincing them to give you an A in the class. Were you happy with the results? What would you have done differently?
5. Visit www.foreseemed.com/artificial-intelligence-in-health-care and summarize how your health care will change in the future as a result of AI.
6. Go to www.zapier.com/blog/ai-job-search/. Pick one of the nine tools listed and describe how it will impact your future job search.

Closing Case

MIS POM MKT AI in the Car Repair Industry

There are four major players in the car repair business: the customer, the customer's insurance company, the claims adjuster, and the car repair shop (also known as a body shop). In addition, there are two types of claims adjusters: staff adjusters and independent adjusters. Staff adjusters, who are also known as company adjusters or employee adjusters, work for an insurance company as salaried employees. In contrast, independent adjusters are contracted through a third-party claims-handling company. The insurance company outsources the claim to one of these companies, which, in turn, assigns it to an independent adjuster.

The traditional car repair process. If a customer has an accident, a claims adjuster examines the damage and estimates the cost to repair the automobile. The goal of an appraisal is to determine the

fair value of the vehicle. In certain cases, the repair can cost more than the car is worth. In these cases, the insurance company will typically pay the customer what the car is worth as determined by the appraisal.

The first step in the appraisal process is to report the accident to the insurance company. Traditionally, claims adjusters had to travel to the scene of the wreck to appraise the vehicle. An appraisal expert would interview the customer to determine the circumstances of the accident before examining the vehicle itself.

During an appraisal, the adjuster determines the extent of the damage and the overall condition of the car itself. Significantly, appraisers have specific criteria to follow and standards to apply to determine how much the repair will cost. The amount of coverage under the customer's car insurance policy determines how much money the customer receives toward the car's repairs. The damage

to the vehicle may be so severe that the adjuster writes off the car as a total loss.

At roughly the same time, the customer brings the vehicle to a repair shop. The shop performs diagnostics on the vehicle and estimates the cost of repairs, according to the original equipment manufacturer's (OEM's) repair procedures.

Body shop owners maintain that they must follow precise OEM repair procedures. In contrast, insurance companies are trying to save money. The shop owners contend that claims adjusters, paid by insurance companies, typically want to pay less for repairs than the owners' estimates. Adjusters decide what the insurance companies will pay, which means that customers may have to pay for repair expenses not covered by their insurance policies.

One body shop owner explained that his shop had a difficult relationship with adjusters until one adjuster showed him the specific insurance company parameters that adjusters must meet. If adjusters approve repairs outside these parameters, they could lose their jobs. In turn, the owner began to educate adjusters about what it takes to safely repair a vehicle. He also began to provide a photo and supporting documentation, such as OEM repair procedures, for every line item on the vehicle repair plan.

Today's car repair process. Since the COVID-19 pandemic, shop owners see fewer appraisers. Instead, insurance companies are deploying machine learning systems that use digital photographs to make virtual estimates of repair costs.

Virtual estimates are estimates where an adjuster does not physically inspect a damaged car. Instead, the insurance company instructs drivers who have been in an accident to download an app. The app tells them to take photos of their cars at certain angles and in certain light. Based on those photos alone, a claims adjuster estimates the cost of repairing the car.

Virtual estimates save time and money for insurance companies. In person, adjusters can travel to and inspect three to eight vehicles per day. With photos, adjusters save travel time and gasoline expense and can complete 15 to 20 estimates per day.

When insurance companies employ machine learning to analyze digital photos, they speed the process up still more. Automobiles are excellent candidates for image-based machine learning. Cars have a consistent form: doors, windshields, bumpers, and so on. Many things can go wrong with the 30,000 parts in an average car, but the most common parts generally look a certain way. Therefore, insurers train their machine learning algorithms in classifying images using millions of photos of damaged cars of every make and model.

The system can then analyze a photo taken by a policyholder and draw conclusions about what needs to be fixed or whether a human inspection is required. Using data from local parts suppliers and repairers, the system then estimates the cost. Finally, the system guides the adjuster through the estimate process, and the adjuster double-checks the system's estimate.

Virtual estimates seem to be very accurate at quickly differentiating vehicles that can be fixed from vehicles that are totaled. Experts contend that they are also accurate at evaluating minor vehicle damage and crashes in which no one is hurt. Significantly, these types of accidents comprise the majority of accidents.

In fact, Tractable (<https://tractable.ai>), a company that uses computer vision and machine learning to develop algorithms for insurance companies, claims that 25 percent of its estimates are so accurate that they do not require human intervention. Eventually, Tractable plans to increase the success rate to 75 percent.

Insurance companies acknowledge that their systems do make errors. However, they emphasize that these systems are constantly evolving and will continue to become more precise and accurate as they analyze increasing amounts of data.

Before the pandemic, about 15 percent of auto claims in Canada were settled by means of photos, with no need for an in-person visit by an adjuster. According to TD and LexisNexis, this percentage has gone up to between 85 percent and 100 percent post-pandemic. A more conservative estimate suggests 65 percent of auto insurance claims in Canada are AI-based.

Some insurers around the world have deployed a completely automated process for virtual estimates, at least for some kinds of damage. The Spanish insurer Admiral Seguros, for example, has begun using a machine learning system to resolve auto claims within minutes after policyholders upload photos of the damage.

As another example, in March 2021, Israeli smart-dashcam company Nexar began working with Japan's Mitsui Sumitomo Insurance to translate the high-definition video footage and acceleration and GPS data captured by its cameras into scripts, like subtitles on a foreign movie. Adjusters can use these scripts to settle claims. The system then learns when the adjusters turn its scripts into line items on estimates.

Interestingly, despite the better efficiencies generated by the machine learning systems, some body shop owners still prefer appraisers to visit their shops. This process enables the owners to develop a relationship with the appraisers and to discuss the cost of repairs in person. In addition, many shop owners assert that the vast majority of virtual estimates are too low. One owner argued that adjusters cannot diagnose damage like a bent wheel or a misaligned frame from a photograph.

Further, the owners contend that they are spending more time arguing with insurance companies to determine the correct price for a repair—time for which they are not compensated. In some cases, this process results in damaged vehicles remaining in the shop longer than usual.

During the pandemic, insurers used estimates produced from customers' photos for all types of collisions, even severe ones. According to the insurance companies, estimates are no more than starting points for repair shops. Body shop owners, however, contend that customers become frustrated with them when the insurer's initial estimate is lower than the repairer's quote. As a result, the repairers shops feel caught in the middle. They do not know when artificial intelligence has been applied to the estimates they receive. According to the shop owners, whatever is happening in the process is not consistent.

The automobile repair industry illustrates the impacts of technology replacing in-person interactions. Insurance companies hope that their algorithms can eventually create standards that both insurers and repairers will be able to agree on, thus reducing these disagreements.

Questions

1. Among the four entities in the car repair business, who would be the "winner" as the industry implements machine learning solutions to the claims adjustment process? That is, which of the four entities would realize the most benefits? Support your answer with examples.
2. Among the four entities in the car repair business, who would be the "loser" as the industry implements machine learning solutions to the claims adjustment

process? That is, which of the four entities would realize the fewest benefits? Support your answer with examples.

Sources: Compiled from T. Laurinavicius, “How AI Is Transforming the Insurance Industry,” <https://www.v7labs.com/blog/ai-insurance>, July 19, 2022; M. Thomas, “25 AI Insurance Examples to Know,” <https://builtin.com/artificial-intelligence/ai-insurance>, July 11, 2022; N. Shevchuk, “Digital Transformation in Car Insurance Industry: Streamline Recognition of Car Damage Assessment,” <https://www.altamira.ai/blog/ai-powered-car-damage-assessment/>, April 7, 2022; M. Ksycinski, “How AI Is Transforming Automotive and Car Insurance,” *Grape Up*, April 22, 2022; “Embracing AI in the World of Auto Insurance,” *Inside Big*

Data, October 10, 2021; A. Malik, “Insurers Come Out of COVID Looking at AI-Based Claims Tech,” *Canadian Underwriter*, July 7, 2021; L. Tucker, “Car Repair Claims See Increased Use of AI,” *iot techtrends*, April 16, 2021; A. Marshall, “AI Comes to Car Repair, and Body Shop Owners Are Not Happy,” *Wired*, April 13, 2021; R. Balasubramanian, A. Libarikian, and D. McElhaney, “Insurance 2030—The Impact of AI on the Future of Insurance,” *McKinsey & Company*, March 12, 2021; A. Linn, “Less Stress, Less Time: How a Brazilian Startup Is Using Azure AI to Make Car Repairs Easier,” <https://news.microsoft.com/source/features/ai/car10-azure-car-repair-app/>, November 8, 2019; T. Keller, “Embracing Artificial Intelligence in Auto Repair Shops,” *Shop Owner*, July 23, 2019; T. Kwartler, “How AI Is Changing the Way We Assess Vehicle Repair,” *Venture Beat*, February 4, 2017.

Hardware

TECHNOLOGY GUIDE OUTLINE

LEARNING OBJECTIVES

TG 1.1 Introduction to Hardware

TG 1.1 Identify the major hardware components of a computer system.

TG 1.2 Strategic Hardware Issues

TG 1.2 Discuss strategic issues that link hardware design to business strategy.

TG 1.3 Computer Hierarchy

TG 1.3 Describe the various types of computers in the computer hierarchy.

TG 1.4 Input and Output Technologies

TG 1.4 Differentiate the various types of input and output technologies and their uses.

TG 1.5 The Central Processing Unit

TG 1.5 Describe the design and functioning of the central processing unit.

Introduction

As you begin this Technology Guide, you might be wondering, “Why do I have to know anything about hardware?” There are several reasons why you will benefit from understanding the basics of hardware. First, regardless of your major (and future functional area in an organization), you will be using different types of hardware throughout your career. Second, you will have input concerning the hardware that you will use. In this capacity, you will be required to answer many questions, such as these:

- Is my hardware performing adequately for my needs? If not, what types of problems am I experiencing?
- Do I need more functionality in my hardware, and if so, what functionality would be most helpful to me?

Third, you will have input into decisions when your functional area or organization upgrades or replaces its hardware. Some organizations will allocate the hardware budget to functional areas or departments. In such cases, you might be responsible for making hardware decisions (at least locally) yourself. MIS employees will act as advisors, but you will provide important input into such decisions.

TG 1.1

Introduction to Hardware

LEARNING OBJECTIVE

Identify the major hardware components of a computer system.

Recall from Chapter 1 that the term *hardware* refers to the physical equipment used for the input, processing, output, and storage activities of a computer system. Decisions about hardware focus on three interrelated factors: appropriateness for the task, speed, and cost. The incredibly rapid rate of innovation in the computer industry complicates hardware decisions because computer technologies become obsolete faster than other organizational technologies.

The overall trends in hardware are that it becomes smaller, faster, cheaper, and more powerful over time. In fact, these trends are so rapid that they make it difficult to know when to purchase (or upgrade) hardware. This difficulty lies in the fact that companies that delay hardware purchases will, more than likely, be able to buy more powerful hardware for the same amount of money in the future. It is important to note that this is a trade-off. An organization that delays purchasing computer hardware gives up the benefits of whatever it could buy today until the future purchase date arrives.

Hardware consists of the following:

- *Central processing unit (CPU)*: Manipulates the data and controls the tasks performed by the other components
- *Primary storage*: Temporarily stores data and program instructions during processing
- *Secondary storage*: Stores data and programs for future use
- *Input technologies*: Accept data and instructions and convert them to a form that the computer can understand
- *Output technologies*: Present data and information in a form people can understand
- *Communication technologies*: Provide for the flow of data from external computer networks (e.g., the internet and intranets) to the CPU, and from the CPU to computer networks

TG 1.2

Strategic Hardware Issues

LEARNING OBJECTIVE

Discuss strategic issues that link hardware design to business strategy.

For most business people, the most important issues are what the hardware enables, how it is advancing, and how rapidly it is advancing. In many industries, exploiting computer hardware is a key to achieving competitive advantage. Successful hardware exploitation comes from thoughtful consideration of the following questions.

- How do organizations keep up with the rapid price reductions and performance advancements in hardware? For example, how often should an organization upgrade its computers and storage systems? Will upgrades increase personal and organizational productivity? How can organizations measure such increases?
- How should organizations determine the need for the new hardware infrastructures, such as cloud computing? (We discuss cloud computing in Technology Guide 3.)
- Portable computers and advanced communications technologies have enabled employees to work from home or from anywhere. Will these new work styles benefit employees and the organization? How do organizations manage such new work styles?

- How do organizations manage employees who use their own portable devices (e.g., tablets and smartphones) for both personal and work purposes? That is, how do organizations handle the bring-your-own-device (BYOD) phenomenon?
- How should organizations make use of Device-as-a-Service (DaaS)? DaaS allows organizations to outsource the purchase and maintenance of hardware to the service provider. DaaS allows for more flexibility to meet users' requirements as their needs and responsibilities change.

TG 1.3

Computer Hierarchy

LEARNING OBJECTIVE

Describe the various types of computers in the computer hierarchy.

The traditional standard for comparing classes of computers is their processing power. This section presents each class of computers from the most powerful to the least powerful. It describes both the computers and their roles in modern organizations.

Supercomputers

The term *supercomputer* does not refer to a specific technology. Rather, it indicates the fastest computers available at any given time. In mid-2022, the fastest supercomputers had speeds approaching 1,100 petaflops (1 petaflop is 1,000 trillion floating-point operations per second). A floating-point operation is an arithmetic operation that involves decimals.

Large organizations use supercomputers to execute computationally demanding tasks involving very large data sets, such as for military and scientific applications. In the business environment, for example, large banks use supercomputers to calculate the risks and returns of various investment strategies, and health-care organizations use them to analyze giant databases of patient data to determine optimal treatments for various diseases. Some of the most recent supercomputers include IBM's Summit and Sierra, Cray's Titan, China's Tianhe-2, and Japan's Fugaku.

An emerging form of supercomputing is called exascale computing. The power of exascale supercomputing is hard to grasp, but imagine this scenario: exascale supercomputing can process one quintillion operations per second. Now consider that, if every one of the 7.7 billion people on the planet completed one calculation per second, it would take them more than 6 years to achieve what an exascale supercomputing system can do in just 1 second. This type of computing power will change weather forecasting, electricity distribution, complex engineering designs, and much more. Frontier—a supercomputer at the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL)—is the world's first exascale computer.

Mainframe Computers

Mainframes remain popular in large enterprises for extensive computing applications that are accessed by thousands of users at one time. Examples of mainframe applications are airline reservation systems, corporate payroll programs, website transaction processing systems (e.g., Amazon and eBay), and student grade calculation and reporting.

Today's mainframes perform at teraflop (trillions of floating-point operations per second) speeds and can handle millions of transactions per day. Mainframes can also provide a secure, robust environment in which to run strategic, mission-critical applications.

In 2021, IBM released version 2.5 of its z/OS mainframe operating system. This update will upgrade mainframes to incorporate AI capabilities and support hybrid cloud operations. Since many organizations have a significant investment in their on-premise mainframe computers, this will allow those organizations to utilize their existing technology in more modern ways.

mainframes Relatively large computers used in large enterprises for extensive computing applications that are accessed by thousands of users.

microcomputers The smallest and least expensive category of general-purpose computers, also called micros, personal computers, or PCs.

Microcomputers

Microcomputers—also called *personal computers*, or *PCs*—are the smallest and least expensive category of general-purpose computers. It is important to point out that people frequently define a PC as a computer that uses the Microsoft Windows operating system. In fact, a variety of PCs are available, and many of them do not use Windows. One well-known example is the Apple Mac, which uses the Mac OS operating system.

notebook computer See **laptop computers**.



Laptop computer

UmbertoPantalone/Getty Images



Tablet

Kaspars Grinvalds/Adobe Stock Photos

FIGURE TG 1.1 Laptop, notebook and tablet computers.

laptop computers (notebook computers) Small, easily transportable, lightweight microcomputers.

thin client A computer that does not offer the full functionality of a *fat client*.

fat clients Computers that offer full functionality without having to connect to a network.

server Computers that support networks, enabling users to share files, software, and other network devices.

wearable computer A miniature computer worn by a person allowing the user to multitask.

Laptop computers (or **notebook computers**) are small, easily transportable, lightweight microcomputers that fit comfortably into a briefcase (**Figure TG 1.1**). They provide users with access to processing power and data outside an office environment.

For example, the Google Chromebook is a thin client laptop that runs Google's Chrome operating system. A **thin client** is a computer that does not offer the full functionality of a PC. A **fat client** is a computer that has the ability to perform many functions without a network connection. Thin clients are less complex than fat clients because they do not have locally installed software. When thin clients need to run an application, they access it from a **server** over a network rather than from a local disk drive.

A thin client would not have Microsoft Office installed on it. Thus, thin clients are easier and less expensive to operate and support than fat clients. The benefits of thin clients include fast application deployment; centralized management; lower cost of ownership; and easier installation, management, maintenance, and support. The main disadvantage of thin clients is that, if the network fails, users can do very little on their computers. In contrast, if users have fat clients and the network fails, they can still perform some functions because they have software, such as Microsoft Office, installed on their computers.

Tablet Computers

A **tablet computer** (or *tablet*) is a complete computer contained entirely in a flat touch screen that users operate with a stylus, digital pen, fingertip, or soft (virtual) keyboard, instead of a physical keyboard or mouse. Examples of tablets include the Apple iPad Pro and the Microsoft Surface Pro 9.

Handheld Computers

Handheld computers are mobile devices that are typically flat, touch screen devices that users interact with using their voice or touch. These devices typically have multiple network antennas, allowing for satellite, cellular, Wi-Fi, Bluetooth, and near field communication (NFC) connections. Most handheld computers unify several devices in one. They operate as a camera, GPS, computer (with near-desktop type experiences), mobile phone, music player, and much more. They operate through applications (apps) that provide endless possibilities for these devices. They connect to wearable computers (discussed in the next topic) to create personal area networks around users. Such networks can connect watches, headphones, car radios, pens, scanners, medical devices, weight scales, and much more. Often, we refer to these handheld computers as smartphone.

Wearable Computers

Wearable computers are miniature computers that people wear under, with, or on top of their clothing. Key features of wearable computers are that there is constant interaction between the computer and the users and that the users can multitask, meaning they do not have to stop what they are doing to use the device. Examples of wearable computers are the Apple Watch (www.apple.com/watch), the Sony SmartWatch, and the Fitbit activity tracker (www.fitbit.com).

Input and Output Technologies

LEARNING OBJECTIVE

Differentiate the various types of input and output technologies and their uses.

Input Technologies

Input technologies allow people and other technologies to enter data into a computer. The two main types of input devices are human data-entry devices and source-data automation devices. As their name implies, *human data-entry* devices require a certain amount of human effort to input data. Examples are keyboard, mouse, pointing stick, trackball, joystick, touch screen, stylus, and voice recognition.

In contrast, *source-data automation* devices input data with minimal human intervention. These technologies speed up data collection, reduce errors, and gather data at the source of a transaction or other event. Bar code readers are an example of source-data automation.

An interesting type of human input is gesture-based input. **Gesture recognition** refers to technologies that enable computers to interpret human gestures. These technologies are an initial step in designing computers that can understand human body language. This process creates a richer interaction between machines and humans than has been possible with other input devices.

Gesture recognition enables humans to interact naturally with a computer without any intervening mechanical devices. With gesture-based technologies, the user can move the cursor by pointing a finger at a computer screen. These technologies could make conventional input devices (the mouse, keyboards, and touch screens) redundant. An example of a gesture-based input device is the Leap Motion Controller (www.ultraleap.com).

Zoom (www.zoom.us/) added gesture recognition to its platform to allow more natural engagement in online meetings. For example, if a participant physically raises their hand, the gesture will be recognized and trigger the virtual hand raise for the other meeting participants.

Common source-data automation input devices include magnetic stripe readers, bar code scanners, QR code readers, optical mark readers, magnetic ink character readers, sensors (see the section on Internet of Things in Chapter 8), and cameras.

gesture recognition An input method that interprets human gestures, in an attempt for computers to begin to understand human body language.

Output Technologies

The output generated by a computer can be transmitted to the user through several output devices and media. These devices include monitors, printers, plotters, and speakers.

Augmented Reality, Virtual Reality, and Mixed Reality

Augmented reality (AR) is a live, direct, or indirect, view of a physical, real-world environment whose elements are augmented, or enhanced, by computer-generated sensory input such as sound, video, graphics, or GPS data via smartphones, tablets, heads-up displays, or smart glasses. Vuzix Blade (www.vuzix.com) is an example of smart glasses. A very popular form of AR is the filters on Snapchat that allow users to add apparel, change hairdos, have animals crawl on them, or change their face completely.

Virtual reality (VR) is a fully immersive experience that provides a realistic, three-dimensional, computer-generated environment replicating sight, touch, hearing, and in some cases, smell. Virtual reality brings the user into the virtual environment by removing outside stimuli via VR headsets.

VR is designed to reproduce a real environment or create an imaginary environment in which users can explore and interact. The user becomes a part of the virtual world and, while there, can manipulate objects or perform a series of actions. VR devices include Meta's Oculus

augmented reality (AR) A live, direct or indirect, view of a physical, real-world environment whose elements are enhanced by computer-generated sensory input such as sound, video, graphics, or GPS data.

virtual reality (VR) A term that describes a realistic, three-dimensional, computer generated environment that replicates sight, touch, hearing, and in some cases, smell.

mixed reality (MR)

Technology that integrates the virtual and physical world into one experience.

Quest 2 (www.oculus.com), Sony's Playstation VR (www.playstation.com), Magic Leap One (www.magicleap.com), and HTC's Vive Cosmos (www.vive.com).

Mixed reality (MR) is an extension of augmented reality that allows physical and virtual elements to interact with one another in an environment. Because MR maintains a connection to the real world, it is not considered a fully immersive experience. In an MR environment, wherever users go and whatever they see wearing MR technology, the three-dimensional content that they encounter will react to them the same way as it would in the real world. For example, an object will move closer to users when they move closer to it. Also, users can turn an object using gestures.

Mixed reality technology integrates the virtual and physical worlds into one connected experience with the help of eye tracking, gesture recognition, and voice recognition technology through a headset or a pair of smart glasses and a pair of motion controllers. MR devices include Microsoft HoloLens 2 (www.microsoft.com), Lenovo Explorer (www.lenovo.com), Samsung HMD Odyssey (www.samsung.com), Acer Windows Mixed Reality (www.acer.com), and Google Cardboard (<http://arvr.google.com/cardboard>).

Augmented Reality Examples

POM Manufacturing

- For simulation purposes, Airbus (www.airbus.com) deployed an AR model of a new aircraft, allowing designers and engineers to view various components, potential upgrades, and sensors, before going into production. With the AR model, Airbus gave its employees the opportunity to make important design changes before beginning production.
- BMW (www.bmw.com) is speeding up its vehicle concept and prototype engineering processes by as much as 12 months using a new AR application. Engineers and designers use AR goggles that allow the real-world, physical vehicle body to be overlaid with true-to-scale holographic 3D models. This process helps in assessing different concept variations and assembly procedures for future vehicles without the need for many test models. People at different locations around the world can use multi-user mode to review designs and concepts together.

HRM **POM** Training

- In Porsche's (www.porsche.com) assembly plant in Leipzig, Germany, equipment experts guide employees through their AR glasses and teach them on the job.

POM **MKT** Customer Service

- Vuforia Chalk (<https://vuforiachalk.com>) is an app that helps customers repair appliances with real-time virtual assistance. Users point their smartphone cameras at the appliance and remote tech support workers draw on customers' screens to guide them through the repair steps.

MKT Grocery Shopping

- Hyper (<https://www.hyperar.com/>) provides an in-store app that gives directions to customers so that they can locate any product. As customers use this app, store employees can focus on other tasks rather than directing or taking customers to products.

MKT **Retail** Retailers are using AR to improve the buyer's experience by bridging the gap between the perception of a product and the actual product. For instance, with AR, buyers can know the size and look of the product in a realistic way.

- Augment (www.augment.com) is a SaaS platform where users can visualize their products in 3D in a real environment using mobile phones and tablets.
- Yihaodian (owned by Walmart) is the largest Chinese online grocery store. The grocer has placed physical images of stocked grocery shelves on walls and other surfaces in urban public areas in China. Passersby can scan codes under the images with a mobile device to purchase the corresponding groceries online.

- NexTech AR Solutions (www.nextechar.com) provides a try-it-on feature that can be added to existing digital storefronts. The feature uses the camera on a customer's smartphone or desktop device to enable shoppers to digitally put on eyewear, jewellery, and clothing to see how these items look.
- Warby Parker (www.warbyparker.com) has a proprietary try-it-on feature in its app so customers can see how different styles of eyewear will look on them.
- Sephora (www.sephora.com) allows customers to try on makeup with its Virtual Artist 3D live experience.
- Google Lens allows users to scan QR codes and objects through their smartphone cameras. Google Lens's Style Match feature provides consumers the capability to identify pieces of clothing or furniture and view similar designs available online and through e-commerce platforms.
- Walmart provides an AR price checking tool for customers that allows them to scan physical products to display up-to-date information that includes the product name, how much the item costs, customer reviews from Walmart.com, and other valuable information.
- The NHL and Calgary-based company Dynamic Vision have developed the Stanley Cup Experience based on AR technology. Using your tablet or phone, you can take a photo or video of yourself with the Stanley Cup as if it was right beside you. You can hold it, toss it in the air, walk around with it—all as if the actual trophy was right there.
- Maple Leaf Sports & Entertainment (MLSE) recently partnered with Amazon Web Services to build AR and VR fan experiences that would allow people watching a game in person to access real-time player stats and get deeper into the play on the ice through AR glasses.

Entertainment

- Dance Reality is an app that guides users through detailed steps and timing of countless dance styles by placing virtual footprints on the floor in front of them.

Education

- Textbooks are being printed on clickable paper, which is an interactive print solution that bridges the traditional offline–online gap. Pages contain multiple hotspots; each hotspot links to one or more sources, instantly taking readers from two-dimensional printed content to online, multichannel content.
- Numerous AR apps can identify objects in a user's sight, instantaneously presenting relevant information. For instance, if you walk past an old building, you might effortlessly learn about its history and appearance, dating back to its first construction. For example, the Canadian Museum for Human Rights introduced an AR app to give guests an immersive digital experience titled *Proclamation, 1892* linked to the Proclamation of the *Constitution Act, 1982*. Imagine if you were looking at the White House, the Louvre, Westminster Abbey, and many other historical sites.
- BBC's Civilisations (www.bbc.co.uk) lets users hold, spin, and view X-rays of ancient artifacts while listening to historical narrations.
- The World Wildlife Fund's (www.worldwildlife.org) Free Rivers app transforms users' tabletops into natural landscapes, allowing users to digitally manipulate entire ecosystems to better understand how water flow impacts habitats.

Health Care

- AccuVein (www.accuvein.com) helps doctors and nurses locate patients' veins more easily.
- Philips's Azurion (www.usa.philips.com) image-guided therapy platform, built specifically for the HoloLens 2, provides surgeons with real-time patient data and 3D imagery as they operate.
- NeuroSync (www.neurosync.health) has developed eye-tracking technology to diagnose concussions and balance disorders.
- The OrCam (www.orcam.com) MyEye allows a visually impaired user to be able to read text without asking others for help. The device snaps a picture of any text from any surface and relays the information to the user via a small earpiece.

Virtual Reality Examples

HRM Training

- One increasingly common area for VR is training, for example, training of aircraft pilots. Using an HTC Vive VR headset, student pilots become fully immersed in a cockpit while sensors monitor their heart rate and other measurements. The sensors give flight instructors an accurate reading of how immersed students actually are in the learning experience.
- **HRM** Walmart is using more than 17,000 Oculus Go headsets in stores to train staff on new technology, customer service, and regulatory compliance. The retailer also uses VR to test whether workers have the skills for middle management.
- **HRM** Farmers Insurance has developed a VR training program that uses AI-powered skills. The insurer also has a VR tool with 500 simulated damage combinations and scenarios to help staff practise home damage assessments.
- **HRM** Firefighters can combat virtual wildfires with VR platforms such as FLAIM Trainer (www.flaimsystems.com) or VectorSolutions (www.vectorsolutions.com).
- **HRM** Fidelity Investments (www.fidelity.com) used VR to build workplace relationships among new employees who were working remotely as a result of the COVID-19 pandemic. Fidelity has also created a VR conference room to foster collaboration among its remote employees.

MKT Retail

- Buggy (www.buggy.ca) and McEwan Fine Foods in Toronto have launched the first 3D virtual grocery shopping portal in Canada. By using the Buggy app or website, customers are transported to one of McEwan's grocery stores, virtually walk down the aisles, pick the items they would like to purchase, and add them to their cart. The virtual store is set up like one of McEwan's physical stores but in a seamless 3D store environment.

POM Engineering

- Engineers use VR in three-dimensional computer-aided design. For example, the automotive, aerospace, and ground transportation industries use VR in their product development, engineering, and manufacturing processes.

Architectural Design

- Architects use VR during the design process to actually “see” projects before they are built, thereby giving them a sense of scale and proportion. VR models also eliminate the need to make physical miniatures of projects and enable clients to experience the project before and during construction.

MKT Entertainment

- Disney released a VR experience titled Disney Movies VR (www.disneymoviesvr.com), free for download. The experience allows users to interact with the characters and worlds from the Disney, Marvel, and Lucasfilm universes.
- Many companies use omnidirectional cameras (also known as 360-degree or VR cameras) by GoPro, Nokia, Samsung, Ricoh, and Nikon. These cameras record in all directions, a process called VR photography. Films produced by VR cameras permit the audience to view an entire environment in every scene.

Education

- During the COVID-19 pandemic, several schools incorporated VR experiences into their curriculum to allow students to continue their classes. For example, Nancy Campbell Academy in Stratford, Ontario, launched a VR experience with Oculus Quest headsets, allowing students to continue learning remotely while the campus was closed.
- Many K–12 programs are using headsets from Oculus, HTC, and Google Cardboard to send students on virtual field trips, tour the solar system, and walk through the Jurassic period.

MKT Travel

- Companies in the retail travel industry such as Flight Centre (www.flightcentre.com.au) use VR to enable customers to view cruise ship cabins and hotel rooms before booking their trips.
- The Oculus Quest 2 offers an app called Wander where users can virtually wander around the world. Search by text or by a map and see Google Street View images. Since street view images are captured with a 360-degree camera, users can turn any direction from any location and experience the area.

Health Care

- **HRM** Medical Realities (www.medicalrealities.com) uses VR modules to help train health-care practitioners. The firm's platform covers a variety of training scenarios, including a physician's office and the operating room, as well as medical school education such as dissecting VR cadavers.

Mixed Reality Examples**Health Care**

- A research project at Imperial College Healthcare Trust in London is using Microsoft's mixed-reality headset, HoloLens, to plan plastic surgery. The system can identify which tissue and veins can be used in reconstructive operations.
- Medical services such as 3D4Medical (www.3d4medical.com) and Echopixel (www.echopixel.com) use existing medical image data sets to create mixed-reality environments of patient-specific anatomy, allowing students and physicians to view and dissect images just as they would a real-world, physical object. These services also help physicians explain medical conditions to patients.

MKT Retail

- Lowe's (www.lowes.com), IKEA (www.ikea.com), Wayfair (www.wayfair.com), Sotheby's (www.sothebys.com), and other home-product retailers use MR that allows customers to see how their products will look like in their homes and whether the products will fit into specific rooms and spaces.

HRM Training

- Honeywell has developed a mixed-reality simulation tool to train its industrial employees using Microsoft HoloLens.
- Organizations can use headsets to help guide staff through complicated tasks such as fixing a particular piece of machinery or diagnosing and repairing an automobile.

Mining

- Canadian technology company NSS has developed an augmented reality system that uses Microsoft's HoloLens 2 to let miners work more safely inside a mine. The mixed reality system allows a miner to take measurements and explore the mine cavity but at a safe distance from the wall where explosives will be placed to extract the rock.

TG 1.5**The Central Processing Unit****LEARNING OBJECTIVE**

Describe the design and functioning of the central processing unit.

The **central processing unit** performs the actual computation or “number crunching” inside any computer. The CPU is a **microprocessor** made up of millions of microscopic transistors embedded in a circuit on a silicon wafer, or *chip*. Some examples of microprocessor

central processing unit (CPU) Hardware that performs the actual computation or “number crunching” inside any computer.

microprocessor The CPU, made up of millions of transistors embedded in a circuit on a silicon wafer or chip.

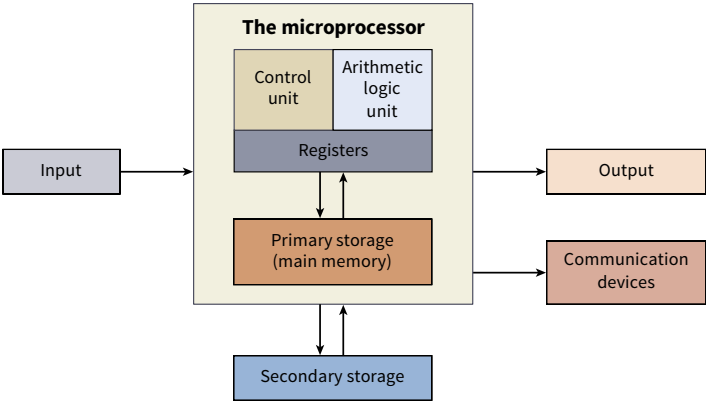


FIGURE TG 1.2 Parts of a microprocessor.

control unit Portion of the CPU that controls the flow of information.

arithmetic logic unit (ALU) Portion of the CPU that performs the mathematical calculations and makes logical comparisons.

binary form The form in which data and instructions can be read by the CPU—only 0s and 1s.

bit Short for *binary digit* (0s and 1s), the only data that a CPU can process.

manufacturers include NVIDIA, Intel, AMD, and Qualcomm, among others. For this reason, microprocessors are commonly referred to as chips.

As shown in **Figure TG 1.2**, the microprocessor has different parts, which perform different functions. The **control unit** sequentially accesses program instructions, decodes them, and controls the flow of data to and from the arithmetic logic unit, the registers, the caches, primary storage, secondary storage, and various output devices. The **arithmetic logic unit (ALU)** performs the mathematical calculations and makes logical comparisons. The registers are high-speed storage areas that store very small amounts of data and instructions for short periods.

How the CPU Works

In the CPU, inputs enter and are stored until they are needed. At that point, they are retrieved and processed, and the output is stored and then delivered somewhere. **Figure TG 1.3** illustrates this process, which works as follows:

- The inputs consist of data and brief instructions about what to do with the data. These instructions come into the CPU from random access memory (RAM). Data might be entered by the user through the keyboard, for example, or read from a data file in another part of the computer. The inputs are stored in registers until they are sent to the next step in the processing.
- Data and instructions travel in the chip through electrical pathways called *buses*. The size of the bus—analogue to the width of a highway—determines how much information can flow at any time.
- The control unit directs the flow of data and instructions within the chip.
- The ALU receives the data and instructions from the registers and makes the desired computation. These data and instructions have been translated into **binary form**—that is, only 0s and 1s. A “0” or a “1” is called a **bit**. The CPU can process only binary data. All types of data, such as letters, decimal numbers, photographs, music, and so on, can be converted to a binary representation, which can then be processed by the CPU.

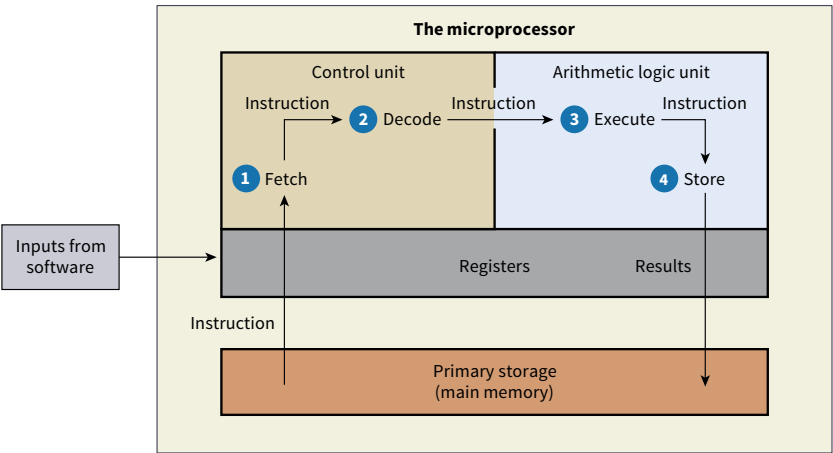


FIGURE TG 1.3 How the CPU works.

- The data in their original form and the instructions are sent to storage registers and then are sent back to a storage place outside the chip, such as the computer's hard drive. Meanwhile, the transformed data go to another register and then on to other parts of the computer (e.g., to the monitor for display or to storage).

Intel offers excellent demonstrations of how CPUs work. Search the Web for “Intel” with “Explore the Curriculum” to find their demos. This cycle of processing, known as a *machine instruction cycle*, occurs billions of times per second.

Advances in Microprocessor Design

Historically, improvements in chip designs occurred at an increasingly fast rate, as described by **Moore's law**. In 1965, Gordon Moore, a cofounder of Intel Corporation, predicted that microprocessor complexity would double approximately every 18 months. His prediction was amazingly accurate for some 45 years. The advances predicted from Moore's law arose mainly from the following innovations:

- Producing increasingly miniaturized transistors. For example, the Intel i9 chip has approximately 50 billion transistors.
- Placing multiple processors on a single chip. Chips with more than one processor are called *multicore* chips. For example, the most powerful Intel i9 chip contains 10 cores.
- Three-dimensional (3D) chips require less power than two-dimensional chips while improving performance. These chips are particularly valuable in handheld devices because they extend the device's battery life.

In 2022, Apple released the M1 Ultra. This chip has an amazing 114 billion transistors in over a hundred processing cores dedicated to logic, graphics, and artificial intelligence. The most significant innovation was the use of a bridge to connect multiple chips to create one high-performance chip. Chip production had almost reached limits of being able to add more processors and this technique (the bridge) will allow Moore's law, and the subsequent hardware improvements, to continue to progress.

In addition to increased speed and performance, Moore's law has had an impact on cost. For example, in 1997, a desktop computer with a Pentium II microprocessor, 64 megabytes of random access memory (RAM), a 4-gigabyte hard drive, and a 17-inch monitor cost \$4,000. In early 2023, a computer with a 12th-generation Intel i7 processor, 16 gigabytes (GB) of RAM, a 512 GB hard drive cost approximately \$1,700. Significantly, the 2023 desktop is far faster, has 500 times more RAM, and has 500 times more hard drive storage (without counting the solid-state storage) than the 1997 desktop, for 42.5 percent of the cost.

Two developments are making the slowing of Moore's law less problematic: graphics processing units and quantum computing. *Graphics processing units* (GPUs) were invented by NVIDIA (www.nvidia.com) in 1999. Traditional central processing units (CPUs) are composed of a limited number of cores with a large amount of cache memory. As a result, CPUs can manage a few tasks at one time and are effective at serial processing (one task at a time).

In contrast, GPUs consist of hundreds of cores and can manage thousands of tasks simultaneously. Therefore, GPUs are effective at parallel processing (many tasks at once), meaning that they break down complex problems into thousands or millions of separate tasks and work them out at once. GPUs are particularly suited for computer graphics, image processing, and artificial intelligence applications.

A new computing paradigm has emerged, called *quantum computing*. Classical computers manipulate bits (0s and 1s) to perform operations. In contrast, quantum computers use quantum bits, or qubits. Quantum computers also use 0s and 1s, but qubits have a third state called *superposition*. That is, superposition allows qubits to represent a one or a zero, or any linear combination of a one and a zero, at the same time. Superposition enables quantum computers to process exponentially more data than classical computers.

For example, let's say we want to search for a particular name in a telephone book. With one classical computer, we would start at the beginning and search the phone book sequentially until we found the name we wanted. With two classical computers, we could search the

Moore's law Prediction by Gordon Moore, an Intel cofounder, that microprocessor complexity would double approximately every two years.

phone book twice as fast because one computer would start at the beginning and one would start at the end until one or the other found the correct name. With three classical computers, we would search the phone book three times as fast, and so on. If we search the phone book with a quantum computer, it would examine all the names in the book simultaneously, finding the correct name instantaneously.

Quantum computers are an emerging technology and the race is on to develop these machines. For example, German automaker Volkswagen is using Toronto-based quantum computer Xanadu (www.xanadu.ai) to enhance the performance of quantum algorithms to simulate various battery materials. Similarly, Canadian grocery retailer Save-On-Foods is using quantum computers from D-Wave to improve the management of in-store logistics, reducing the amount of computing time from 25 hours to 2 minutes.

Computer Memory

The amount and type of memory that a computer possesses has a great deal to do with its general utility. A computer's memory also determines the types of programs that the computer can run, the work it can perform, its speed, and its cost. There are two basic categories of computer memory. The first is *primary storage*. It is called "primary" because it stores small amounts of data and information that the CPU will use immediately. The second category is *secondary storage*, which stores much larger amounts of data and information (e.g., an entire software program) for extended periods.

byte An eight-bit string of data, needed to represent any one alphanumeric character or simple mathematical operation.

Memory Capacity As you have seen, CPUs process only binary units—0s and 1s—which are translated through computer languages into bits. A particular combination of bits represents a certain alphanumeric character or a simple mathematical operation. Eight bits are needed to represent any one of these characters. This eight-bit string is known as a **byte**. The storage capacity of a computer is measured in bytes. Bits typically are used as units of measure only for telecommunications capacity, as in how many million bits per second can be sent through a particular medium.

The hierarchy of terms used to describe memory capacity is as follows:

- **Kilobyte.** Kilo means "one thousand," so a kilobyte (KB) is approximately 1,000 bytes. To be more precise, a kilobyte is 1,024 bytes. Computer designers find it convenient to work with powers of 2: 1,024 is 2 to the 10th power, and 1,024 is close enough to 1,000 that for *kilobyte* people use the standard prefix *kilo*, which means exactly 1,000 in familiar units such as the kilogram or kilometre.
- **Megabyte.** Mega means "one million," so a megabyte (MB) is approximately 1 million bytes. Most personal computers have hundreds of megabytes of RAM.
- **Gigabyte.** Giga means "one billion," so a gigabyte (GB) is approximately 1 billion bytes.
- **Terabyte.** A terabyte is approximately 1 trillion bytes. The storage capacity of modern personal computers can be several terabytes.
- **Petabyte.** A petabyte is approximately 1,000 terabytes.
- **Exabyte.** An exabyte is approximately 1,000 petabytes.
- **Zettabyte.** A zettabyte is approximately 1,000 exabytes.

To get a feel for these amounts, consider the following example: If your computer has one terabyte of storage capacity on its hard drive (a type of secondary storage), it can store approximately 1 trillion bytes of data. If the average page of text contains about 2 KB, then your hard drive could store 500 million pages, or 1 million books like this one.

primary storage (also called main memory) High-speed storage located directly on the motherboard that stores data to be processed by the CPU, instructions telling the CPU how to process the data, and operating system programs.

Primary Storage **Primary storage**, or main memory, as it is sometimes called, stores three types of information for very brief periods of time: (1) data to be processed by the CPU, (2) instructions for the CPU as to how to process the data, and (3) operating system programs that manage various aspects of the computer's operation. Primary storage takes place in

chips mounted on the computer's main circuit board, called the *motherboard*. These chips are located as close as physically possible to the CPU chip. As with the CPU, all the data and instructions in primary storage have been translated into binary code.

The four main types of primary storage are (1) register, (2) cache memory, (3) random access memory (RAM), and (4) read-only memory (ROM).

Registers are part of the CPU. They have the least capacity, storing extremely limited amounts of instructions and data only immediately before and after processing.

Cache memory is a type of high-speed memory that enables the computer to temporarily store blocks of data that are used more often and that a processor can access more rapidly than main memory (RAM). Cache memory is located physically closer to the CPU than RAM. Blocks that are used less often remain in RAM until they are transferred to cache; blocks used infrequently remain in secondary storage. Cache memory is faster than RAM because the instructions travel a shorter distance to the CPU.

Random access memory (RAM) is the part of primary storage that holds a software program and small amounts of data for processing. Compared with the registers, RAM stores more information and is located farther away from the CPU. However, compared with secondary storage, RAM stores less information and is much closer to the CPU.

RAM is temporary and, in most cases, *volatile*—that is, RAM chips lose their contents if the current is lost or turned off, as from a power surge, brownout, or electrical noise generated by lightning or nearby machines.

Most of us have lost data at one time or another because of a computer crash or a power failure. What is usually lost is whatever is in RAM, the cache, or the registers at the time, because these types of memory are volatile. Therefore, you need greater security when you are storing certain types of critical data or instructions. Cautious computer users frequently save data to nonvolatile memory (secondary storage). Most modern software applications also have autosave functions.

Read-only memory (ROM) is the place—actually, a type of chip—where certain critical instructions are safeguarded. ROM is nonvolatile, so it retains these instructions when the power to the computer is turned off. The read-only designation means that these instructions can only be read by the computer and cannot be changed by the user. An example of ROM is the instructions needed to start or boot the computer after it has been shut off.

Secondary Storage **Secondary storage** is designed to store very large amounts of data for extended periods. Secondary storage has the following characteristics:

- It is nonvolatile.
- It takes more time to retrieve data from it than from RAM.
- It is cheaper than primary storage (see **Figure TG 1.4**).
- It can use a variety of media, each with its own technology.

One secondary storage medium, **magnetic tape**, is kept on a large open reel or in a smaller cartridge or cassette. Although this is an old technology, it remains popular because it is the cheapest storage medium and it can handle enormous amounts of data. As a result,

registers High-speed storage areas in the CPU that store very small amounts of data and instructions for short periods.

cache memory A type of high-speed memory that enables the computer to temporarily store blocks of data that are used more often and that a processor can access more rapidly than main memory (RAM).

random access memory (RAM) The part of primary storage that holds a software program and small amounts of data when they are brought from secondary storage.

read-only memory (ROM) Type of primary storage in which certain critical instructions are safeguarded; the storage is nonvolatile and retains the instructions when the power to the computer is turned off.

secondary storage Technology that can store very large amounts of data for extended periods.

magnetic tape A secondary storage medium on a large open reel or in a smaller cartridge or cassette.

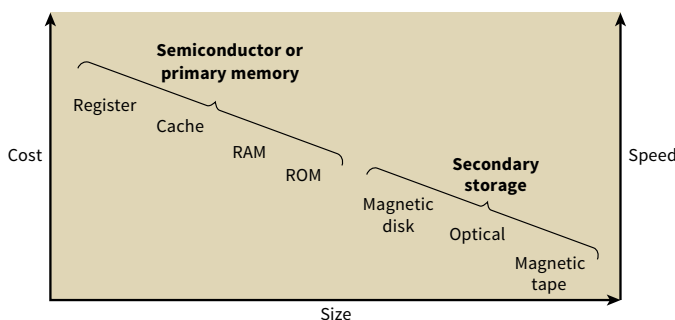


FIGURE TG 1.4 Primary storage compared with secondary storage.

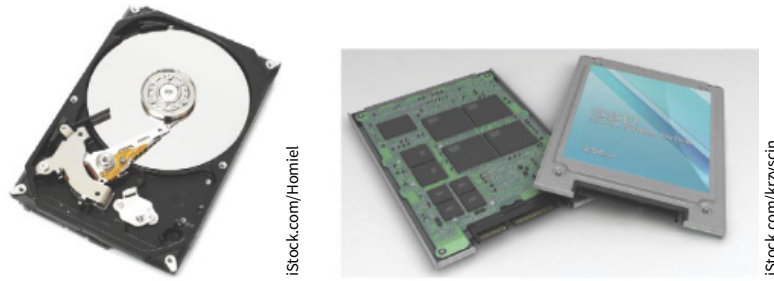


FIGURE TG 1.5 Traditional hard drives are less expensive, but solid-state drives are faster and are more reliable.

magnetic disks (or hard drives or fixed disk drives)

A form of secondary storage on a magnetized disk divided into tracks and sectors that provide addresses for various pieces of data.

solid-state drives (SSDs) Data storage devices that serve the same purpose as a hard drive and store data in memory chips.

optical storage devices

A form of secondary storage in which a laser reads the surface of a reflective plastic platter.

flash memory devices

Nonvolatile electronic storage devices that are compact, are portable, require little power, and contain no moving parts.

many organizations use magnetic tape for archival storage. The downside is that it is the slowest method for retrieving data because all the data are placed on the tape sequentially. This process means that the system might have to run through the majority of the tape before it comes to the desired piece of data.

Magnetic disks (or hard drives or fixed disk drives) are the most commonly used mass storage devices because of their low cost, high speed, and large storage capacity. Hard disk drives read from, and write to, stacks of rotating (at up to 15,000 rpm) magnetic disk platters mounted in rigid enclosures and sealed against environmental and atmospheric contamination (see **Figure TG 1.5**). These disks are permanently mounted in a unit that may be internal or external to the computer.

Solid-state drives (SSDs) are data storage devices that serve the same purpose as a hard drive and store data in memory chips. Whereas hard drives have moving parts, SSDs do not. SSDs use the same interface with the computer's CPU as hard drives and are therefore a seamless replacement for hard drives. SSDs offer many advantages over hard drives. They use less power, are silent and faster, and produce about one-third the heat of a hard drive. The major disadvantage of SSDs is that they cost more than hard drives.

Unlike magnetic media, **optical storage devices** do not store data through magnetism. Rather, a laser reads the surface of a reflective plastic platter. Optical disk drives are slower than magnetic hard drives, but they are less fragile and less susceptible to damage from contamination.

Optical disks can also store a great deal of information, both on a routine basis and when combined into storage systems. Types of optical disks include compact disk read-only memory and digital video disk.

Compact disk read-only memory (CD-ROM) storage devices have high capacity, low cost, and high durability. However, because a CD-ROM is a read-only medium, it cannot be written on. A *CD-R* can be written to, but once this is done, what was written on it cannot be changed later. That is, a *CD-R* is writable, which a *CD-ROM* is not, but it is not rewritable, which a *CD-RW* (compact disk, rewritable) is. There are applications for which not being rewritable is a plus, because it prevents some types of accidental data destruction. The *CD-RW* adds rewritability to the recordable compact disk market.

The digital video disk (*DVD*) is a 5-inch disk with the capacity to store about 135 minutes of digital video. DVDs can also perform as computer storage disks, providing storage capabilities of 17 gigabytes. DVD players can read current *CD-ROMs*, but current *CD-ROM* players cannot read DVDs. The access speed of a DVD drive is faster than that of a typical *CD-ROM* drive.

Blu-ray disks can store 50 gigabytes per layer. Development of Blu-ray technology is ongoing, with multilayered disks capable of storing up to 100 gigabytes.

The various disk technologies are under pressure from on-demand, streaming services over the internet. As the bandwidth of the internet increases, so will the pressure on disk technologies.

Flash memory devices (or *memory cards*) are nonvolatile electronic storage devices that contain no moving parts and use 30 times less battery power than hard drives. Flash devices are also smaller and more durable than hard drives. The trade-offs are that flash devices store

less data than hard drives. Flash devices are used with digital cameras, handheld and laptop computers, telephones, music players, and video game consoles.

One popular flash memory device is the **thumb drive** (also called *memory stick*, *jump drive*, or *flash drive*). These devices fit into Universal Serial Bus (USB) ports on personal computers and other devices, and they can store many gigabytes. Thumb drives have replaced magnetic floppy disks for portable storage.

thumb drive Storage device that fits into the USB port of a personal computer and is used for portable storage.

Before you go on...

1. Decisions about hardware focus on what three factors?
2. What are the overall trends in hardware?
3. Define hardware and list the major hardware components.
4. Describe the different types of computers.
5. Distinguish between human data-input devices and source-data automation.
6. Briefly describe how a microprocessor functions.
7. Distinguish between primary storage and secondary storage.

What's in IT for me?

For All Business Majors

The design of computer hardware has profound impacts for business people. Personal and organizational success can depend on an understanding of hardware design and a commitment to knowing where it is going and what opportunities and challenges hardware innovations will bring. Because these innovations are occurring so rapidly, hardware decisions at both the individual level and the organizational level are difficult.

At the *individual level*, most people who have a home or office computer system and want to upgrade it, or people who are contemplating

their first computer purchase, are faced with the decision of *when* to buy as much as *what* to buy and at what cost. At the *organizational level*, these same issues plague IS professionals. However, they are more complex and costly. Most organizations have many different computer systems in place at the same time. Different classes of computers may be innovated at different times or rates. Therefore, managers must decide when old hardware *legacy systems* still have a productive role in the organization and when they should be replaced. A legacy system is an old computer system or application that continues to be used, typically because it still functions for the users' needs, even though newer technology is available.

Summary

TG 1.1 Identify the major hardware components of a computer system.

Modern computer systems have six major components: the central processing unit (CPU), primary storage, secondary storage, input technologies, output technologies, and communications technologies.

TG 1.2 Discuss strategic issues that link hardware design to business strategy.

Strategic issues linking hardware design to business strategy include the following: How do organizations keep up with the rapid price/

performance advancements in hardware? How often should an organization upgrade its computers and storage systems? How can organizations measure benefits gained from price/performance improvements in hardware?

TG 1.3 Describe the various types of computers in the computer hierarchy.

Supercomputers are the most powerful computers, designed to handle intensive computational demands. Organizations use mainframes for centralized data processing and managing large databases. Microcomputers are small, complete, general-purpose computers. Laptop or notebook computers are small, easily transportable computers.

Tablet computers are complete computers contained entirely in a flat touch screen that uses a stylus, digital pen, fingertip, or soft (virtual) keyboard as input devices. Wearable computers are miniature computers that people wear under, with, or on top of their clothing.

TG 1.4 Differentiate the various types of input and output technologies and their uses.

The two main types of input devices are human data-entry devices and source-data automation devices. *Human data-entry* devices require a certain amount of human effort to input data. Examples are keyboard, mouse, pointing stick, trackball, joystick, touch screen, stylus, and voice recognition. *Source-data automation* devices input data

with minimal human intervention. These technologies gather data at the source of a transaction or other event. Bar code readers are an example of source-data automation.

TG 1.5 Describe the design and functioning of the central processing unit.

The CPU consists of the arithmetic logic unit, which performs the calculations; the registers, which store minute amounts of data and instructions immediately before and after processing; and the control unit, which controls the flow of information on the microprocessor chip. After processing, the data in their original form and the instructions are sent back to a storage location outside the chip.

Key Terms

arithmetic logic unit (ALU) 470
Augmented reality (AR) 465
binary form 470
bit 470
byte 472
Cache memory 473
central processing unit 469
control unit 470
fat client 464
Flash memory devices 474
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Random access memory (RAM) 473
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Registers 473
Secondary storage 473
server 464
Solid-state drives (SSDs) 474
thin client 464
thumb drive 475
Virtual reality (VR) 465
Wearable computers 464

Discussion Questions

1. What factors affect the speed of a microprocessor?
2. If you were the CIO of a firm, what factors would you consider when selecting secondary storage media for your company's records (files)?
3. Given that Moore's law has proved itself over the past two decades, speculate on what chip capabilities will be in 10 years. What might your desktop PC be able to do?
4. If you were the CIO of a firm, how would you explain the workings, benefits, and limitations of using thin clients as opposed to fat clients?
5. Where might you find embedded computers at home, at school, or at work?

Problem-Solving Activities

1. Access the websites of the major chip manufacturers—for example, Intel (www.intel.com) and Advanced Micro Devices (www.amd.com)—and obtain the latest information regarding new and

planned chips. Compare performance and costs across these vendors. Be sure to take a close look at the various multicore chips.

Software

TECHNOLOGY GUIDE OUTLINE

LEARNING OBJECTIVES

TG 2.1 Software Issues

TG 2.1 Discuss the major software issues that confront modern organizations.

TG 2.2 Systems Software

TG 2.2 Describe the general functions of the operating system.

TG 2.3 Application Software

TG 2.3 Identify the major types of application software.

Introduction

As you begin this Technology Guide, you might be wondering, “Why do I have to know anything about software?” There are several reasons why you will benefit from understanding the basics of software. First, regardless of your major (and future functional area in an organization), you will be using different types of software throughout your career. Second, you will have input concerning the software that you will use. In this capacity, you will be required to answer many questions, such as:

- Does my software help me do my job?
- Is this software easy to use?
- Do I need more functionality in my hardware or software, and if so, what functionality would be most helpful to me?

Third, you will have input into decisions when your functional area or organization upgrades or replaces its software. Some organizations will allocate the software budget to functional areas or departments. In such cases, you might be responsible for making software decisions (at least locally) yourself. MIS employees will act as advisers, but you will provide important input into such decisions.

Computer hardware is only as effective as the instructions you give it. Those instructions are contained in software. The importance of computer software cannot be overestimated. The first software applications for computers in business were developed in the early 1950s. At that time, software was less costly. Today, software comprises a much larger percentage of the cost of modern computer systems; the price of hardware has dramatically decreased, while both the complexity and the price of software have significantly increased.

The ever-increasing complexity of software has also increased the potential for errors, or *bugs*. Large applications today may contain millions of lines of computer code, written by hundreds of people over the course of several years. Thus, the potential for errors is huge, and testing and debugging software is expensive and time-consuming.

In spite of these overall trends—increasing complexity, cost, and numbers of defects—software has become an everyday feature of our business and personal lives. Your examination

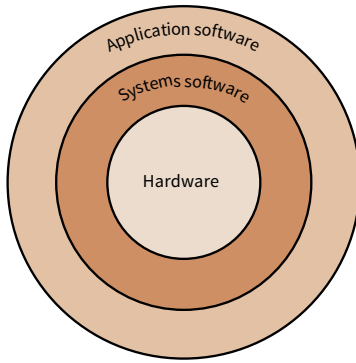


FIGURE TG 2.1 Systems software acts as an intermediary between hardware and functional applications.

computer programs The sequences of instructions for the computer, which comprise software.

documentation Written description of the functions of a software program.

of software begins with definitions of some fundamental concepts. Software consists of **computer programs**, which are sequences of instructions for the computer. The process of writing, or coding, programs is called programming. Individuals who perform this task are called *programmers*.

Computer programs include **documentation**, which is a written description of the program's functions. Documentation helps the user operate the computer system, and it helps other programmers understand what the program does and how it accomplishes its purpose. Documentation is vital to a business organization. Without it, the departure of a key programmer or user could deprive the organization of the knowledge of how the program is designed and functions.

A computer can do nothing until it is instructed by software. Computer hardware, by design, is general purpose. Software enables the user to instruct the hardware to perform specific functions that provide business value. There are two major types of software: systems software and application software. **Figure TG 2.1** illustrates the relationship among hardware, systems software, and application software.

TG 2.1

Software Issues

LEARNING OBJECTIVE

Discuss the major software issues that confront modern organizations.

The importance of software in computer systems has brought new issues to the forefront for organizational managers. These issues include software defects (bugs), licensing, updates and agility, open systems, and open-source software.

Software Defects

All too often, computer program code is inefficient, poorly designed, and riddled with errors. The Software Engineering Institute (SEI) at Carnegie Mellon University in Pittsburgh defines good software as usable, reliable, defect-free, cost-effective, and maintainable. As our dependence on computers and networks increases, the risks associated with software defects are becoming more serious.

The SEI maintains that, on average, professional programmers make between 100 and 150 errors in every 1,000 lines of code they write. Fortunately, the software industry recognizes this problem. Unfortunately, however, the problem is enormous, and the industry is only starting to take steps to resolve it. One critical step is better design and planning at the beginning of the development process (discussed in Chapter 13).

Software Licensing

Many people routinely copy proprietary software. However, making copies without the manufacturer's explicit permission—a practice known as *piracy*—is illegal. The Business Software Alliance (BSA; www.bsa.org), a nonprofit trade association dedicated to promoting a safe and legal digital world, collects, investigates, and acts on software piracy tips. The BSA has calculated that piracy costs software vendors around the world billions of dollars annually. Most of the tips the BSA receives come from current and past employees of offending companies.

To protect their investment, software vendors must prevent their products from being copied and distributed by individuals and other software companies. A company can copyright its software, which means that the Canadian Intellectual Property Office (or the Copyright Office in the United States) grants the company the exclusive legal right to reproduce, publish, and sell that software.

The number of computing devices in organizations continues to grow, and businesses continue to decentralize, so IS managers are finding it increasingly difficult to supervise their software assets. It is IS managers' responsibility to make sure that the software their companies are using is licensed; otherwise, companies can face hefty penalties of up to hundreds of thousands of dollars in fines.

Software Updates and Agility

Organizations are in constant need of changes and updates to their software applications. As the number of applications and users has grown over the years, the need for updates and changes has grown as well. Not only has the volume grown, but the speed at which these changes are needed has accelerated. Many IT departments now cannot keep up with the volume or speed of change requests. As such, many organizations are making use of software development strategies that involves users in the development and maintenance of software.

DevOps, defined in Chapter 13 as a combination of “development” and “operations,” includes users in the entire process with the goal of reducing the time to deployment, increasing the usability of the finished product, and lowering the cost of new app development. DevOps often makes use of Low-Code/No-Code development tools (Chapter 13) that require either no coding skills at all or very basic coding skills. These tools typically allow users to make use of drag-and-drop icons to visually create an application. Updates and ongoing modifications can be handled in the same way. While IT departments maintain control over security, data access, and style guidelines, users can modify the look and feel and function of the application as they and their customers require.

Open Systems

The **open systems** concept refers to a group of computing products that work together. In an open system, the same operating system with compatible software is installed on all computers that interact within an organization. An example would be an organization that installed Microsoft Windows on every PC it owned and made this a standard so that everyone understood the compatibility requirements.

A complementary approach is to employ application software that will run across all computer platforms. Through the use of open (also referred to as public), Application Programming Interfaces (API) companies can easily share their data with each other and their customers. An open or public API is made available to everyone and allows third parties to develop apps that interact with other applications and software based on the same architecture. Where hardware, operating systems, and application software are all designed as open systems, users can purchase the best software, called *best of breed*, for a job without worrying about whether it will run on a particular hardware or software platform. Some refer to this model as “composable” architecture (see Chapter 10 Opening Case).

open systems Computing products that work together by using the same operating system with compatible software on all the computers that interact in an organization.

Open-Source Software

Organizations today are increasingly selecting open-source software rather than proprietary software. **Proprietary software** is purchased software that has restrictions on its use, copying, and modification. Companies that develop proprietary software spend money and time developing their products, which they then sell in the marketplace. This software is labelled *proprietary* because the developer keeps the source code—the actual computer instructions—private (just as Coca-Cola does with its soft drink formula). Therefore, companies that purchase the software can use it in their operations, but they cannot change the source code themselves.

In contrast, the source code for **open-source software** is available at no cost to both developers and users. This software is distributed with licence terms that ensure that its source code will always be available for all users.

proprietary software Software that has been developed by a company and has restrictions on its use, copying, and modification.

open-source software Software made available in source-code form at no cost to developers.

Open-source software is produced by worldwide “communities” of developers who write and maintain the code. Inside each community, however, only a small group of developers, called *core developers*, is allowed to modify the code directly. All the other developers must submit their suggested changes to the core developers.

There are advantages to implementing open-source software in an organization. According to OpenSource (www.opensource.org), open-source development produces high-quality, reliable, low-cost software. This software is also flexible, meaning that the code can be changed to meet users’ needs. In many cases, open-source software can be more reliable than proprietary software. Because the code is available to many developers, more bugs are discovered early, and they are fixed immediately. Technical support for open-source software is also available from firms that offer products derived from the software. An example is Red Hat (www.redhat.com), a major Linux vendor that supplies solutions to problems associated with open-source technology. Specifically, Red Hat provides education, training, and technical support for a fee.

Open-source software, however, has some disadvantages. The major drawback is that companies that use open-source software depend on the continued goodwill of an army of volunteers for enhancements, bug fixes, and so on, even if they have signed a contract that includes support. Some companies will not accept this risk, although as a practical matter, the support community for Linux, Apache, and Firefox is not likely to disappear. Furthermore, organizations that do not have in-house technical experts will have to purchase maintenance-support contracts from a third party. Open-source software also raises questions concerning ease of use, the time and expense needed to train users, and compatibility with existing systems either within or outside the organization.

There are many examples of open-source software, including the GNU (GNU’s Not UNIX) suite of software (www.gnu.org) developed by the Free Software Foundation (www.fsf.org), the Linux operating system (www.linux.com), Apache Web server (www.apache.org), the Sendmail SMTP (Send Mail Transport Protocol) email server, the Perl programming language (www.perl.org), and the Firefox browser from Mozilla (www.mozilla.com); office suites that include Apache’s OpenOffice (www.openoffice.org) and LibreOffice (www.libreoffice.org); the learning platform Moodle (www.moodle.org); MySQL (www.mysql.com) open-source database management software; and ERP systems such as OpenBravo (www.openbravo.com) and Odoo (www.odoo.com). In fact, more than 150,000 open-source projects are under way at SourceForge (www.sourceforge.net), the popular open-source hosting site.

Open-source software is moving to the mainstream, as you see by the many major companies that use this type of software. For example, Microsoft Cloud platform Azure (azure.microsoft.com) uses Linux on its servers, SugarCRM (www.sugarcrm.com) for certain customer relationship management tasks, and MySQL (www.mysql.com) open-source database management software. Furthermore, Athabasca University uses Alfresco (www.alfresco.com) to manage some of the images and video for its website.

TG 2.2

Systems Software

LEARNING OBJECTIVE

Describe the general functions of the operating system.

systems software The class of computer instructions that serve primarily as an intermediary between computer hardware and application programs; provides important self-regulatory functions for computer systems.

Systems software is a set of instructions that serves primarily as an intermediary between computer hardware and application programs. Systems software performs many functions:

- It controls and supports the computer system and its information-processing activities.
- It enables computer systems to perform self-regulatory functions by loading itself when the computer is first turned on.
- It provides commonly used sets of instructions for all applications.

- It helps users and IT personnel program, test, and debug their own computer programs.
- It supports application software by directing the computer's basic functions.

The major type of systems software with which we are concerned is the operating system. The **operating system (OS)** is the “director” of your computer system's operations. It supervises the computer's overall operation by monitoring the computer's status, scheduling operations, and managing input and output processes. Well-known desktop operating systems include Microsoft Windows (www.microsoft.com), Apple Mac OS X (www.apple.com), and Linux (www.linux.com). When a new version with new features is released, the developers often give the new version a new designation. For example, in early 2023, the current version of Windows was Windows 11, and the latest version of the macOS was Catalina.

The operating system also provides an interface between the user and the hardware. This user interface hides the complexity of the hardware from the user. That is, you do not have to know how the hardware actually operates; you simply have to know what the hardware will do and what you need to do to obtain the desired results.

The ease or difficulty of the interaction between the user and the computer is determined to a large extent by the **graphical user interface (GUI)**. The GUI allows users to directly control the hardware by manipulating visible objects (such as icons) and actions that replace complex commands. Microsoft Windows provides a widely recognized GUI.

GUI technology incorporates features such as virtual reality, head-mounted displays, speech input (user commands) and output, pen and gesture recognition, animation, multimedia, artificial intelligence, and cellular/wireless communication capabilities. These new interfaces, called *natural user interfaces* (NUIs), will combine social, haptic, and touch-enabled gesture-control interfaces. (A *haptic interface* provides tactile feedback through the sense of touch by applying forces, vibrations, or motions to the user.)

The operating system and the user interfaces combine to create the **user experience** (UX), also called customer experience (CX) if the user is a customer. UX simply refers to how people interact with a system or an application. It is crucial to design for UX today so that users do not push back on adopting or using a system. Within an organization, employers might be able to tell employees what systems they will use, but if your customers do not enjoy the CX with your app, they will leave and find another app that fits their needs. According to a 2022 study published by Techjury.net, over 70 percent of users will abandon an app if it takes more than 3 seconds to load, and while many users download an average of 40 apps on their phone, they regularly use less than half of them. The UX/CX is crucial to keeping users/customers in the app.

operating system (OS) The main system control program, which supervises the computer's overall operations, allocates CPU time and main memory to programs, and provides an interface between the user and the hardware.

graphical user interface (GUI) Systems software that allows users to have direct control of the hardware by manipulating visible objects (such as icons) and actions, which replace command syntax.

user experience The experience a user or customer has when interacting with an app or website.

TG 2.3

Application Software

LEARNING OBJECTIVE

Identify the major types of application software.

Application software is a set of computer instructions that provides specific functionality to a user. This functionality may be broad, such as general word processing, or narrow, such as an organization's payroll program. Essentially, an application program applies a computer to a certain need. As you will see, modern organizations use many different software applications.

Application software may be developed in-house by the organization's information systems personnel, or it may be commissioned from a software vendor. Alternatively, the software can be purchased, leased, or rented from a vendor that develops applications and sells them to many organizations. This “off-the-shelf” software may be a standard package, or it may be customizable. Special-purpose programs or “packages” can be tailored for a specific purpose, such as inventory control and payroll. A **package**, or **software suite**, is a group of programs with integrated functions that has been developed by a vendor and is available for purchase in a prepackaged form. Microsoft Office is a well-known example of a package or software suite.

application software The class of computer instructions that directs a computer system to perform specific processing activities and provide functionality for users.

package Common term for an integrated group of computer programs developed by a vendor and available for purchase in prepackaged form.

software suite See **package**.

TABLE TG 2.1 Personal Application Software

Category of Personal Application Software	Major Functions	Examples
Spreadsheets	Use rows and columns to manipulate primarily numerical data; useful for analyzing financial information and for what-if and goal-seeking analyses	Microsoft Excel Corel Quattro Pro Apple iWork Numbers
Word processing	Allow users to manipulate primarily text with many writing and editing features	Microsoft Word Apple iWork Pages
Desktop publishing	Extend word processing software to allow production of finished, camera-ready documents, which may contain photographs, diagrams, and other images combined with text in different fonts	Microsoft Publisher QuarkXPress Adobe
Data management	Allow users to store, retrieve, and manipulate related data	Microsoft Access FileMaker Pro
Presentation	Allow users to create and edit graphically rich information to appear on electronic slides	Microsoft PowerPoint Apple Keynote
Graphics	Allow users to create, store, and display or print charts, graphs, maps, and drawings	Adobe PhotoShop CorelDRAW
Personal information management	Allow users to create and maintain calendars, appointments, to-do lists, and business contacts	Google Calendar Microsoft Outlook
Personal finance	Allow users to maintain chequebooks, track investments, monitor credit cards, and bank and pay bills electronically	Quicken Microsoft Money
Web authoring	Allow users to design websites and publish them on the Web	WordPress Adobe Dreamweaver
Communications	Allow users to communicate with other people over any distance	Skype Zoom

personal application software
General-purpose, off-the-shelf application programs that support general types of processing, rather than being linked to any specific business function.

speech-recognition software
Software that recognizes and interprets human speech, either one word at a time (discrete speech) or in a stream (continuous speech).

General-purpose, off-the-shelf application programs designed to help individual users increase their productivity are referred to as **personal application software**. Table TG 2.1 lists some of the major types of personal application software.

Speech-recognition software, also called *voice recognition*, is an input technology, rather than strictly an application, that enables users to provide input to systems software and application software. As the name suggests, this software recognizes and interprets human speech, either one word at a time (*discrete speech*) or in a conversational stream (*continuous speech*). Advances in processing power, new software algorithms, and better microphones have enabled developers to design extremely accurate speech-recognition software. Applications for voice recognition technology abound. For example, both Apple's OS and Microsoft's Windows 11 operating systems come with built-in voice technology. Banks and telecom carriers often use voice recognition software in their call centres. Hospitals are also using voice recognition software in wireless devices to find hospital staff (nurses, doctors, etc.) without searching through a paper-based hospital directory.

Before you go on...

1. What does the statement “hardware is useless without software” mean?
2. What are the differences between systems software and application software?
3. What is open-source software, and what are its advantages? Can you think of any disadvantages?
4. Describe the functions of the operating system.

What's in IT for me?

ACCT For the Accounting Major

Accounting application software performs the organization's accounting functions, which are repetitive and performed in high volumes. Each business transaction (e.g., a person hired, a pay cheque processed, an item sold) produces data that must be captured. Accounting applications capture these data and then manipulate them as necessary. Accounting applications adhere to relatively standardized procedures, handle detailed data, and have a historical focus (i.e., what happened in the past).

FIN For the Finance Major

Financial application software provides information about the firm's financial status to persons and groups inside and outside the firm. Financial applications include forecasting, funds management, and control applications. Forecasting applications predict and project the firm's future activity in the economic environment. Funds management applications use cash flow models to analyze expected cash flows. Control applications enable managers to monitor their financial performance, typically by providing information about the budgeting process and performance ratios.

MKT For the Marketing Major

Marketing application software helps management solve problems that involve marketing the firm's products. Marketing software includes marketing research and marketing intelligence applications. Marketing applications provide information about the firm's products and competitors, its distribution system, its advertising and personal selling activities, and its pricing strategies. Overall, marketing applications help managers develop strategies that combine the four major elements of marketing: product, promotion, place, and price.

POM For the Production/Operations Management Major

Managers use production/operations management (POM) application software for production planning and as part of the physical production system. POM applications include production, inventory, quality, and cost software. These applications help management operate manufacturing facilities and logistics. Materials requirements planning (MRP) software is also widely used in manufacturing. This software identifies which materials will be needed, how much will be needed, and the dates on which they will be needed. This information enables managers to be proactive.

HRM For the Human Resources Management Major

Human resources management application software provides information concerning recruiting and hiring, education and training, maintaining the employee database, termination, and administering benefits. HRM applications include workforce planning, recruiting, workforce management, compensation, benefits, and environmental reporting subsystems (e.g., equal employment opportunity records and analysis, union enrolment, toxic substances, and grievances).

MIS For the MIS Major

If your company decides to develop its own software, the MIS function is responsible for managing this activity. If the company decides to buy software, the MIS function deals with software vendors in analyzing their products. The MIS function is also responsible for upgrading software as vendors release new versions.

Summary

TG 2.1 Discuss the major software issues that confront modern organizations.

Computer program code often contains errors. The industry recognizes the enormous problem of software defects, and steps are being taken to resolve this issue. Software licensing is another issue for organizations and individuals. Copying proprietary software is illegal. Software vendors copyright their software to protect it from being copied. As a result, companies must license vendor-developed software to be able to use it. Organizations must also decide between open-source software and proprietary software. Each type of software has its pros and cons that must be carefully considered.

TG 2.2 Describe the general functions of the operating system.

Operating systems manage the actual computer resources (i.e., the hardware). They schedule and process applications; manage and protect

memory; manage the input and output functions and hardware; manage data and files; and provide security, fault tolerance, graphical user interfaces, and windowing.

TG 2.3 Identify the major types of application software.

The major types of application software are spreadsheet, data management, word processing, desktop publishing, graphics, multimedia, communications, speech recognition, and groupware. Software suites combine several types of application software (e.g., word processing, spreadsheet, and data management) into an integrated package.

Key Terms

application software 481
computer programs 478
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graphical user interface (GUI) 481
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open-source software 479
operating system (OS) 481
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proprietary software 479

software suite 481
speech-recognition software 482
systems software 480
user experience 481

Discussion Questions

1. You are the CIO of your company, and you have to develop an application of strategic importance to your firm. What are the advantages and disadvantages of using open-source software?
 2. Describe how hardware and software are synergistic.
 3. If you are a CIO, what is more important to you: the number of downloads or the number of active users? Why?
-

Problem-Solving Activities

1. A great deal of free software is available over the internet. Look for a free software website and look at the applications that can be downloaded for free. Would you feel safe downloading a software program from this site onto your computer? Why or why not?
2. Visit the websites for two different operating systems for laptop or notebook computers and compare their capabilities. Prepare a presentation with your findings.
3. Visit your mobile device's app store. Select an app that has been available for at least 12 months and read the user reviews over time. Look for comments on the experience (UX) people have interacting with it. Prepare a presentation with your findings.

Cloud Computing

TECHNOLOGY GUIDE OUTLINE

LEARNING OBJECTIVES

TG 3.1 Introduction

TG 3.1 Describe the problems that modern information technology departments face.

TG 3.2 The Basics of Cloud Computing

TG 3.2 Describe the key characteristics and advantages of cloud computing.

TG 3.3 Different Types of Clouds

TG 3.3 Describe each of the four types of clouds.

TG 3.4 Cloud Computing Services

TG 3.4 Explain the operational model of each of the three types of cloud services.

TG 3.5 The Benefits of Cloud Computing

TG 3.5 Identify the key benefits of cloud computing.

TG 3.6 Concerns and Risks with Cloud Computing

TG 3.6 Discuss the concerns and risks associated with cloud computing.

TG 3.7 The “Big Three” Cloud Computing Vendors

TG 3.7 Describe the pros and cons for each of the Big Three cloud computing vendors.

TG 3.8 Web Services and Service-Oriented Architecture

TG 3.8 Explain the role of Web services in building a firm’s IT applications, providing examples.

We devote this Technology Guide to a vital topic: cloud computing. A working knowledge of cloud computing will enhance your appreciation of what technology can and cannot do for a business. It will also enable you to make an immediate contribution by analyzing how your organization manages its IT assets. Going further, you will be using these computing resources in your career, and you will have input into decisions about how your department and organization can best use them. Cloud computing can also be extremely valuable if you decide to start your own business.

We present many examples of how the cloud can be used for business purposes. The cloud can also provide you with personal applications. Therefore, this guide can help you plan for your own use of the cloud. For a more detailed discussion of how you can use the cloud, see the section titled IT’s Personal: “The Cloud.”

TG 3.1

Introduction

LEARNING OBJECTIVE

Describe the problems that modern information technology departments face.

You were introduced to the concept of IT infrastructure in Chapter 1. Recall that an organization's *IT infrastructure* consists of IT components—hardware, software, networks, databases, people, and procedures—and IT services—developing information systems, managing security and risk, and managing data. (It is helpful to review Figure 1.3 of Chapter 1 here.) The organization's IT infrastructure is the foundation for all of the information systems that the organization uses.

The Evolution of Modern Information Technology Infrastructure

Modern IT infrastructure has evolved through several stages since the early 1950s, when firms first began to apply information technology to business applications. These stages are as follows:

- *Stand-alone mainframes*: Organizations initially used mainframe computers in their engineering and accounting departments. The mainframe was typically housed in a secure area, and only MIS personnel had access to it.
- *Mainframe and dumb terminals*: Forcing users to go to wherever the mainframe was located was time-consuming and inefficient. As a result, firms began placing so-called dumb terminals—essentially electronic typewriters with limited processing power—in user departments. This arrangement enabled users to input computer programs into the mainframe, a process called *remote job entry*.
- *Stand-alone personal computers*: In the late 1970s, the first personal computers appeared. The IBM PC's debut in 1981 legitimized the entire personal computer market. Users began bringing personal computers to the workplace to improve their productivity—for example, by using spreadsheet and word-processing applications. These computers were not initially supported by the firm's MIS department. However, as the number of personal computers increased dramatically, organizations decided to support these devices, and they established policies as to which PCs and software they would support.
- *Local area networks (client/server computing)*: When personal computers are networked, individual productivity increases. For this reason, organizations began to connect personal computers to local area networks (LANs) and then connected these LANs to the mainframe, a type of processing known as *client/server computing*.
- *Enterprise computing*: In the early 1990s, organizations began to use networking standards to integrate different kinds of networks throughout the firm, thereby creating enterprise computing. As the internet became widely used after 1995, organizations began using the TCP/IP networking protocol to integrate different types of networks. All types of hardware were networked, including mainframes, personal computers, smartphones, printers, and many others. Software applications and data now flow seamlessly throughout the enterprise and between organizations.
- *Cloud computing and mobile computing*: Today, organizations and individuals can use the power of cloud computing. As you will see in this Technology Guide, cloud computing provides access to a shared pool of computing resources, including computers, storage, applications, and services, over a network, typically the internet.

Keep in mind that the computing resources in each stage can be cumulative. For example, most large firms still use mainframe computers (in addition to all the other types of computing resources) as large servers to manage operations that involve millions of transactions per day.

On-Premise Computing

To appreciate the impacts of cloud computing, you first need to understand traditional IT departments in organizations and the challenges they face. Traditionally, organizations have used **on-premise computing**. That is, they own their IT infrastructure (their software, hardware, networks, and data management) and maintain it in their data centres.

On-premise computing incurs expenses for IT infrastructure, the expert staff needed to build and maintain complex IT systems, physical facilities, software licences, hardware, and staff training and salaries. In addition to all of this spending, organizations typically do not use their infrastructure to its full capacity. The majority of IT expenses are typically applied to maintaining the existing IT infrastructure, while the remainder are allocated to developing new systems. As a result, on-premise computing can actually inhibit an organization's ability to respond quickly and appropriately to today's rapidly changing business environments.

As you will see in the next section, cloud computing can help organizations manage the problems that traditional IT departments face with on-premise computing. In the next section, we define cloud computing and describe its essential characteristics.

on-premise computing

A model of IT management in which companies own their IT infrastructure (their software, hardware, networks, and data management) and maintain it in their data centres.

Before you go...

1. Describe the stages in the evolution of today's IT infrastructure.
2. Describe the challenges that traditional IT departments face with on-premise computing.

TG 3.2

The Basics of Cloud Computing

LEARNING OBJECTIVE

Describe the key characteristics and advantages of cloud computing.

Information technology departments have always been tasked with delivering useful IT applications to business users. For a variety of reasons, today's IT departments are facing increased challenges in delivering useful applications. As you study cloud computing, you will learn how it can help organizations manage the problems that occur in traditional IT departments. You will also discover why so many organizations are using cloud computing.

What Is Cloud Computing?

We define **cloud computing** as a type of computing that delivers convenient, on-demand, pay-as-you-go access for multiple customers to a shared pool of configurable computing resources (e.g., servers, networks, storage, applications, and services) that can be rapidly and easily accessed over the internet. Cloud computing allows customers to acquire resources at any time and then delete them the instant they are no longer needed.

Cloud native is the name of an approach to building applications and services specifically for a cloud computing environment. The term also refers to the characteristics of those apps and services. Cloud-native applications tend to be developed to operate in containers and are deployed as a collection of microservices. See Chapter 13 and recall that microservices are the individual functions within an application.

With cloud computing, setting up and maintaining an IT infrastructure need no longer be a challenge for an organization. Businesses do not have to scramble to meet the evolving needs of developing applications. Cloud computing also reduces upfront capital expenses and operational costs and enables businesses to better use their infrastructure and share it from one project to the next. In general, cloud computing eases the difficult tasks of procuring,

cloud computing

A technology in which tasks are performed by computers that are physically removed from the user and accessed over a network, in particular the internet.

configuring, and maintaining hardware and software environments. It allows enterprises to get their applications up and running faster, with easier manageability and less maintenance. It also makes it possible to adjust IT resources (e.g., servers, storage, and networking) more rapidly to meet fluctuating and unpredictable business demand.

Significantly, cloud computing is often a key ingredient in an organization's digital transformation. Let's take a look at Guinness World Records.

People from anywhere on the globe can apply online for a record attempt at Guinness World Records (GWR; www.guinnessworldrecords.com). Any attempt must be measurable and repeatable. Would-be record breakers must provide evidence, which usually includes video, photos, and witness statements.

In 2019, the volume of the data coming in from the public had increased from 500 megabytes per month to 4 terabytes. The organization receives some 50,000 applications per year.

The organization has changed from being a publishing house that produces its iconic book of records to a creative consultancy that works with brands on marketing campaigns. The book remains the core of GWR's business and it allows the organization to engage in marketing efforts.

GWR's move from publishing house to creative consultancy was supported by its digital transformation program. In its transformation, GWR migrated its IT infrastructure to an Amazon Web Services (AWS) cloud computing platform. AWS enabled GWR to introduce a standard records management platform, which integrates all the records from GWR's global business units. In addition, AWS enabled GWR to deploy a digital asset management system that controls all the evidence relating to record attempts as well as the videos that GWR produces for its marketing clients.

Cloud Computing Characteristics

The cloud computing phenomenon has several important characteristics. We take a closer look at them in this section.

Cloud Computing Provides On-Demand Self-Service A customer can access needed computing resources automatically. This characteristic gives customers *elasticity* and *flexibility*. That is, customers can increase (scale up) or decrease (scale down) the amount of computing they need.

For example, during the Christmas buying season, retailers need much more computational capacity than at other times of the year. By using cloud computing, they can scale up before American Thanksgiving (and Black Friday) and scale down after New Year's Eve, when Boxing Week ends. That is, they scale up during peak periods of business activity and scale down at other times.

Consider video game and entertainment software retailer EB Games (recently rebranded as GameStop; www.gamestop.com). The retailer counts over 4,400 stores located throughout Canada, the United States, and 14 other countries.

EB began online operations, which grew rapidly. Initially, the firm purchased its own hardware to manage the increasing demand for its online offerings. However, the hardware was unable to scale up to meet the demand. Accordingly, EB shifted its online operations to cloud computing using Amazon Web Services.

By using cloud computing, the retailer was able to move faster with new projects, reduce its IT infrastructure costs, improve its user experience, and manage peak demand and daily operations. EB was also able to move to a continuous delivery model for new IT services. The firm went from deploying new features about once per month to multiple deployments per week.

Cloud Computing Encompasses the Characteristics of Grid Computing **Grid computing** pools various hardware and software components to create a single IT environment with shared resources. Grid computing shares the processing resources of many geographically dispersed computers across a network.

- Grid computing enables organizations to use their computing resources more efficiently.
- Grid computing provides fault tolerance and redundancy, meaning that there is no single point of failure, so the failure of one computer will not stop an application from executing.
- Grid computing makes it easy to *scale up*—that is, to access increased computing resources (i.e., add more servers)—to meet the processing demands of complex applications.

grid computing A technology that applies the unused processing resources of many geographically dispersed computers in a network to form a virtual supercomputer.

Grid computing makes it easy to *scale down* (remove computers) if extensive processing is not needed.

Consider Oxford University's Digital Mammogram National Database project in the UK. The project aimed to improve breast cancer screening and reduce the rate of erroneous diagnoses. The users of the system are radiologists, doctors, and technicians who want to query, retrieve, process, and store patients' breast images and diagnostic reports. These images tend to be large and require fast access, high quality, and rigid privacy.

The system uses a large distributed database that runs on a grid computing system. The grid was formed collaboratively, by sharing resources (CPU cycles and data) among different organizations. The database contains digital mammographies with explanatory notes and comments about each image. Because medical and university sites have different equipment, the images and reports are standardized before they are stored in the database.

The system has enabled individual medical sites to store, process, and manage mammograms as digital images and to enable their use through data mining and sharing of these mammography archives. Radiologists can collaborate on diagnoses without being in the same physical location.

With this system in place, the institutions involved have improved their collaboration, resulting in quicker, more accurate diagnoses. By pooling their resources, each institution gained access to a much larger and more sophisticated set of resources, without increasing their costs proportionately.

Cloud Computing Encompasses the Characteristics of Utility Computing In **utility computing**, a service provider makes computing resources and infrastructure management available to a customer as needed. The provider then charges the customer for its specific usage rather than a flat rate. Utility computing enables companies to efficiently meet fluctuating demands for computing power by lowering the costs of owning the hardware infrastructure.

Cloud Computing Uses Broad Network Access The cloud provider's computing resources are available over a network, accessed with a Web browser, and they are configured so that they can be used with any computing device.

Cloud Computing Pools Computing Resources The provider's computing resources are available to serve multiple customers. These resources are dynamically assigned and reassigned according to customer demand.

Cloud Computing Often Occurs on Virtualized Servers Cloud computing providers have placed hundreds or thousands of networked servers inside massive data centres called **server farms** (see **Figure TG 3.1**). Recall that a *server* is a computer that supports networks, thus enabling users to share files, software, and other network devices. Server farms require massive amounts of electrical power, air conditioning, backup generators, and security. They also need to be located fairly close to fibre-optic communications links (**Figure TG 3.2**).

Going further, Gartner estimates that typical usage rates on servers are very low, generally from 5 to 10 percent. That is, most of the time, organizations are using only a small percentage of their total computing capacity. Chief information officers (CIOs) tolerate this inefficiency to make certain that they can supply sufficient computing resources to users in case demand should spike. To alleviate this problem, companies and cloud computing providers are turning to virtualization.

Server virtualization uses software-based partitions to create multiple virtual servers—called *virtual machines*—on a single physical server. The major benefit of this system is that each server no longer has to be dedicated to a particular task. Multiple applications can run instead on a single physical server, with each

utility computing

A technology whereby a service provider makes computing resources and infrastructure management available to a customer as needed.

server farms Massive data centres, which may contain hundreds of thousands of networked computer servers.

server virtualization

A technology that uses software-based partitions to create multiple virtual servers (called *virtual machines*) on a single physical server.

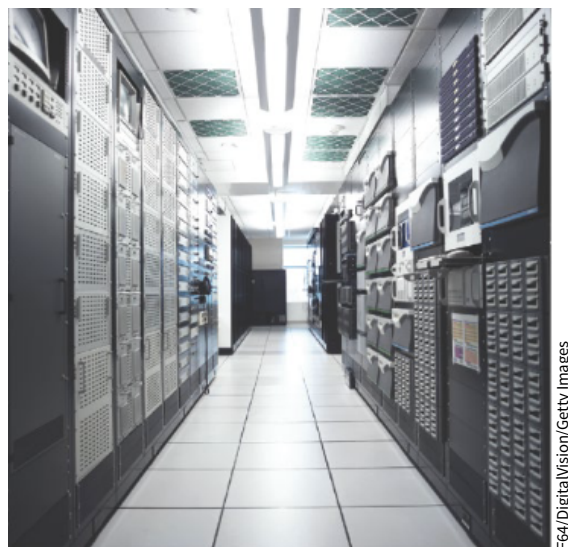


FIGURE TG 3.1 A server farm. Notice the ventilation in the racks and ceiling.

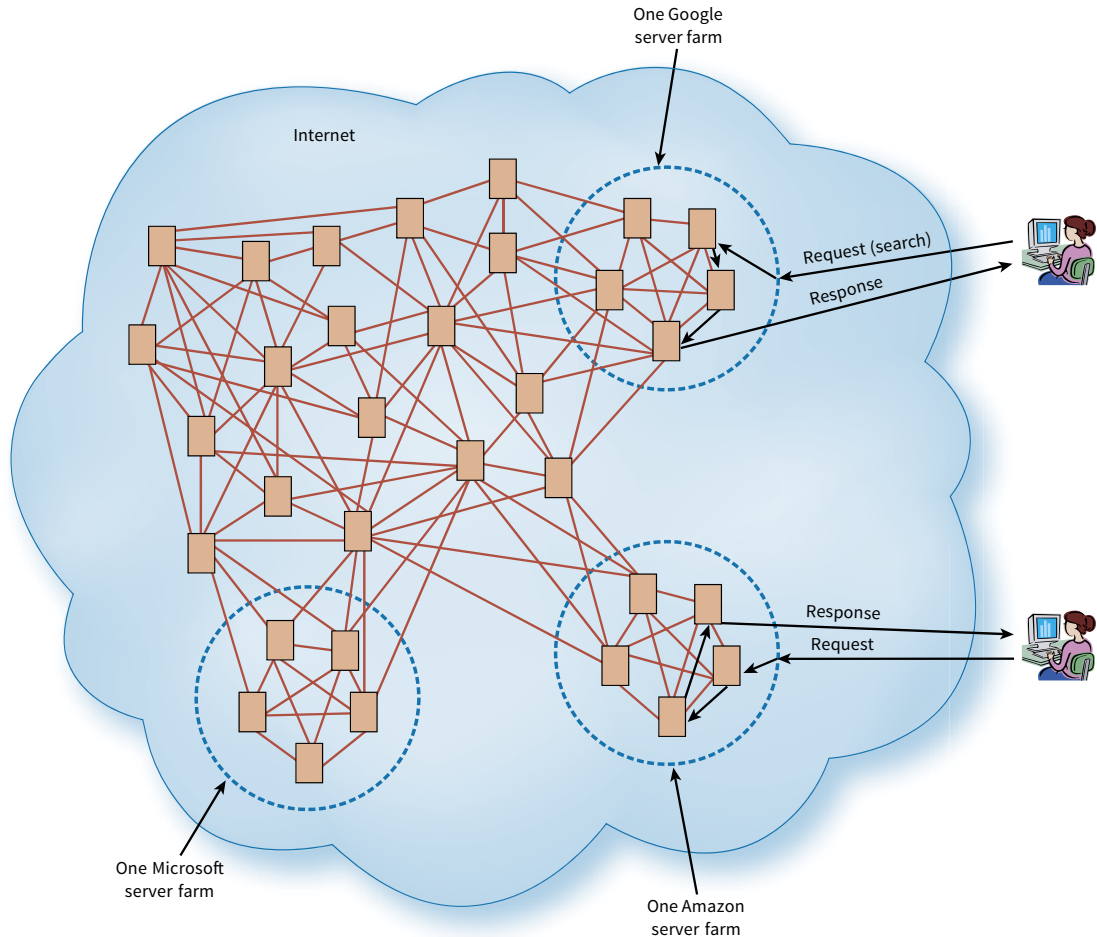


FIGURE TG 3.2 Organizational server farms in relation to the internet.

application running within its own software environment. As a result, virtualization enables companies to increase server usage. Companies can also realize cost savings in two areas. First, they do not have to buy additional servers to meet peak demand. Second, they reduce their utility costs because they are using less energy. The following example illustrates the benefits of virtualization for the city of Yawata in Japan.

The city of Yawata in Kyoto Prefecture, Japan, is very active in developing its networked city government. The city's information system was designed to support its daily operations. Since it was installed, the system has functioned as an IT service for city employees and members of the public.

Over a decade later, the city's continuing efforts to develop a more advanced digital community resulted in an increasing number of physical servers, with accompanying increases in power consumption. The rise in power usage was a particular problem as the city has a strong commitment to eco-friendliness.

To reduce hardware expenses, the city was running multiple applications on a single physical server, an approach that sometimes caused server availability issues. To make the system more secure and stable, the city wanted to have an individual dedicated server for each application.

Yawata decided to implement a server virtualization solution and realized a number of benefits when it did. First, it reduced its number of physical servers from 12 to 4. This reduction led to decreases in power consumption, which has helped the city reduce its environmental impact. Second, each application now runs on a single virtual machine. This means

that server availability has markedly increased, each app runs more efficiently, and the entire system is more stable. Third, by virtualizing its data centre, the city is able to address future server resource needs without having to add additional physical servers.

In the next section, you learn about the various ways in which customers (individuals and organizations) can implement cloud computing. Specifically, you will read about public clouds, private clouds, hybrid clouds, and vertical clouds.

Before you go on...

1. Describe the characteristics of cloud computing.
2. Define server virtualization.

TG 3.3 Different Types of Clouds

LEARNING OBJECTIVE

Describe each of the four types of clouds.

There are three major types of cloud computing that companies provide to customers or groups of customers: public clouds, private clouds, and hybrid clouds. A fourth type of cloud computing is called a vertical cloud ([Figure TG 3.3](#)).

Public Cloud

Public clouds are shared, easily accessible, multicustomer IT infrastructures that are available non-exclusively to any entity in the general public (individuals, groups, and organizations). Public cloud vendors provide applications, storage, and other computing resources as services over the Internet. These services may be free or offered on a pay-per-usage model.

public clouds Shared, easily accessible, multicustomer IT infrastructures that are available non-exclusively to any entity in the general public (individuals, groups, and organizations).

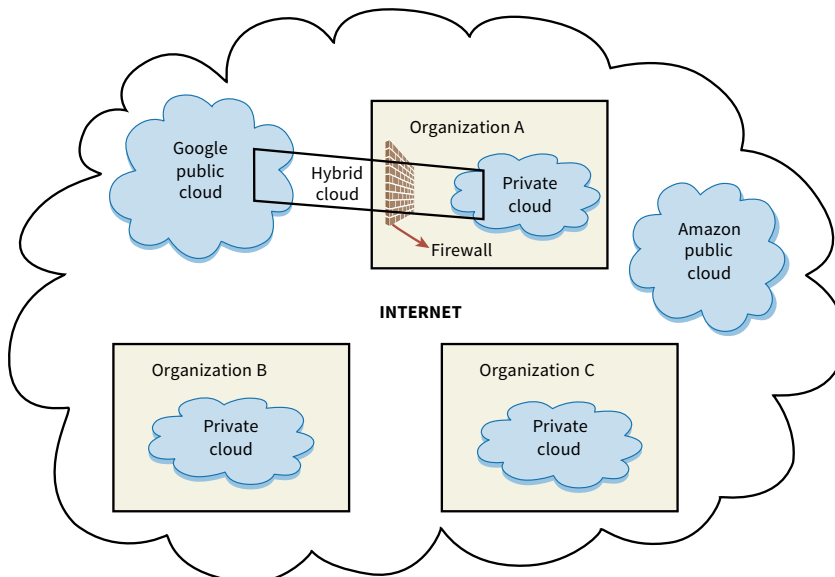


FIGURE TG 3.3 Public clouds, private clouds, and hybrid clouds.

International media companies such as Viacom (www.viacom.com), Bloomberg (www.bloomberg.com), and ESPN (www.espn.com) rely on Sambatech to deliver video content to online viewers across Latin America. As a result of its rapid growth, Sambatech decided to use cloud computing. The firm's chief technology officer noted that buying and managing complex IT (i.e., on-premise computing) was never part of the company's strategy.

Sambatech turned to Rackspace (www.rackspace.com), a public cloud provider, to help it with its huge IT capacity demands. In 2009, Sambatech needed Rackspace to host about 1 terabyte of data. By 2015, Rackspace was hosting over 100 terabytes of Sambatech's data. Furthermore, when Sambatech needs additional processing power—to deliver videos for a new marketing campaign, or to coincide with a large sporting event—Rackspace provides that power quickly and affordably.

Private Cloud

private clouds (also known as internal clouds or corporate clouds) IT infrastructures that are accessible only by a single entity or by an exclusive group of related entities that share the same purpose and requirements, such as all the business units within a single organization.

Private clouds (also known as *internal clouds* or *corporate clouds*) are IT infrastructures that can be accessed only by a single entity or by an exclusive group of related entities that share the same purpose and requirements, such as all of the business units within a single organization. Private clouds provide IT activities and applications as a service over an intranet within an enterprise. Enterprises adopt them to ensure system and data security. For this reason, these systems are implemented behind the corporate firewall. As an example of a private cloud, let's take a look at the National Security Agency in the U.S. (NSA; www.nsa.gov).

The NSA was running out of storage space for its hundreds of different databases that contain information needed to run the agency as well as to produce intelligence on foreign matters. As a result, NSA analysts had to access many different databases to do their jobs. Questions that spanned more than one database had to be manually integrated by the analyst. The agency needed to consolidate its databases to make its analysts more efficient and effective.

At first, the NSA decided to simply add more storage capacity. However, this approach actually added to the problem, so the agency decided to implement a private cloud. When all its different databases were put into one private cloud, analysts had to interface with only one system, making their jobs much easier.

The private cloud contains data that the agency acquires and uses for its missions. The cloud has strict security protocols and strong encryption, as well as a distributed architecture across multiple geographic areas. The cloud also provides a way to track every instance of every individual accessing data as specific as a single word or name in a file. This tracking includes when the data arrived, who can access them, who did access them, and who downloaded them, copied them, printed them, forwarded them, modified them, or deleted them. Furthermore, if the data have legal requirements, such as that they must be purged after five years, a notice will automatically tell NSA staff that action needs to be taken. One agency staff member noted that, if the NSA had had this ability at the time, it is unlikely that U.S. soldier Bradley Manning would have succeeded in obtaining classified documents in 2010.

Since the implementation of the private cloud, analysts can perform tasks in minutes that once took days, overall data management costs have decreased, and the security of the data has been greatly enhanced.

Hybrid Cloud

hybrid clouds Clouds composed of public and private clouds that remain unique entities but are bound together, offering the benefits of multiple deployment models.

Hybrid clouds are composed of public and private clouds that remain unique entities but are nevertheless tightly integrated. This arrangement offers users the benefits of multiple deployment models. Hybrid clouds deliver services based on security requirements, the mission-critical nature of the applications, and other company-established policies. For example, customers may need to maintain some of their data in a private cloud for security, privacy, and regulatory reasons while storing other, less sensitive data in a public cloud because it is less expensive. Let's examine Amazon's deployment of hybrid cloud computing, called AWS Outposts.

With Outposts, Amazon customers purchase its servers, plus software that integrates those servers with Amazon's machines in its cloud. Outposts is a *hybrid cloud*, which provides the ability to use cloud services for some applications, on-site servers for mission-critical applications, and a common interface to integrate all these applications.

Amazon entered this market because approximately 80 percent of organizations operate their software applications in corporate data centres (on-premise computing) for security, regulatory, or practical reasons. For instance, Disney (www.disney.com) hosts video streaming and animation software on a hybrid cloud with AWS. For Disney animators working in the Los Angeles area, a delay of more than 10 milliseconds between touching a stylus to the screen and seeing the mark itself made rendering software useless. *Rendering* is an extremely computer-intensive process of generating a digital image from a physical picture or model. Amazon's main West Coast data centre, more than 1,000 miles to the north in Oregon, could not resolve the problem due to speed-of-light considerations. But Disney's use of AWS hybrid cloud computing provided the solution.

There are many other examples of organizations using AWS Outposts. For example, Morningstar, a global leader in independent investment research, uses Outposts to build applications using Amazon's private cloud services and, once built, make them available across the company through the AWS public cloud. This enables the company to accelerate cloud technology adoption within development teams, keep up with accelerating business and customer needs, and support the company's long-term cloud strategy.

All firms in the hybrid cloud computing space offer specially assigned teams that deliver their products directly to customers' data centres. There, the customers' IT personnel can just plug the servers in, link them to a cloud vendor account, download software updates, and begin operations. If a server fails, the cloud vendor will mail the customer a new server and a return box for the defective one.

Amazon Outposts competes with IBM, Hewlett Packard Enterprise, Dell Technologies, and Microsoft to provide these services.

Multiple Clouds (Multiclouds)

Multicloud environments are the most common approach to cloud computing. Global security firm McAfee's (www.mcafee.com) 2019 Cloud Adoption and Risk Report had a surprising finding. The firm asked 1,400 IT professionals in 11 countries to estimate the total number of cloud services in use in their organization. Respondents came up with an average of 31 cloud services. When McAfee investigated further, the actual average figure was almost 2,000 services.

Let's distinguish between hybrid clouds and multiclouds. *Hybrid cloud* has traditionally meant the combination of private (either on-premise or hosted in a co-location facility) and public cloud infrastructure, with orchestration tools used to deploy workloads and manage the balance between the two. *Co-location* means that a cloud vendor rents out either an entire facility or servers within a data centre to a customer. For instance, a customer might employ public cloud resources for regular or episodic increases of computing and/or storage requirements.

In contrast, *multicloud* describes how organizations use multiple cloud providers to meet different technical or business requirements. With multicloud environments, customers use cloud-native applications built from containers and microservices using component services from different cloud providers.

There are several reasons for using multiclouds. One of the most common reasons is the desire to avoid being locked into a particular cloud vendor's infrastructure, add-on services, and pricing model. Cloud-native applications based on containers and microservices are designed to be portable between clouds, but providers will generally try to make their platforms difficult to leave, with specific functions and services that differentiate them from their competitors. Another reason for avoiding vendor lock-in is so that organizations can take advantage of best-of-breed solutions.

Organizations can also minimize latency by choosing a cloud provider with data centres that are geographically close to their customers. The reason is that network performance degrades as the number of network transmissions between servers increases.

Data governance requirements, such as the European Union's General Data Protection Regulation, will often require customer data to be held in particular locations. Unless organizations are willing to deploy and operate their own on-premise data centres, these firms will have to take a multicloud approach.

All cloud vendors occasionally suffer outages. Therefore, organizations are reluctant to run their entire workloads in one vendor's cloud because they run the risk of a mission-critical application becoming unavailable. Multiclouds provide better security, failover, and disaster recovery; that is, resilience. *Failover* occurs when standby servers automatically take over when a server fails.

Vertical Clouds

vertical cloud A set of cloud computing services optimized for use in a particular industry.

A **vertical cloud** is a set of cloud computing services optimized for use in a particular industry. Unlike organizations that can use general-purpose cloud computing services, those within certain industries often have more specific information technology requirements involving security, compliance, and other issues. Vertical cloud computing vendors offer services that help their customers meet those unique requirements.

Many industries use vertical cloud computing services, such as health care, financial services, manufacturing, government, utilities, oil and gas, and others. For example, health care organizations in Canada must ensure data privacy in accordance with the Personal Information Protection and Electronic Documents Act (PIPEDA) and specific provincial privacy of information legislation such as Ontario's Personal Health Information Privacy Act, Alberta's Health Information Act, or British Columbia's Personal Health Information Access and Protection of Privacy (E-Health) Act. Therefore, these organizations might prefer a cloud provider that offers legislation-compliant services, as well as services for electronic medical records and other applications unique to the health care industry. See Microsoft Cloud (<https://www.microsoft.com/en-ca/sites/healthcare-canada/solutions/>), for example. There are a number of specialized vertical cloud vendors. In addition, some of the major public cloud vendors also offer industry-specific services. For example, Amazon Web Services provides AWS (<https://aws.amazon.com/canada/publicsector>), a service tailored specifically for Canadian public-sector agencies that have sensitive operations and strict regulatory requirements.

Before you go on...

1. What is a public cloud?
2. What is a private cloud?
3. What is a hybrid cloud?
4. What is a vertical cloud?

TG 3.4

Cloud Computing Services

LEARNING OBJECTIVE

Explain the operational model of each of the three types of cloud services.

Cloud computing services are based on three models: infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), and software-as-a-service (SaaS). These models represent the three types of computing generally required by consumers: infrastructure to run software and store data (IaaS), platforms to develop applications (PaaS), and software applications to process their data (SaaS). **Figure TG 3.4** illustrates the differences among the three models.

ON-PREMISE SOFTWARE	INFRASTRUCTURE-AS-A-SERVICE	PLATFORM-AS-A-SERVICE	SOFTWARE-AS-A-SERVICE
CUSTOMER MANAGES - Applications - Data - Operating system - Servers - Virtualization - Storage - Networking	CUSTOMER MANAGES - Applications - Data - Operating system VENDOR MANAGES - Servers - Virtualization - Storage - Networking	CUSTOMER MANAGES - Applications - Data VENDOR MANAGES - Operating system - Servers - Virtualization - Storage - Networking	VENDOR MANAGES - Applications - Data - Operating system - Servers - Virtualization - Storage - Networking
Examples	Amazon, IBM, Google, Microsoft, Rackspace	Microsoft Windows Azure, Google App Engine, Force.com	Salesforce.com, Google Apps, Dropbox, Apple iCloud, Box.net

FIGURE TG 3.4 Comparison of on-premise software, infrastructure-as-a-service, platform-as-a-service, and software-as-a-service.

As you examine the figure from left to right, note that the customer manages the service less and less, and the vendor manages it more and more.

Although each model has its distinctive features, all three share certain characteristics. First, customers rent them instead of buying them. This arrangement shifts IT from a capital expense to an operating expense. Second, vendors are responsible for maintenance, administration, capacity planning, troubleshooting, and backups. Finally, obtaining additional computing resources—that is, scale from the cloud—is usually fast and easy. Examples include more storage from an IaaS vendor, the ability to handle more PaaS projects, and more users of a SaaS application.

Infrastructure as a Service

With the **infrastructure-as-a-service (IaaS)** model, cloud computing providers offer remotely accessible servers, networks, and storage capacity. They supply these resources on demand from their large resource pools, which are located in their data centres. We can think of IaaS as a domain for systems administrators, as it allows clients to migrate their physical or hardware infrastructure to the cloud. Examples include Amazon Elastic Compute Cloud, Google Compute Engine, Rackspace, and many others.

IaaS customers are often technology companies with IT expertise. These companies want access to computing power, but they do not want to be responsible for installing or maintaining it. Companies use the infrastructure to run software or simply to store data.

To deploy their applications, IaaS users install their operating system and their application software on the cloud computing provider's computers. They can deploy any software on this infrastructure, including different operating systems, applications, and development platforms. Each user is responsible for maintaining its own operating system and application software. Cloud providers typically bill IaaS services on a utility computing basis—that is, the cost reflects the amount of resources the user consumes.

Cloud data management is an important application of IaaS. *Cloud data management* is the practice of storing a company's data on an offsite server that is typically owned by a vendor that specializes in cloud data hosting. Cloud data management offers many benefits to clients, which include the following:

infrastructure-as-a-service (IaaS) A model with which cloud computing providers offer remotely accessible servers, networks, and storage capacity.

- *Improved security.* Improved security results, first, from the reduced risk of data loss due to device damage or hardware failure. Second, cloud vendors typically employ very advanced security measures and practices.
- *Scalability and savings.* Cloud vendors allow users to add and subtract storage and computing power as needed, which results in cost savings.
- *Governed access.* Cloud vendors enable all authorized users to access the data they need from wherever they are, a process called *data democratization*. Such access supports a collaborative work culture.
- *Automated backups, disaster recovery, and updates.* Cloud vendors provide automated data backups that speed up the process of disaster recovery after emergencies. For example, if a ransomware attack encrypted a firm's data, the cloud vendor would enable the client to restore data and continue business operations. In addition, cloud vendors update applications automatically, ensuring that the client does not have to pause work while the in-house IT group updates applications.
- *Improved data quality.* Cloud data management solutions help companies remove data silos and create a single source of truth for every data point. Data remain clean, consistent, and current. *Single source of truth* is a concept ensuring that everyone in an organization bases business decisions on the same data.
- *Sustainability.* Cloud data management enables organizations to reduce the carbon footprint created by their own IT facilities and to provide telecommuting options to their employees.

Let's look at an example. Southern Water (www.southernwater.co.uk) is a utility that used cloud data management to remove data silos. The utility manages the supply of water and waste management to 4.5 million people in southeastern England. Its assets include 83 water treatment plants, 8,700 miles (14,000 km) of water mains, 2,375 pumping stations, and approximately 2,500 miles (4,000 km) of sewers. The utility employs 3,000 people and 1,500 contractors.

The utility's data are varied and complex; some of them concern assets that are 200 years old (i.e., some of the water mains in the area date back to the early nineteenth century). The company has 80,000 sensors that gather data every 15 minutes. Its call centre staff deal with thousands of customer calls, generating audio data that are analyzed to provide better customer service.

In the past, Southern Water had groups of people in individual departments managing data. The data from many of the utility's essential business processes were isolated in departmental spreadsheets and Microsoft Access databases. If the utility had ignored this problem, it would have caused additional costs and difficulties in the future, a situation called technical debt. *Technical debt* refers to the implied cost of additional rework caused by choosing an easy solution now instead of using a better approach that would take longer to implement.

Southern Water transformed its approach to data management to improve decision making. This process involved transitioning to a Microsoft Azure cloud-based data management solution and placing all its data workers in a centralized team. With the transition, the utility gained access to a cloud-based analytics solution that delivered significant savings. In just one instance, Southern Water was able to integrate pump data to assess pump efficiency even though many pumps have different names. The team also gained a better understanding of the entire utility's data, which helped to improve data literacy throughout the organization.

platform-as-a-service (PaaS) A model in which customers rent servers, operating systems, storage, a database, software development technologies such as Java and .NET, and network capacity over the internet.

Platform as-a-Service

In the **platform-as-a-service (PaaS)** model, customers rent servers, operating systems, storage, a database, software development technologies such as Java and .NET, and network capacity over the internet. We can think of PaaS as a domain for software developers. PaaS helps software developers build, test, deploy, maintain, and manage every step of the development lifecycle of applications. Examples include Amazon Web Services Elastic Beanstalk, Microsoft Azure, Cloud Foundry, and many others.

The PaaS model allows the customer both to run existing applications and to develop and test new applications. PaaS offers customers several advantages, including the following:

- Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers.
- Underlying computing and storage resources automatically scale to match application demand.
- Operating system features can be upgraded frequently.
- Geographically distributed development teams can work together on software development projects.
- PaaS services can be provided by diverse sources located throughout the world.
- Initial and ongoing costs can be reduced by the use of infrastructure services from a single vendor rather than maintaining multiple hardware facilities that often perform duplicate functions or suffer from incompatibility problems.

Novartis International AG (www.novartis.com), a pharmaceutical company based in Basel, Switzerland, has used PaaS to improve its performance. The company employs approximately 100,000 people in 140 countries, including Canada, and has core businesses in pharmaceuticals, vaccines and diagnostics, and consumer health.

Novartis needed an alternative to its systems development process. The process was inflexible and expensive and delivered new functionalities much too slowly. These problems meant that the company was limited in the number of new development projects it could undertake. It needed to reduce its systems development effort and cost while delivering systems with the required functionality more quickly.

As a result, Novartis turned to Dell Boomi AtomSphere (www.boomi.com). Using this PaaS product, Novartis was able to reduce development efforts and deliver twice the amount of new functionality in one-sixth the time than was possible earlier.

Software-as-a-Service

With the software-as-a-service (SaaS) delivery model, cloud computing vendors provide software that is specific to their customers' requirements. We can think of SaaS as a domain for end users or business clients. That is, users and clients can run SaaS programs on their own data. Examples include Google Apps, Salesforce, Dropbox, and numerous others.

SaaS is the most widely used service model, and it provides a broad range of software applications. SaaS providers typically charge their customers a monthly or yearly subscription fee.

SaaS applications reside in the cloud instead of on a user's hard drive or in a data centre. The host manages the software and the infrastructure that runs this software and stores the customer's data. The customers do not control either the software, beyond the usual configuration settings, or the infrastructure, beyond changing the resources they use, such as the amount of disk space required for their data. This process eliminates the need to install and run applications on the user's computers, thereby simplifying maintenance and support.

What differentiates SaaS applications from other applications is their ability to scale. As a result, applications can run on as many servers as is necessary to meet changing demands. This process is transparent to the user.

To reduce the risk of an infrastructure outage, SaaS providers regularly back up all of their customers' data. Customers can also back up their data on their own storage hardware.

To understand how SaaS operates, consider Mary Kay (www.marykay.com). The cosmetics giant implemented Oracle's Taleo cloud-based recruitment software in the United States, China, and Brazil. Mary Kay did not have an applicant tracking system. The company's recruiting process relied on Microsoft Excel spreadsheets and Access databases. Recruiters at Mary Kay could not see what was going on with the manual system. If someone applied for jobs in two different departments, a recruiter from each department would often call the applicant without realizing that the other recruiter had also contacted them.

Taleo provides Mary Kay with a centralized repository for tracking internal and external job candidates. The software also automated processes such as job applications, onboarding, and forms. Taleo also integrates with LinkedIn, providing instant access to LinkedIn profiles and candidate records with a single click. Furthermore, it can fill in forms with LinkedIn credentials.

A subset of SaaS is the *desktop-as-a-service* (DaaS) model, also known as a *cloud desktop* or *desktop in the cloud*. In this model, a SaaS provider hosts a software environment for a desktop personal computer, including productivity and collaboration software—spreadsheets, word-processing programs, and so on—such as Google Apps, Microsoft 365, and other products. The DaaS model can be financially advantageous for consumers because they do not need to purchase a fully configured personal computer, or fat client. This model also makes the PC environment simpler to deploy and administer.

Functions-as-a-Service

functions-as-a-service (XaaS) A category of cloud computing services that provides a platform allowing customers to develop, run, and manage applications' functions without the complexity of building and maintaining the infrastructure typically associated with developing and deploying an app.

Functions-as-a-service (FAAS) or Everything-as-a-service (XaaS) is a category of cloud computing services that provides a platform allowing customers to develop, run, and manage applications' functions without the complexity of building and maintaining the infrastructure typically associated with developing and deploying an app. These functions are triggered by a given event.

FaaS is a good choice for real-time (event-driven) actions. Suppose an organization needs daily sales data to help manage inventory. Every time a customer buys an item, that transaction is added to a database table. An FaaS function would trigger a function within that database table, process the data from the transaction, and either display them to a manager or even trigger another function to order more of that product.

There can be confusion between FaaS and serverless computing. *Serverless computing* is a cloud computing execution model in which the cloud vendor runs the server and dynamically manages the allocation of machine resources. That is, customers do not need to be concerned with a server configuration when deploying an application. With this model, customers shift more of the responsibilities for running an application.

For example, suppose an organization needed to deploy an e-commerce application. It would be easier to build and deploy just one application that did all the work of presenting products, managing the shopping cart, and configuring the payment system rather than having separate applications. At the same time, it would be much more manageable to keep this integrated e-commerce application with all the associated embedded functions within one single cloud platform, rather than having them as separate applications.

In this case, serverless computing would be the best way to go. Even if the company's e-commerce store grows, the serverless computing service will scale the application to meet the demand. Furthermore, the application will always be running and ready to process new orders. Another example would be if an organization needed to run a mission-critical database.

Security-as-a-Service

security-as-a-service (SECaaS) A category of cloud services where an external provider handles and manages cybersecurity for an organization including services like data loss prevention, antivirus management, and intrusion detection among others.

Security-as-a-service (SECaaS) is a category of cloud services where an external provider handles and manages cybersecurity for an organization. Outsourced security solutions cover services like data loss prevention, antivirus management, and intrusion detection, among others. SECaaS provides the latest security advancements and a dedicated 24/7 security team to focus on managing your resources. It is also much easier and faster to scale security operations when the third party focuses solely on this aspect of your technology. SECaaS also provides guidance, support, and protection during data migrations, when organizations are especially vulnerable to attack.

Low-Code and No-Code Cloud Services

Low-code and no-code tools (see Technology Guide 2) allow anybody, regardless of their programming knowledge, to create applications and use data to solve problems. Many of these tools are now available in the cloud, requiring little more than a subscription to the service

for employees to begin designing and building applications. This category of low-code and no-code solutions includes tools for building websites and Web applications and designing just about any kind of digital solution that companies may need. Low-code and no-code solutions are even becoming available for creating AI-powered applications, drastically lowering the barriers to entry for companies wanting to leverage AI and machine learning. Tools like Figma (www.figma.com), and Airtable (www.airtable.com) allow users to carry out tasks that previously would have required coding experience. Cloud-based programming tools further remove barriers to end-user development.

IT's Personal: "The Cloud"

This Technology Guide defines the cloud as distributed computing services and presents many examples of how the cloud can be used for both personal and business purposes. This IT's Personal item is intended to help you differentiate between the business and personal applications of the cloud and to help you plan for your own use of the cloud.

First, you need to understand that there is no single "cloud." Rather, almost all businesses refer to their internet-based services as "cloud services." Basically, anything you do over the internet that you used to do on a local computer is a form of cloud computing. When you store files on Dropbox, create a document using Google Docs, or use iCloud to store purchases or sync documents, you are using cloud-based services that are intended for personal use.

Infrastructure-as-a-service is an important application of the cloud for personal purposes. Dropbox is one of the most prominent companies in this area. In the past, users had to carry around a USB drive, a CD, an external hard drive, or (back in the day) floppy disks to store their personal information. Today, users can

employ Dropbox for this purpose. At the time of writing, a free Dropbox account offered 2 GB of online storage. Not only does Dropbox offer you a place to store your files (eliminating the need for a removable storage infrastructure), but it also provides for synchronization across computers and access from mobile devices.

Software-as-a-service has been a popular option for quite some time. For example, Google Docs offers internet-based word processing, spreadsheet, presentation, forms, and drawing tools. Microsoft's Office 365 product also offers these services and allows you to use a computer program without having to install it on your computer or mobile device. You simply access the entire program (and your saved files) over the internet.

A word of caution, however. Along with its seemingly endless possibilities, cloud computing raises many critical security and privacy issues. Because your files, apps, and editing capability will no longer be stored on a local machine, they are only as safe as the company to which you have entrusted them makes them. So, when you select a cloud provider, make sure you choose wisely!

Before you go on...

1. Describe infrastructure-as-a-service.
2. Describe platform-as-a-service.
3. Describe software-as-a-service.
4. Describe function-as-a-service.

TG 3.5

The Benefits of Cloud Computing

LEARNING OBJECTIVE

Identify the key benefits of cloud computing.

Cloud computing offers benefits for both individuals and organizations. It allows companies to increase the scale and power of their IT and the speed at which it can be deployed and accessed. It eliminates administrative problems and operates across locations, devices, and organizational boundaries.

Nearly half of the respondents in a recent CIO economic impact survey indicated that they evaluate cloud computing options first—before traditional IT approaches—when considering

new IT investments. IBM predicts that the global cloud computing market will grow by close to 20 percent annually to US \$791 billion by 2028. We will now examine three major benefits that cloud computing provides to individuals and organizations.

Benefit 1: Cloud Computing Has a Positive Impact on Employees

Cloud computing enables companies to give their employees access to all the information they need no matter where they are, what device they are using, or whom they are working with. Consider the following example.

The lawyers in one law firm constantly needed to access documents and data. The firm's data volume had expanded from 30 gigabytes to more than 40 terabytes in just one year. Moreover, all of these data had to be stored and accessed securely. In the past, lawyers often had to manually copy case-relevant data onto external hard drives and USB devices and then ship these devices back and forth among themselves and with the firm's headquarters. These processes were insecure, time-consuming, and expensive.

To address these needs, the law firm turned to cloud computing for data storage, off-site disaster recovery, and multisite access within a highly secure public cloud. Rather than maintaining a massive inventory of extra storage as required by its old IT infrastructure, the firm can now increase storage capacity on demand. The cloud provides attorneys with constant access through encrypted communication channels. Furthermore, it facilitates collaboration among distributed teams of lawyers, thereby increasing their overall productivity. The cloud environment has made the firm's lawyers much more efficient, and its IT expenses have declined by 60 percent.

Benefit 2: Cloud Computing Can Save Money

Over time, building and operating an on-premise IT infrastructure will typically be more expensive than adopting the cloud computing model. Cloud providers purchase massive amounts of IT infrastructure (e.g., hardware and bandwidth) and gain cost savings by buying in large quantities. As a result, these providers continually take advantage of Moore's law (discussed in Technology Guide 1). For example, the Amazon cloud, known as Amazon Web Services, has reduced its prices many times over the last 10 years.

As a result, cloud computing can reduce or eliminate the need to purchase hardware, build and install software, and pay software licensing fees. The organization pays only for the computing resources it needs, and then only when it needs them. This pay-for-use model allows greater flexibility and eliminates or reduces the need for significant capital expenditures.

For example, Canadian bank CIBC announced in September 2021 that it was migrating its data and apps to Google Cloud, making it the country's first big bank to use a public cloud platform. The move allows CIBC to improve client experiences and drive innovation. The bank plans to use Google Cloud's artificial intelligence, data analytics, and machine learning capabilities to provide more tailored, convenient financial services for its consumers. CIBC will also be able to update its IT infrastructure, decrease expenses, and improve security and resilience by transferring to the cloud. This example shows how cloud computing can result in cost savings, improved security, and increased agility.

Benefit 3: Cloud Computing Can Improve Organizational Flexibility and Competitiveness

Cloud computing allows organizations to use only the amount of computing resources they need at a given time. Therefore, companies can efficiently scale their operations up or down as needed to meet rapidly changing business conditions. Cloud computing is also able to deliver computing services faster than the on-premise computing can.

Ontario-based company Northwestel (<https://www.nwtel.ca>) recently adopted cloud computing technology. The company uses Microsoft's Azure cloud computing technology to improve customer experiences, as well as services like online gaming, video chat, and more. Northwestel found that migrating to the cloud has allowed for faster, more streamlined operations and lower costs. Similarly, Canadian financial services company Desjardins Group (<https://www.desjardins.com>) has embraced cloud computing to improve the client experience and optimize operations. The company's move to the cloud has enabled it to improve employee access to data and consolidate data management. Decision-making procedures have become faster and more effective as a result. By using the cloud to provide online and mobile services such as online banking and mobile payments, Desjardins Group has also enhanced the consumer experience. These services have improved client satisfaction and assisted the company in maintaining market dominance. Businesses may boost operational effectiveness, enhance data management, and improve the customer experience by switching to the cloud.

Before you go on...

1. Describe how cloud computing can help organizations expand the scope of their business operations.
2. Describe how cloud computing can help organizations respond quickly to market changes.

TG 3.6

Concerns and Risks with Cloud Computing

LEARNING OBJECTIVE

Discuss the concerns and risks associated with cloud computing.

Fortune Business Insights™ predicted that worldwide spending on cloud computing would grow at an annual rate of 19 percent through the year 2028. Even if this prediction turns out to be accurate, however, cloud computing will still account for less than 5 percent of total worldwide IT spending that year. Why is this percentage so low? The reason is that there are serious concerns with cloud computing. These concerns fall into six categories: legacy IT systems, reliability, privacy, security, the legal and regulatory environment, and criminal use of cloud computing.

Concern 1: Legacy IT Systems

Historically, organizational IT systems have accumulated a diversity of hardware, operating systems, and applications. When bundled together, these systems are called “legacy spaghetti.” They cannot easily be transferred to the cloud because they must first be untangled and simplified. Furthermore, many IT professionals have vested interests in various legacy systems and resist efforts to exchange them for cloud computing.

Concern 2: Reliability

Many sceptics contend that cloud computing is not as reliable as a well-managed on-premise IT infrastructure. Although cloud providers are improving the redundancy and reliability of their offerings, outages still occur. Consider the following examples involving Microsoft and Google.

In January 2023, customers worldwide, with the exception of those in China, lost access to Microsoft Azure's cloud as well as services such as Outlook, Exchange Online, and Teams. The problems were traced back to an update to the company's global wide area network (WAN), which was rolled back. Customers reported connectivity issues, such as network latency, when attempting to connect to Azure as well as other Microsoft services such as Microsoft 365 and PowerBI.

Similarly in March 2023, Google Cloud users experienced problems due to a problem that slowed down their servers. The company's engineers described the problem as "cloud load balancing," and it primarily affected the data centres in the eastern U.S.

Concern 3: Privacy

Privacy advocates have criticized cloud computing for posing a major threat to privacy because the providers control, and thus lawfully or unlawfully monitor, the stored data and communications between the user and the host company.

Using a cloud computing provider also complicates data privacy because of the extent to which cloud processing and cloud storage are used to implement cloud services. The point is that customer data may not remain on the same system or in the same data centre. This situation can lead to legal concerns over jurisdiction.

There have been efforts to address this problem by integrating the legal environment. One example is the U.S.-EU Safe Harbor, a streamlined process for U.S. companies to comply with the European Union directive on the protection of personal data.

Concern 4: Security

Critics also question how secure cloud computing really is. Because the characteristics of cloud computing can differ widely from those of traditional IT architectures, providers need to reconsider the effectiveness and efficiency of traditional security mechanisms. Security issues include access to sensitive data, data segregation (among customers), privacy, error exploitation, recovery, accountability, malicious insiders, and account control.

The security of cloud computing services is a contentious issue that may be delaying the adoption of this technology. Security issues arise primarily from the unease of both the private and public sectors with the external management of security-based services. The fact that providers manage these services gives them a great incentive to prioritize building and maintaining strong security services.

Another security issue involves the control over who is able to access and use the information stored in the cloud. (Recall our discussion of least privilege in Chapter 4.) Many organizations exercise least-privilege controls effectively with their on-premise IT infrastructures. Some cloud computing environments, in contrast, cannot apply such controls effectively. This problem occurs because cloud computing environments were originally designed for individuals or groups, not for hierarchical organizations in which some people have both the right and the responsibility to exercise control over other people's private information. To address this problem, cloud computing vendors are working to incorporate administrative, least-privilege functionality into their products. In fact, many have already done so.

Consider Panama City, Florida, as an example. Panama City was one of the first cities in the United States to adopt Google Apps for Government. The city was searching for a way to gain visibility into who was using Google Apps and how users were collaborating both inside and outside the city's IT domain. Furthermore, the city needed the ability to control and enforce data-sharing policies where necessary. It decided to adopt Cisco CloudLock (<https://www.cisco.com/c/en/us/products/security/cloudlock/index.html>).

CloudLock provides a security system to protect its clients' information assets located in public cloud applications like Google Apps. It addresses key data management issues such as the following:

- Data inventory: How many information assets exist and what are their types?
- Which information assets are shared with the public or over the internet?
- Who has access to what information assets and which information assets are accessible to whom?

Using CloudLock, Panama City was able to notify data owners of policy violations or exposed documents containing potentially sensitive information, change or revoke excessive privilege, and audit permission changes. Furthermore, the city's IT manager was able to designate department leaders to manage their respective organizational unit's data policies and usage by giving them access to the CloudLock application.

Concern 5: The Regulatory and Legal Environment

There are numerous legal and regulatory barriers to cloud computing, many of which involve data access and transport. For example, the European Union prohibits consumer data from being transferred to non-member countries without the consumers' prior consent and approval. Companies located outside the European Union can overcome this restriction by demonstrating that they provide a "safe harbour" for the data. Some countries, such as Germany, have enacted even more restrictive data export laws. Cloud computing vendors are aware of these regulations and laws and are working to modify their offerings so that they can assure customers and regulators that data entrusted to them are secure enough to meet all of these requirements.

To obtain compliance with regulations such as the Personal Information Protection and Electronic Documents Act (PIPEDA) and Bill 198 in Canada; the Federal Information Security Management Act (FISMA), the Health Insurance Portability and Accountability Act (HIPAA), and the Sarbanes—Oxley Act in the United States; the Data Protection Directive in the European Union; and the credit card industry's Payment Card Industry Data Security Standard (PCI DSS), cloud computing customers may have to adopt hybrid deployment modes that are typically more expensive and may offer restricted benefits. It is typically the responsibility of the cloud customer to ensure that the cloud computing service it is contracting with complies with all the information and privacy laws that may apply.

Concern 6: Criminal Use of Cloud Computing

Cloud computing makes available a well-managed, generally reliable, scalable global infrastructure that is, unfortunately, as well suited to illegal computing activities as it is to legitimate business activities. We look here at a number of possible illegal activities.

The huge amount of information stored in the cloud makes it an attractive target for data thieves. Moreover, the distributed nature of cloud computing makes it very difficult to catch criminals.

Cloud computing makes immense processing power available to anyone. Criminals using cloud computing have access to encryption technology and anonymous communication channels that make it difficult for authorities to detect their activities. When law enforcement pursues criminals, the wrongdoers can rapidly shut down computing resources in the cloud, thus greatly decreasing the chances that there will be any clues left for forensic analysis. When criminals no longer need a machine and shut it down, other clients of cloud vendors immediately reuse the storage and computational capacity allocated to that machine. Therefore, the criminal information is overwritten by data from legitimate customers. It is nearly impossible to recover any data after a machine has been *de-provisioned*.

Criminals are registering for an account (with assumed names and stolen credit cards, of course) with a cloud vendor and "legitimately" using services for illegal purposes. For example, criminals use Gmail to plan crimes and share stolen information. Another example is that criminals use cloud computing for brute force password cracking (see Chapter 4). Although such uses are prohibited by most companies' terms-of-service agreements, policing the cloud is expensive and not very rewarding for cloud providers.

Many cloud vendors offer geographical diversity—that is, virtual machines that are located in different physical locations around the world. Criminals can use this feature in transnational attacks. Such attacks place political and technical obstacles in the way of authorities seeking to trace a cyberattack back to its source.

Another weakness exploited by criminals arises from the Web-based applications, or SaaS offerings, provided by cloud vendors. With millions of users commingling on tens of thousands of servers, a criminal can easily mix in among legitimate users.

Even more complicated for authorities and victims, cyberattacks can originate within cloud programs that we use and trust. For example, researchers at the security firm F-Secure reported that they had detected several phishing sites hosted within Google Docs. What made the attacks possible is a feature within Google's spreadsheet system that lets users create Web-based forms, with titles such as "Webmail Account Upgrade" and "Report a Bug." These forms, located on a Google server, were authenticated with Google's encryption certificate. Significantly, they requested sensitive information such as the user's full name, username, Google password, and so on, according to the F-Secure researchers.

Before you go on...

1. Discuss the various risks of cloud computing.
2. In your opinion, which risk is the greatest? Support your answer.

TG 3.7 The "Big Three" Cloud Computing Vendors

LEARNING OBJECTIVE

Describe the pros and cons for each of the Big Three cloud computing vendors.

The "Big Three" public IaaS and PaaS cloud vendors are Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform. According to Synergy Research Group (www.srgresearch.com), AWS is the global market leader for public IaaS and PaaS, with 33 percent of this market, followed by Azure at 23 percent, Google at 10 percent, and Alibaba at 5 percent. Other leading public cloud vendors include VMware Cloud, IBM Cloud, and Oracle Cloud. Let's take a closer look at the Big Three cloud vendors.

All of the Big Three cloud vendors offer largely similar services. For example, all three offer managed services related to popular container services such as Kubernetes and all three offer excellent networking capabilities with automated server load balancing and connectivity to on-premise systems.

All three support relational databases, NoSQL databases, and data warehouses. Specifically, Amazon offers its Relational Database Service, DynamoDB (NoSQL), as well as Redshift, the firm's data warehouse product. Microsoft offers its Azure SQL Database, Cosmos DB (NoSQL), and Azure Data Warehouse. For relational database support, Google offers Cloud SQL and Cloud Spanner. For NoSQL database support, it provides Cloud Bigtable, Cloud Firestore, Firebase Realtime Database, and Cloud Memorystore. And for data warehouse support, it offers Cloud Bigtable.

All three vendors support serverless computing. AWS Lambda, Azure serverless computing, and Google Cloud serverless computing are event-driven, serverless computing platforms that run code in response to events and automatically manage the computing resources required by that code.

Prices for the three vendors are roughly comparable, as the three compete with each other. The three vendors offer slightly different pricing models, discounts, and make frequent price cuts. Not all customers pay the sticker price, especially at the enterprise level, where volume discounts can be negotiated. All three vendors offer free introductory tiers, allowing customers to try their services before they buy.

The key question is: What differentiates these cloud providers from one another? Selecting one cloud vendor over the others depends on the individual customer and the workloads that the customer operates. Often, organizations use multiple cloud providers within different parts of their operations or for different use cases.

Amazon Web Services

Strengths AWS’s key strength is the breadth and depth of its services: it offers more than 175 services including compute, storage, database, analytics, networking, mobile, developer tools, management tools, the Internet of Things, security, and others.

Compute AWS’s main offering is its Elastic Compute Cloud (EC2), which can be customized with a large number of options. Amazon also provides related services such as Elastic Beanstalk for app deployment, the EC2 Container service, and AWS Lambda.

Storage AWS storage includes its Simple Storage Service (S3), Elastic Block Storage, Elastic File System, and Import/Export large volume data transfer service. AWS also offers Glacier archive backup and Storage Gateway, which integrates with on-premise computing environments.

Hybrid Options AWS Outposts is Amazon’s hybrid cloud computing product. As noted in Section TG 3.3, Outposts is a fully managed service where the vendor delivers pre-configured servers to a client’s premises, and the client can run AWS services in its data centre.

Machine Learning Amazon deployed SageMaker to simplify the adoption of machine learning. SageMaker is a fully managed service that enables developers and data scientists to quickly build, train, and deploy machine learning models. AWS offers a broad set of off-the-shelf machine learning services for use cases such as image recognition (AWS Rekognition), text-to-speech deep learning models (Polly), and the engine that powers Alexa (Lex).

Customer Base High-profile customers are one of AWS’s strong points. Major customers include Netflix, AstraZeneca, Airbnb; Aldo Group, National Bank, Financial Times, Dow Jones, Nasdaq, Nike, Pfizer, and others.

Pros and Cons Amazon ranks highly on platform configuration options, monitoring and policy features, security, and reliability. Its partner ecosystem and general product strategy are market leading and its AWS Marketplace has a large number of third-party software services.

In the past, Amazon used to be dismissive of the benefits of hybrid cloud computing. As noted in Section TG 3.3, though, the company is now competing in this area with its product, Outposts. Another problem is that certain organizations may want to limit their reliance on a single cloud computing provider. In fact, some boards of directors in potentially threatened industry verticals have directed their IT groups to avoid the use of AWS where possible.

Microsoft Azure

Strengths Azure is popular with executives who have long-standing relationships with Microsoft. Azure is seamlessly integrated with Office 365 and Teams.

Compute Azure’s offering is centred around its Virtual Machines, with other tools such as Cloud Services and Resource Manager to help deploy applications in the cloud.

Storage Microsoft offers its Azure Storage service, Azure Blob (binary large object) block storage, as well as Table, Queue, and File storage. Azure also offers Site Recovery, Import Export, and Azure Backup. A *binary large object (blob)* is a collection of binary data stored as a single entity in a database management system. Blobs are typically images, audio, or other multimedia objects.

Hybrid Options Microsoft is an established vendor for hybrid deployments with Azure, which provides customers with the hardware and software required to deploy Azure public cloud services from a customer’s data centre with a shared management portal.

Machine Learning Microsoft's Azure Machine Learning enables developers to write, test, and deploy machine learning algorithms.

Customer Base Microsoft customers include Canadian organizations such as the City of Ottawa, GoodFood meal delivery grocer, construction company AECON, and multinationals such as Ford, NBC News, Easyjet, and others.

Pros and Cons Azure is most attractive if Microsoft already has a strong presence within an organization and can easily play a role in helping these companies transition to the cloud. Azure integrates well with key Microsoft on-premise systems such as Windows Server, System Center, and Active Directory.

One of Azure's problems, though, has been a series of outages, as we described earlier in Section TG 3.6, Concern 2.

Google Cloud Platform

Strengths Although all three vendors are strong in machine learning, Google excels in this area. Google also has expertise with open-source technologies, particularly with containers.

Compute Google's scalable Compute Engine delivers virtual machines in the company's data centres. The virtual machines are quick to start up, come with persistent disk storage, offer consistent performance, and are highly customizable depending on the customer's needs.

Storage Google offers Cloud Storage for objects and blobs as well as for archival storage. Its Persistent Disk and Local SSD provide storage for virtual machines and containers. Fire-store offers scalable file storage and Cloud Storage for Firebase provides scalable storage for user-generated content from apps. Google Data Transfer Services allow fast offline, online, or cloud-to-cloud data transfer.

Hybrid Options Google's hybrid offering Anthos enables customers to build and manage hybrid applications in customers' data centres or in Google's cloud. Built on open-source technologies including Kubernetes, Istio, and Knative, Anthos ensures consistency between on-premise and cloud environments. Knative is an open-source community project that adds components for deploying, operating, and managing serverless, cloud-native applications on Kubernetes.

Significantly, Anthos allows organizations not only to run applications on-premise and in Google's public cloud but also to manage workloads running on third-party clouds such as AWS and Azure. This feature gives customers the freedom to deploy, run, and manage their applications on the cloud(s) of their choice, without requiring administrators and developers to learn new and different environments.

Machine Learning Google offers a one-stop-shop AI platform, which enables machine learning developers and data scientists to build and deploy models based on the firm's open source TensorFlow deep learning library.

Customer Base Google has not had quite the same level of enterprise success as its two main competitors but it does have notable customers. Spotify completed its migration to the Google Cloud Platform in 2018, and UK bank HSBC has also chosen Google for its analytics and machine learning capabilities. Note that HSBC is taking a multicloud approach, partnering with all three cloud vendors for different tasks.

Pros and Cons Google has a good track record with innovative cloud-native companies and a solid standing in the open-source community. The company has strengths in Big Data and analytics applications, machine learning, and cloud-native applications. Google's market

strategy has focused on smaller, innovative projects at large organizations, rather than becoming a strategic cloud partner.

Google has struggled to break into the enterprise market. In addition, Google has the smallest global footprint of the Big Three and has no presence in China, one of the world's largest markets. AWS and Azure have regions in mainland China that are owned and operated by Chinese third-party partners. AWS's partners are Beijing Sinnet Technology and Ningxia Western Cloud Data Technology, and Azure has partnered with 21Vianet.

Before you go on...

1. Describe the similarities among the Big Three cloud computing vendors.
2. What is the single biggest advantage for each of the Big Three cloud computing vendors? Support your choice.
3. What is the single biggest disadvantage for each of the Big Three cloud computing vendors? Support your choice.

TG 3.8 Web Services and Service-Oriented Architecture

LEARNING OBJECTIVE

Explain the role of Web services in building a firm's IT applications, providing examples.

Thus far, we have explained how cloud computing can deliver a variety of functionalities to users in the form of services (think IaaS, PaaS, and SaaS). We conclude by examining Web services and service-oriented architecture.

Web services are applications delivered over the internet (the cloud) that MIS professionals can select and combine through almost any device, from personal computers to mobile phones. By using a set of shared standards, or protocols, these applications permit different systems to “talk” with one another—that is, to share data and services—without requiring human beings to translate the conversations. Web services have enormous potential because they can be employed in a variety of environments: over the internet, on an intranet inside a corporate firewall, or on an extranet set up by business partners. They can also perform a wide variety of tasks, from automating business processes, to integrating components of an enterprise-wide system, to streamlining online buying and selling.

Web services provide numerous benefits for organizations:

- The organization can use the existing Internet infrastructure without having to implement any new technologies.
- Organizational personnel can access remote or local data without having to understand the complexities of this process.
- The organization can create new applications quickly and easily.

The collection of Web services that are used to build a firm's IT applications constitutes a **service-oriented architecture (SOA)**. Businesses accomplish their processes by executing a series of these services. One of the major benefits of Web services is that they can be reused across an organization in other applications. For example, a Web service that checks a consumer's credit could be used with a service that processes a mortgage application or credit card application.

web services Applications delivered over the internet that IT developers can select and combine through almost any device, from personal computers to mobile phones.

service-oriented architecture An IT architecture that makes it possible to construct business applications using Web services.

(a) HTML

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" http://www.wiley.com/college/gisslen/0470179961/video/
video111
<html xmlns="http://www.wiley.com/college/rainer/0470179061/video/video111.html"><head>
<meta http-equiv="content-Type" content="text/html; charset=ISO-8859-1">
<title>CSS Text Wrapper</title>
<link type="text/css" rel="stylesheet" href="css/stylesheet.css">
</head><body id="examples">

<div id="container">
  <div class="wrapper">
    <div class="ex">
      <script type="text/javascript">shapewrapp
er("15","7.5,141,145|22.5,89,89|37.5,68,69|52.5,46,50|67.5,3
height: 15px; width: 39px;"></div><div style="float: left; clear: left; height: 15px; width: 27px;"></div><div style="float:
15px; width: 4px;"></div><div style="float: left; clear: left; height: 15px; width: 6px;"></div><div style="float:
right; cle
width: 43px;"></div><div style="float: left; clear: left; height: 15px; width: 57px;"></div><div style="float: right; clear:
<span style="font-size: 13px;" class="c">
```

(b) XML

```
<feature numbered="no" xml:id="c08-fea-0001">
  <titleGroup>
    <title type="featureName">OPENING CASE</title>
    <title type="main">Tiger Tans and Gifts</title>
  </titleGroup>
  <section xml:id="c08-sec-0002">
    <p>
      <blockFixed onlyChannels="print" type="graphic">
        <mediaResource alt="p0310" copyright="John Wiley & Sons, Inc." eRights="yes"
          href="urn:x-wiley:9781118443590:media:rainer9781118443590c08:p0310" pRights="yes"/>
      </blockFixed>
      Lisa Keiling owns a tanning salon in Wedowee, Alabama, that does very well from January to May....
    </p>
  </section>
</feature>
```

FIGURE TG 3.5 (a) Screenshot of an HTML wrapper. This wrapper gives instructions on how to open a video associated with this book. (b) Example of XML tagging.

extensible markup language

(XML) A computer language that makes it easier to exchange data among a variety of applications and to validate and interpret these data.

hypertext markup language

(HTML) A page-description language for specifying how text, graphics, video, and sound are placed on a Web page document.

HTML5 A page-description language that makes it possible to embed images, audio, and video directly into a document without add-ons. It also makes it easier for Web pages to function across different display devices, including mobile devices as well as desktops. It supports the storage of data offline.

Web services are based on four key protocols: XML, SOAP, WSDL, and UDDI (defined below). **Extensible markup language (XML)** is a computer language that makes it easier to exchange data among a variety of applications and to validate and interpret these data. XML is a more powerful and flexible markup language than **hypertext markup language (HTML)**. HTML is a page-description language for specifying how text, graphics, video, and sound are placed on a Web page document. HTML was originally designed to create and link static documents composed primarily of text (**Figure TG 3.5**). Today, however, the Web is much more social and interactive, and many Web pages have multimedia elements, such as images, audio, and video. To integrate these rich media into Web pages, users had to rely on third-party plug-in applications such as Flash, Silverlight, and Java. Unfortunately for users, these add-ons require both additional programming and extensive computer processing.

The next evolution of HTML, called **HTML5**, solves this problem by enabling users to embed images, audio, and video directly into a document without the add-ons. HTML5 also makes it easier for Web pages to function across different display devices, including mobile devices and desktops. HTML5 supports offline data storage for apps that run over the Web. Web pages will execute more quickly, and they will resemble smartphone apps. HTML5 is used in a number of internet browsers, including Apple's Safari browser, Google Chrome, and Mozilla Firefox. Google's Gmail also use HTML5. Popular websites such as **Google.com**, **Facebook.com**, **Microsoft.com**, **Youtube.com**, **X.com**, **Netflix.com**, **Apple.com**, and **Instagram.com** use HTML5 extensively.

Where HTML is limited to describing how data should be presented in the form of Web pages, XML can present, communicate, and store data. For example, in XML a number is not simply a number. The XML tag also specifies whether the number represents a price, a date,

or a product code. Consider this example of XML, which identifies the contact information for Jane Smith.

```
<contact-info>
<name>Jane Smith</name>
<company>AT&T</company>
<phone>(212) 555-4567</phone>
</contact-info>
```

The *simple object access protocol (SOAP)* is a set of rules that define how messages can be exchanged among different network systems and applications through the use of XML. These rules essentially establish a common protocol that allows different Web services to interoperate. For example, Visual Basic clients can use SOA to access a Java server. SOA runs on all hardware and software systems.

The *Web services description language (WSDL)* is used to create the XML document that describes the tasks performed by the various Web services. Tools such as VisualStudio.Net automate the process of accessing the WSDL, reading it, and coding the application to reference the specific Web service.

Universal description, discovery, and integration (UDDI) allows MIS professionals to search for Web services they need by creating public or private searchable directories of these services. In other words, UDDI is the registry of descriptions of Web services.

Before you go...

1. What are Web services?
2. What is a service-oriented architecture?

What's in IT for me?

For All Business Majors

As with hardware (see Technology Guide 1), the design of enterprise IT architectures has profound impacts on businesspeople. Personal and organizational success can depend on an understanding of cloud computing and a commitment to knowing the opportunities and challenges it will bring.

At the organizational level, cloud computing has the potential to make the organization function more efficiently and effectively, while saving it money. Web services and SOA make the organization more flexible when deploying new IT applications.

At the individual level, you might use cloud computing yourself if you start your own business. Remember that cloud computing provides start-up companies with world-class IT capabilities at a very low cost.

Summary

TG 3.1 Describe the evolution of the IT function.

- **Stand-alone mainframes:** Organizations initially used mainframe computers in their engineering and accounting departments. The mainframe was typically housed in a secure area and only MIS personnel had access to it.
- **Mainframe and dumb terminals:** Firms placed dumb terminals in user departments. This arrangement enabled users to input computer programs into the mainframe from their departments.

- **Stand-alone personal computers:** In the late 1970s, users began bringing personal computers to the workplace to improve their productivity. These computers were not initially supported by the MIS department, but organizations eventually decided to support them.
- **Local area networks (client/server computing):** Organizations began to connect personal computers to local area networks (LANs) and then connected these LANs to the mainframe, a type of processing known as *client/server computing*.

- **Enterprise computing:** In the early 1990s, organizations began to use networking standards to integrate different kinds of networks throughout the firm, thereby creating enterprise computing. As the internet became widely used after 1995, organizations began using the TCP/IP networking protocol to integrate different types of networks. All types of hardware were networked, including mainframes, personal computers, smartphones, printers, and many others. Software applications and data now flow seamlessly throughout the enterprise and between organizations.
- **Cloud computing and mobile computing:** Today, organizations and individuals can use the power of cloud computing. Cloud computing provides access to a shared pool of computing resources, including computers, storage, applications, and services, over a network, typically the internet.

TG 3.2 Define cloud computing and its key characteristics.

Cloud computing is a type of computing that delivers convenient, on-demand, pay-as-you-go access for multiple customers to a shared pool of configurable computing resources (e.g., servers, networks, storage, applications, and services) that can be rapidly and easily accessed over the internet.

The essential *characteristics* of cloud computing include the following:

- Cloud computing provides on-demand self-service.
- Cloud computing includes the characteristics of grid computing.
- Cloud computing includes the characteristics of utility computing.
- Cloud computing uses broad network access.
- Cloud computing pools computing resources.
- Cloud computing typically occurs on virtualized servers.

TG 3.3 Describe each of the four types of clouds.

Public clouds are shared, easily accessible, multicustomer IT infrastructures that are available non-exclusively to any entity in the public (individuals, groups, and organizations). *Private clouds* (also known as *internal clouds* or *corporate clouds*) are IT infrastructures that are accessible only by a single entity, or by an exclusive group of related entities that share the same purpose and requirements, such as all the business units within a single organization. *Hybrid clouds* are composed of public and private clouds that remain unique entities but are bound together, offering the benefits of multiple deployment models. *Vertical clouds* serve specific industries.

TG 3.4 Explain the operational model of each of the three types of cloud services.

With the *infrastructure-as-a-service* model, cloud computing providers offer remotely accessible servers, networks, and storage capacity. In the *platform-as-a-service* model, customers rent servers, operating systems, storage, a database, software development technologies such

as Java and .NET, and network capacity over the internet. With the *software-as-a-service* delivery model, cloud computing vendors provide software that is specific to their customers' requirements.

TG 3.5 Identify the key benefits of cloud computing.

The benefits of cloud computing include making individuals more productive, facilitating collaboration, mining insights from data, developing and hosting applications, cost flexibility, business scalability, improved usage of hardware, market adaptability, and product and service customization.

TG 3.6 Discuss the concerns and risks associated with cloud computing.

Cloud computing does raise concerns and have risks, which include legacy IT systems, cost, reliability, privacy, security, and the regulatory and legal environment.

TG 3.7 Describe the pros and cons for each of the Big Three cloud computing vendors.

Amazon. Amazon ranks high on platform configuration options, monitoring and policy features, security, and reliability. Its partner ecosystem and general product strategy are market leading, and its AWS Marketplace has a large number of third-party software services.

In the past, Amazon was dismissive of the benefits of hybrid cloud computing.

Microsoft. Azure is most attractive if Microsoft already has a strong presence within an organization and therefore can easily play a role in helping these companies transition to the cloud. Azure integrates well with key Microsoft on-premise systems such as Windows Server, System Center, and Active Directory.

One of Azure's problems, though, has been a series of outages over the years.

Google. Google has a good track record with innovative cloud-native companies and a solid standing in the open-source community. The company has strengths in Big Data and analytics applications, machine learning, and cloud-native applications. Google's market strategy has focused on smaller, innovative projects at large organizations, rather than becoming a strategic cloud partner.

Google has struggled to break into the enterprise market. In addition, Google has the smallest global footprint of the Big Three and has no presence in China, one of the world's largest markets.

TG 3.8 Explain the role of Web services in building a firm's IT applications, providing examples.

Web services are applications delivered over the internet that MIS professionals can select and combine through almost any device, from personal computers to mobile phones. A *service-oriented architecture* makes it possible for MIS professionals to construct business applications using Web services.

Key Terms

cloud computing 487	infrastructure-as-a-service (IaaS) 495	Server virtualization 489
Extensible markup language (XML) 508	on-premise computing 487	service-oriented architecture (SOA) 507
Functions-as-a-service (FaaS or XaaS) 498	platform-as-a-service (PaaS) 496	utility computing 489
Grid computing 488	Private clouds 492	vertical cloud 494
HTML5 508	Public clouds 491	Web services 507
Hybrid clouds 492	Security-as-a-service (SECaaS) 498	
hypertext markup language (HTML) 508	server farms 489	

Discussion Questions

1. What is the value of server farms and virtualization for any large organization?
2. If you were a firm's chief information officer, how would you explain the workings, benefits, and limitations of cloud computing?
3. What is the value of cloud computing to a small organization?
4. What is the value of cloud computing to an entrepreneur who is starting a business?

Problem-Solving Activities

1. Investigate the status of cloud computing by researching the offerings of the following vendors: Dell (www.dell.com), Oracle (www.oracle.com), IBM (www.ibm.com), Alibaba (www.alibaba.com), and Tencent (www.tencent.com). Compare Alibaba and Tencent with the other three cloud vendors.
2. Visit www.morpheusdata.com and watch the demo. Summarize the platform's benefits in hybrid cloud computing.
3. Compare www.dropbox.com and Google Drive (<https://drive.google.com>). Which service would you prefer to use during your next group project and why?

Apply the Concept Activities

Apply the Concept 1.1

LEARNING OBJECTIVE 1.1

Identify the reasons why being an informed user of information systems is important in today's world.

STEP 1: Background (Here is what you are learning.)

Section 1.1 discussed how businesses are utilizing modern technologies to become more productive by connecting to their customers, suppliers, partners, and other parties. Those connections, however, do not exist simply to support the businesses. Do you realize how connected you are? Computers and information systems have become an essential feature of our everyday lives. Most of you have a cellphone within reach and have looked at it within the past 5 minutes. No longer is a phone just a phone; rather, it is your connection to family, friends, shopping, driving directions, entertainment (games, movies, music, etc.), and much more.

When you embark on your career, you likely will have to interface with information systems to post transactions and search for or record information. Accomplishing these tasks will require you to work effectively with computers, regardless of the industry in which you find yourself employed.

STEP 2: Activity (Here is what you do.)

Visit the websites of three local businesses: a bank, a dentist, and a retail shop. Examine their information to see if you can determine what types of information systems they use to support their operations. It is likely that you will find some similarities and differences among the three. Also, see if they have any open positions. If they do, what technical skills do these positions require? Summarize your findings in a paragraph or two.

STEP 3: Deliverable (Here is what you turn in.)

Based on your research, identify five reasons why it is important for you to be an informed user of information technology. Reference your summarized findings to support your reasoning. Submit this list to your instructor, but also keep it in mind. You have just looked into the real world (your local world, in fact) and identified a reason for taking this course!

Apply the Concept 1.2

LEARNING OBJECTIVE 1.2

Describe the various types of computer-based information systems in an organization.

STEP 1: Background

Section 1.2 discussed the various functional areas in which you most likely will be employed and the different IS that support them. It should be no surprise that these are the majors from which you can choose in most colleges of business. The four major functional areas are marketing and sales, finance and accounting, manufacturing, and human resources. Often, these areas will use the same database and networks within a company, but they will use them to support their specific needs. This activity will help you develop a solid understanding of the role of IS within the different functional areas.

STEP 2: Activity

Review the section material that describes the key functions of the four major functional areas. Then, review the basic functions of the following types of information systems: transaction processing, functional area information systems, and decision support.

After you have acquired a solid understanding of the functional areas and information systems that support them, you are ready to move forward with the activity!

STEP 3: Deliverable

Create a table like the one shown below, and classify the activities supported by various types of computer-based information systems. To assist you, we have prefilled one item in each type of system. After you complete your chart, submit it to your professor.

	Transaction Processing	Management Information System	Decision Support System
Marketing and Sales	Enter Sales Data		
Accounting and Finance			
Human Resources			Comply with Employment Equity Laws
Manufacturing		Inventory Reporting	

Apply the Concept 1.3

LEARNING OBJECTIVE 1.3

Discuss ways in which information technology can affect managers and non-managerial workers.

STEP 1: Background

Section 1.3 demonstrated that the essential reason why businesses use information systems is to add value to their daily activities. In fact, IS have radically transformed the nature of both managerial and nonmanagerial work. Managers employ IT to instantly track information that

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

used to be available only in monthly reports. Support staff can view calendars and schedules for all employees and can schedule meetings more easily. Sales representatives can view current product information while visiting with clients. This list does not even scratch the surface of the countless ways technology has added value to modern businesses.

STEP 2: Activity

Consider the restaurant industry. You have probably visited some “old-school” restaurants where your order is written down on a piece of paper and never entered into a computer system for preparation. You have most likely also been to a very modern restaurant where you enter your own order with a tablet, smartphone, or other piece of technology. Visit the link associated with this activity and learn about the Ziosk system and how it affects restaurants.

STEP 3: Deliverable

Imagine you are a restaurant manager considering whether or not to adopt the Ziosk system. Write a report for your boss outlining the system’s benefits and how it could help your restaurant stay competitive.

Apply the Concept 1.4

LEARNING OBJECTIVE 1.4

Identify positive and negative societal effects of the increased use of information technology.

This activity requires visiting one or more external URLs. URL links are available within Wiley’s online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 1: Background

As you have just read, the increased use of IS has had a significant impact on society. Section 1.4 focused on three areas—quality-of-life improvements, robotics, and health care—to spark your interest in the ways our lives are being touched. Unfortunately, the technologies that provide quality-of-life improvements can also create economic and political problems. For example, robots that help streamline production also eliminate jobs. Similarly, health care improvements raise concerns regarding shared data and privacy violations.

STEP 2: Activity

Visit the link associated with this activity and learn about the ways robots are expanding opportunities by providing safer, cleaner, more cost-effective ways for people around the globe to work.

STEP 3: Deliverable

Write a summary of the impact of Universal Robots. Select one project mentioned in the video and detail its benefits and future potential.

Apply the Concept 2.1

LEARNING OBJECTIVE 2.1

Discuss ways in which information systems enable cross-functional business processes and business processes for a single functional area.

STEP 1: Background

This chapter defines a business process as an ongoing collection of related activities that create a product or a service of value to the organization, its business partners, and/or its customers. Normally, we do not see everything that goes into a process; rather, we observe only its results. For example, when you shop at a grocery store, you see stocked shelves. However, the inventory-management processes that operate to keep the shelves stocked—as well as the information systems that support those processes—remain essentially invisible.

STEP 2: Activity

Visit the link provided for this activity and watch the video that demonstrates how ZOHO Inventory supports data flow across several business processes.

STEP 3: Deliverable

Based on the video from Step 2, write a brief description of how the ZOHO Inventory system enables multi-channel selling. Submit your description to your instructor.

Apply the Concept 2.2

LEARNING OBJECTIVE 2.2

Differentiate between business process reengineering, business process improvement, and business process management.

STEP 1: Background

One of the most difficult decisions related to business processes is whether they need to be reengineered or simply managed. Reengineering business processes is a “clean-slate” approach in which you build completely new processes to accomplish current tasks. In contrast, managing these processes involves making current processes more efficient. Put simply, reengineering is radical, whereas management is incremental.

STEP 2: Activity

Consider the many processes involved in getting you (as a student) accepted, enrolled, registered, housed, fed, and, ultimately, educated. Do you recall the processes you went through to accomplish these tasks? Did any of these processes strike you as inefficient?

STEP 3: Deliverable

Imagine that you are a student representative on a committee whose task is to consider reengineering or modifying (managing) these business processes. Prepare a written statement for the committee that will compare and contrast BPR and BPM to determine the advantages and disadvantages of each strategy. Make a recommendation as to which one your university should follow, and present your recommendation to your instructor.

Apply the Concept 2.3

LEARNING OBJECTIVE 2.3

Identify effective IT responses to different kinds of business pressures.

STEP 1: Background

Businesses face immense pressures today from every angle imaginable. The market is constantly shifting, technology becomes obsolete almost as quickly as it is implemented, society expects businesses to take more responsibility for the communities their work impacts, and legal compliance is required. Businesses increasingly employ cutting-edge technologies to navigate these difficult waters.

STEP 2: Activity

Pick one business pressure from each of the three broad categories presented in the chapter: Market, Technology, and Societal/Political/Legal. Now search for a real-world business story related to each of the pressures you have chosen.

STEP 3: Deliverable

After you have selected your three examples, identify an effective IT response to each one. Feel free to use the responses listed in the chapter. For each example, explain why you feel this is an appropriate response to the business pressure you have identified.

Perhaps there is a response outlined in the story you found. If so, determine whether the response was truly effective in dealing with the business pressure. Your submission should follow the outline below:

Broad Category: _____
 Business Pressure: _____
 IT Response: _____
 Description: _____
 Assessment of IT Response: _____

Apply the Concept 2.4

LEARNING OBJECTIVE 2.4

Describe the strategies that organizations typically adopt to counter Porter's five competitive forces.

STEP 1: Background

This section has exposed you to Porter's five forces model, which explains how various forces can affect an organization. The threat of entry of new competitors, suppliers' bargaining power, customers' bargaining power, threat of substitute products or services, and rivalry among existing firms in the industry all have an impact on the organization's success. Based on this model, the chapter presents five strategies for competitive advantage: cost leadership, differentiation, innovation, operational effectiveness, and customer orientation.

Walmart is a worldwide company that focuses on a cost-leadership strategy. Review the ways Walmart uses the five forces (or controls them) to maintain its position as a global cost leader. Although it may be somewhat easy to perform this exercise with a global giant like Walmart, it is very difficult to apply these concepts to small businesses.

STEP 2: Activity

Visit your favourite restaurant and ask to speak to the manager. Asking only a few questions, evaluate whether the manager has a grasp of the five forces model. Do not ask anything specifically about Porter. Rather, inquire about rivals, substitutes, customers' bargaining power, suppliers' power, and so on. A good manager should be familiar with these concepts regardless of whether they use the term *Porter's five forces*. Finally, ask the manager what strategy they use. Then, try to classify that strategy as a cost leadership, differentiation, innovation, operational effectiveness, or customer orientation strategy.

STEP 3: Deliverable

Identify which of the five forces are at work based on the manager's feedback. Then, describe the strategies that *could* help deal with these particular forces, and explain *if* this is what the restaurant is currently attempting to do. If it is not, then explain what it should do differently. Your submission will have two parts: (1) a definition of the forces and (2) a description of the strategies at play in response to those forces.

Apply the Concept 3.1

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 3.1

Define ethics, and explain its three fundamental tenets, and the four categories of ethical issues related to information technology.

STEP 1: Background

As you begin your career, you need to be aware of the current trends affecting the four areas of concern presented in Section 3.1. Privacy (What do people know about you?), property (Who owns the data about you?), accuracy (Are the data about you accurate?), and accessibility (Who can access your data?) are major topics in today's high-tech world. They are especially important in the migration to electronic health records, mobile wallets, social media, and government-run databases, to name a few.

STEP 2: Activity

Visit the link associated with this activity and read the article from *Toronto Life* that was posted in May 2021 about Sanjay Madan's complex fraud. Madan convinced two subordinates to assist in his fraud. Read about the two controls that were circumvented, ostensibly to make it "easier" to process small education grants in Ontario. The fraud raises the difficult question of what to do when a superior asks you to violate controls or work outside your normal job description.

STEP 3: Deliverable

Summarize the article for your professor. In your summary, make certain to define ethics and to describe how the violation of one or more of the three fundamental tenets of ethics (responsibility, liability, and accountability) played a role in making the fraud possible. Finally

(not from the article), discuss how your university could deal with the three areas of ethical concern with regard to your financial information.

Apply the Concept 3.2

LEARNING OBJECTIVE 3.2

Discuss at least one potential threat to the privacy of the data stored in each of three places that store personal data.

STEP 1: Background

Section 3.2 defines privacy as the right to be left alone and free of unreasonable personal intrusions. Information privacy is the right to determine when and to what extent information about you can be gathered and/or communicated to others. And, where our data are concerned, we are in control, right? If so, why do people always fear that “Big Brother” is spying on us and violating our privacy? The law generally assigns a higher priority to society’s right to access information than an individual’s right to privacy.

STEP 2: Activity

Visit the link associated with this activity and watch the video in which author Amy Gajda discusses her recent book about privacy and the public’s right to know. As you watch, consider whether privacy is more objective (clear-cut and easy to understand) or subjective (dependent on situations, persons, ethics, or other factors).

STEP 3: Deliverable

Considering the dynamics presented in the chapter and the video, now imagine that your boss has tasked you with researching a customer list to see what you can find out about them on Facebook. It feels a little creepy because their information was not shared on Facebook for what your boss is asking you to use it for. It feels like an invasion of their privacy. Is it? Prepare a response for your boss that addresses whether you will or will not comply with this task.

This activity requires visiting one or more external URLs. URL links are available within Wiley’s online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

Apply the Concept 4.1

LEARNING OBJECTIVE 4.1

Identify the five factors that contribute to the increasing vulnerability of information resources and provide specific examples of each factor.

STEP 1: Background

Section 4.1 has taught you about the importance of information security, particularly when you are conducting business over the Web. It is important to note that a chain is only as strong as its weakest link. Therefore, although you may have been careful to maintain security across your network, if your business partners have not done so as well, then as your information passes over their networks, it will be at risk.

STEP 2: Activity

Visit VeriSign's website. As you read this page, keep in mind that VeriSign is in the business of protecting websites and Web users, which is something we all appreciate. In fact, it is likely that you feel some level of comfort when you see the VeriSign symbol on an e-commerce site.

STEP 3: Deliverable

Compose a brief memo from VeriSign to a potential client. Identify the five factors that contribute to the increasing vulnerability of information resources and provide examples of how VeriSign can help protect the client's digital assets against these threats. Submit your memo to your instructor.

Apply the Concept 4.2

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 4.2

Compare and contrast human mistakes and social engineering and provide a specific example of each one.

STEP 1: Background

Sensitive information is generally stored in a safe location, both physically and digitally. However, as you have just read, this information is often vulnerable to unintentional threats that result from careless mistakes. As one example, employees frequently use USB (flash) drives to take information home. Although these actions are perfectly legal, the USB drive makes it easy to lose the information or to copy it onto unauthorized machines. In fact, any device that stores information can become a threat to information security—backup drives, CDs, DVDs, and even printers! Printers? Because people can “copy” information? Not quite. Continue the activity to find out more.

STEP 2: Activity

Visit the link associated with this activity. You will find an article about how the hard drive in a computer or printer could be improperly disposed of. The hard drive in a printer sometimes stores images of all the documents that have been copied. In the past, when these printers were discarded, their hard drives were not erased, leaving medical records, police reports, and other private information vulnerable.

STEP 3: Deliverable

Compare and contrast human mistakes and social engineering using the example above. How might someone make a mistake with a printer? How might someone use social engineering to access or create copies of personal information? Put your thoughts into a report and submit it to your instructor.

Apply the Concept 4.3

LEARNING OBJECTIVE 4.3

Discuss the 10 types of deliberate attacks.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 1: Background

Unfortunately, there are many people who take advantage of others. Fraud, espionage, information extortion, identity theft, cyberterrorism, spamming, phishing, and many other deliberate acts have created a world where we must always confirm the identity of the people with whom we share information.

STEP 2: Activity

Visit the link associated with this activity and review at least three of the videos that provide information on how to spot a scam. What do you notice that is similar across the scams?

STEP 3: Deliverable

Prepare a table that includes a title and description of each recommendation on how to spot a scam. Add a statement under your table that discusses the similar methods for spotting a scam.

Apply the Concept 4.4

LEARNING OBJECTIVE 4.4

Describe the three risk mitigation strategies and provide an example of each one in the context of owning a home.

STEP 1: Background

Section 4.4 discussed at length how businesses deal with risk. Risk management is so important that companies frequently assign an entire department to oversee risk analysis and mitigation. When companies address risk, they have three basic methods from which to choose: risk acceptance, risk limitation, and risk transference. Significantly, we do the same thing when it comes to our personal assets.

Like businesses, homeowners face intentional and unintentional threats. To mitigate against these threats, almost all homeowners take certain actions. These actions reflect, among other things, where your home is located. For example, a home on the beach in Prince Edward Island is much more susceptible to floods than a home on a hill in Ontario. However, the home on a hill is (perhaps) more susceptible to tornadoes than the home on the beach.

STEP 2: Activity

Imagine that you own your home. What risks do you need to manage? What property do you need to assess? What is the probability that any asset will be compromised? (*Note:* You will need to assess the risk to each asset.) What are the costs associated with each asset being compromised?

STEP 3: Deliverable

In a document, define the three risk management strategies and provide an example of each one in the context of owning a home. Submit your document to your instructor.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

Apply the Concept 4.5

LEARNING OBJECTIVE 4.5

Identify the three major types of controls that organizations can use to protect their information resources and provide an example of each one.

STEP 1: Background

Security controls are designed to protect all components of an information system, including data, software, hardware, and networks. Because there are so many diverse threats, organizations utilize layers of controls. One security feature discussed in this chapter is firewalls. However, if someone gives their password away to a “phisher,” then the firewall is circumvented.

STEP 2: Activity

Visit the link associated with this activity. The link will take you to the Canadian Anti-Fraud Centre's (CAFC) website, where there is a video about phishing and examples of real phishing emails, including one that was impersonating the CAFC. Review the sample emails to see if you can understand why they would be phishing emails rather than an authentic email.

STEP 3: Deliverable

Identify three major types of controls that organizations could use to prevent or detect employees falling victim to scammers. For each control, explain how it could prevent or detect such phishing attempts. Prepare a document with the three types of controls and examples from the movie and submit it to your instructor.

Apply the Concept 4.6

LEARNING OBJECTIVE 4.6

Explain why it is critical that you protect your information assets, and identify actions that you could take to do so.

STEP 1: Background

After someone has been hacked (i.e., their passwords stolen and their information or bank accounts accessed), the perpetrators could sell the information or use it to steal funds. This can be done by transferring money from bank accounts or making purchases with stolen credit or debit cards. Using someone else's credit cards is a form of identity theft.

STEP 2: Activity

Visit the link associated with this activity, which is the Canada Revenue Agency's (CRA) page on how to protect yourself from identity theft. There is a list of things to do if you are the victim of identity theft.

STEP 3: Deliverable

Assume that someone you know responded to a phishing email by telephoning the number listed in the email. This resulted in unauthorized transactions being made on their credit card (purchases of Bitcoin and payments to unpleasant websites). Prepare a report on what the victim should do to cancel the credit card transactions, prevent further such transactions, and reclaim use of their credit card and financial system.

Apply the Concept 5.1

LEARNING OBJECTIVE 5.1

Discuss ways that common challenges in managing data can be addressed using data governance.

STEP 1: Background

Data governance is of key importance today. Many companies compile data from multiple data sets for the purpose of adding value to the business through data analytics and business intelligence. However, the source of the data is critical.

STEP 2: Activity

Visit <https://enterprisetalk.com/featured/data-governance/> and read this short article about the use of AI and how data governance plays a key role in the reliability of the suggestions AI provides to users.

STEP 3: Deliverable

Write a short summary that describes at least three ways data governance can help create more effective use of AI.

Apply the Concept 5.2

LEARNING OBJECTIVE 5.2

Discuss the advantages and disadvantages of relational databases.

STEP 1: Background

This section has introduced you to the advantages and disadvantages of using a relational database. This is one of those concepts that cannot really be appreciated until you work through the process of designing a database. Even though very few people go on to become database administrators, it is still valuable to have some understanding of how a database is built and administered. In this activity, you will be presented with a scenario, and you will then apply the concepts you have just read about. In the process, you will develop a solid foundation to discuss the advantages and disadvantages of relational databases.

STEP 2: Activity

You are employed as the coordinator of multiple ongoing projects within a company. Your responsibilities include keeping track of the company's commercial projects, its employees, and the employees' participation in each project. Usually, a project will have multiple team members, but some projects have not been assigned to any team members. For each project, the company must keep track of the project's title, description, location, estimated budget, and due date.

Each employee can be assigned to one or more projects. Some employees may also be on leave and therefore will not be working on any assignments. Project leaders usually need to know the following information about their team members: name, address, phone number, Social Insurance Number, highest degree attained, and expertise (e.g., IS, accounting, marketing, finance).

Your manager has instructed you to present an overview of the advantages and disadvantages of a database that would support the company's efforts to manage the data described in this scenario. At a minimum, you should define the tables and the relationships among the key variables to provide structure to the information that would be included in the database.

STEP 3: Deliverable

Using the relational database design you created in Step 2, prepare a discussion of the advantages and disadvantages of this database. How will it benefit the company? What additional challenges might it create?

Submit your design and your discussion to your instructor.

Apply the Concept 5.3

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 5.3

Define *Big Data* and its basic characteristics.

STEP 1: Background

This section describes Big Data as an ongoing phenomenon that is giving businesses access to vast amounts of information. The key "ingredients" that make the Big Data phenomenon a reality are volume, velocity, and variety.

STEP 2: Activity

Precision medicine is a relatively new approach to health care that aims to provide custom recommendations to patients dealing with chronic disease. Many doctors specialize through years of study and experience, but precision medicine attempts to offer this level of specialization by analyzing data—BIG Data. Visit the link associated with this activity and read about the impact of Big Data on precision medicine.

STEP 3: Deliverable

Write a summary describing how volume, velocity, and variety affect precision medicine and what you think the future holds.

Apply the Concept 5.4

LEARNING OBJECTIVE 5.4

Explain the elements necessary to successfully implement and maintain data warehouses.

STEP 1: Background

A set of general ingredients is required for organizations to effectively utilize the power of data marts and data warehouses. Figure 5.4 presents this information. Health care as an industry has not been centralized for many business, legal, and ethical reasons. However, the overall health implications of a centralized data warehouse are unimaginable.

STEP 2: Activity

Visit the link associated with this activity and read the article in *HealthTech* magazine from July 11, 2018, titled “Fitbit Pushes into the Clinical Space to Make Medicine More Personal.” As you read the article, think about how Fitbit and Google are using data warehouses. (The term *warehouse* is not used, but the concept is applicable.)

STEP 3: Deliverable

To demonstrate that you recognize the environmental factors necessary to implement and maintain a data warehouse, imagine that the date is exactly five years in the future. Write a blog post titled “Data from Gadgets Like Fitbit Changed How Medical Data Was Used.” In your article, imagine that all of the ingredients necessary in the environment have come together. Discuss what the environment was like in 2018 and how things have changed today with devices like the Apple Watch and Fitbit.

Be aware that there is no right or wrong answer to this exercise. The objective is for you to recognize the necessary environment for a successful data warehouse implementation. The health care–related example simply provides a platform to accomplish this task.

This activity requires visiting one or more external URLs. URL links are available within Wiley’s online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

Apply the Concept 5.5

LEARNING OBJECTIVE 5.5

Describe the benefits and challenges of implementing knowledge management systems in organizations.

STEP 1: Background

As you have learned in this text, data are captured, stored, analyzed, and shared to create knowledge within organizations. This knowledge is exposed in meetings when colleagues are interpreting the information they received from the latest report, in employee presentations, in emails among coworkers, and in numerous other scenarios. The problem many organizations face is that massive amounts of knowledge are created and shared, but this information is not stored in a centralized, searchable format.

This activity requires visiting one or more external URLs. URL links are available within Wiley’s online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 2: Activity

Visit the links associated with this activity. They will take you to two YouTube videos: *Discover What You Know* by user Ken Porter and *Lee Bryant—Knowledge Management* by user UsNow-Film. Both videos illustrate the importance of capturing knowledge within an organization so it can be shared with the right person at the right time to support effective decision making.

STEP 3: Deliverable

Write a short paragraph or two to discuss the benefits and challenges faced by companies when they attempt to implement a knowledge management system. How many of these elements are technical and how many are social? Also, discuss the ways that companies can use technologies to help capture and share knowledge.

Submit this essay to your instructor.

Apply the Concept 5.6

LEARNING OBJECTIVE 5.6

Understand the processes of querying a relational database, entity-relationship modelling, and normalization and joins.

STEP 1: Background

It is very important that you understand the connections among entities, attributes, and relationships. This section has defined each of these terms for you. Typically, entities are described by their attributes, and they are related to other entities. For example, if “student name” is the entity, then age, gender, country of origin, marital status, and other demographic data are the attributes (characteristics) of that particular student. That student is also related to other entities such as financial information, major, and course information.

STEP 2: Activity

An entity-relationship model is one of the most challenging aspects of designing a database because you have to (1) understand the rules that govern how processes work and (2) be able to define and describe these rules in a picture. This section has provided you with the necessary tools to draw a basic ER model.

Imagine the following scenario. You are designing a database for your local police department to keep track of traffic violations. The department has provided you with the following rules:

- Each officer can write multiple tickets.
- Each ticket will list only one officer.
- Each ticket will list only one driver.
- Drivers can receive multiple tickets.

STEP 3: Deliverable

Using the tools described in this section, demonstrate that you understand the process of ER modelling by drawing and submitting an ER model for the scenario provided in Step 2.

Apply the Concept 6.1

LEARNING OBJECTIVE 6.1

Compare and contrast the major types of networks.

STEP 1: Background

Section 6.1 has introduced you to the different types of networks that connect businesses around the world. These networking capabilities enable modern organizations to operate over many geographic locations. Frequently, a company's headquarters is located in one city with various branches in other countries. In addition, employees often work from home rather than commute to a physical office. The computer network is the technology that allows all of this to happen. For a network to function, a few components are required. In this activity, you will place these components in the appropriate places to create a computer network.

STEP 2: Activity

Consider a company called CND TechWizards, with the following potential network components:

1. **Headquarters:** CND TechWizards manufactures, sells, and services computer equipment. The company's headquarters, located in Calgary, house several key functions, including marketing, accounting, HR, and manufacturing. Each office has a number of PCs that connect to the main server. All offices share data and printers.
2. **Customer service:** The company has technicians who service equipment sold within Canada. Each technician has a laptop that must connect to the database at headquarters about three hours each day to check inventory, enter repairs, and place orders. Technicians are constantly on the road and they need to be able to check inventory whether they are in a hotel or at a customer site. In addition, the technicians must log on each evening to check for updates and post their daily activities.
3. **Employees from home:** CND TechWizards has a number of employees who work from home part-time on flex time. These employees must have a fast, secure connection because some of them are dealing with financial data stored in the main computer and its databases at headquarters. They all live within 20 km of their workplace.

STEP 3: Deliverable

Use the description of CND TechWizards presented above to compare and contrast the types of networks discussed in this section. Explain how these networks will or will not meet the needs of each situation. A table may be useful to present this information, but it is not required. Create a Word document with your description and explanations and submit it to your instructor.

Apply the Concept 6.2

LEARNING OBJECTIVE 6.2

Describe wireline communications media and transmission technologies.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 1: Background

Section 6.2 covers network channels, protocols, and other network fundamentals. These computer networks enable businesses to receive and share information with customers, suppliers, and employees. Made up of several possible cable types and protocols, they are quite literally the backbone of modern businesses.

STEP 2: Activity

Imagine that you work in the billing department of a mid-sized hospital. Recently, your supervisor stated that team effectiveness had not declined at all due to COVID-19 and that they had decided to repurpose the billing department office space. You would now begin to work from home permanently and would be reimbursed for setting up your home office and for your home internet connection. The only requirement is that you finalize the same number of bills each day from home as you did in the office. You can schedule your own time as long as your work gets done.

Visit the links associated with this activity to watch a few videos about telecommuting.

STEP 3: Deliverable

Describe the wireline communication media and the transmission technologies (protocols) that you will need to be able to telecommute. Your description should (at a minimum) include the home internet connection, use of the Web, and connections within the office. It should also describe the protocols that operate to support these connections. Submit your description to your instructor.

Apply the Concept 6.3

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 6.3

Describe the most common methods for accessing the internet.

STEP 1: Background

Section 6.3 has explained the difference between the internet and the World Wide Web. Although many people use these terms interchangeably, they are very different. Most computers today are continuously connected to the internet, though they are not always accessing the Web. Offices and other places of employment typically set up an internet connection via a local area network (LAN). However, at home you have several options to consider.

STEP 2: Activity

Visit the links associated with this activity and watch the YouTube videos listed there. These videos go into a little more detail about the types of connections mentioned in Table 6.2. You will learn about advantages, disadvantages, and things to consider for the different methods of connecting to the internet.

STEP 3: Deliverable

Imagine that your parents are “technologically challenged” (some of you may not have to imagine). They have just bought a house at the beach and they are getting ready to set up an internet connection. At home, there is only one provider, so DSL versus cable versus cellular versus satellite is not an issue. However, there are several options at the beach and your parents do not know where to begin.

Compose an email to your parents that describes the most common methods for accessing the internet to help them develop criteria for making their choice.

Apply the Concept 6.4

LEARNING OBJECTIVE 6.4

Explain the impact that discovery network applications have had on business and everyday life.

STEP 1: Background

Section 6.4 has introduced you to the discovery aspect of networks, specifically the Web. Search engines (of all kinds) open up doors of knowledge for anyone with a question. Translation tools allow you to even discover your answer from websites in other languages. These, however, are very broad tools. Portals help by focusing your search within a narrow realm of information. They also push very specific information to you rather than waiting on you to request everything.

STEP 2: Activity

Before there were online search tools, there was the library card catalogue. It was a method of organizing information in a library so that you could easily retrieve the information you needed. Today, research is handled very differently. Access the link associated with this activity to learn about the use of the library card catalogue.

STEP 3: Deliverable

Search the Web for the book *Journey to the Center of the Earth* by Jules Verne. Use multiple search engines (such as google.ca, ca.yahoo.com, or bing.com), some metasearch engines (such as dogpile.com), and your school's library system. Note the amount and type of information you are able to find about the book in just a few minutes. Write a paragraph that compares your experience to the card catalogue system.

Now think even bigger. If discovery applications have made this much impact on something as simple as finding a book (or information on the book), how much bigger is the impact on business and everyday life? Prepare a second paragraph that discusses the latter question.

Submit both paragraphs to your instructor.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

Apply the Concept 6.5

LEARNING OBJECTIVE 6.5

Explain the impact that communication network applications have had on business and everyday life.

STEP 1: Background

Section 6.5 has introduced you to the communication aspect of networks that have radically changed the way humans interact with each other. Most of these methods of communication are even available on our mobile devices now via a cellular connection. Such drastic changes have brought about many struggles and possibilities for businesses.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 2: Activity

The methods that we use to communicate today vary greatly from just 50 years ago. Access the link associated with this activity to watch a YouTube video about how communication has changed. While it only goes up to 1965, you will still recognize the situations and the uses of improved communications.

STEP 3: Deliverable

Consider the various uses of communications in the video (work, personal, military, emergency, etc.). How do our modern technologies such as internet, video, mobile, and text impact what is possible on these types of communication? Create a list of the ways that the technologies discussed in this section have changed the way we communicate on a personal level, at work, in emergencies, and in military situations and give a brief explanation of each. Discuss at least three changes for each area of communication. Submit your answers to your professor.

Apply the Concept 6.6

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 6.6

Explain the impact that collaboration network applications have had on business and everyday life.

STEP 1: Background

As you have seen, collaboration tools impact people inside and outside the organization. Some collaboration tools allow geographically separated employees to work together, while some allow those across the hall to work more effectively. Other tools just allow larger groups to brainstorm and be creative. The big idea here is that synergy is created when people are able to work together via digital tools that overcome time and space.

STEP 2: Activity

Brightidea provides a suite of products that touches on many of the topics in the chapter. Access the link associated with this activity and watch the YouTube video that introduces the company. Then click the second link to visit the Brightidea website. There are several case studies, videos, and product explanations that will help you understand what this product offers.

STEP 3: Deliverable

As you peruse Brightidea's website, look for evidence that the software supports the topics discussed in this section: workflow, virtual collaboration, crowdsourcing, and teleconferencing. Prepare a set of presentation slides (use any tool at your disposal or at your instructor's request) that discusses the impact that collaboration network applications (such as Brightidea's products) have had on businesses. Present your slides to your class and professor.

Apply the Concept 6.7

LEARNING OBJECTIVE 6.7

Explain the impact that educational network applications have had on business and everyday life.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 1: Background

Imagine that you are an expert in math. Someone hands you a piece of chalk and a small chalkboard and gives you a task of creating an educational experience to share your knowledge with other people. You would probably create a traditional classroom. Now imagine that you are not handed chalk, but are given the internet, video capabilities, file sharing, collaboration, tools, and more! Imagine the possibilities!

STEP 2: Activity

Access the link associated with this activity and view the first video, and then visit the website about D2L Brightspace, a learning management system that several schools use as a platform to offer educational activities using the digital tools available today. This platform can be used to offer e-learning experiences, distance learning opportunities, or fully virtual classrooms.

There are many discussions about how these educational network applications impact an individual's everyday life. Single parents are able to go to school using educational network applications. Working professionals are able to pursue graduate degrees online. But what about the impact on businesses?

STEP 3: Deliverable

Many organizations use these tools to facilitate mandatory training or for onboarding new employees. Visit the second link associated with this activity and view the another video about D2L Brightspace's enterprise offerings. Research its site to create and discuss a list of five ways that educational network applications impact businesses.

Apply the Concept 7.1

LEARNING OBJECTIVE 7.1

Describe the eight common types of electronic commerce.

STEP 1: Background

Today, there are many companies that specialize in making e-commerce a reality for small businesses. Amazon, Shopify, Squarespace, PayPal, and other entities offer services that provide everything a small business needs to sell products and accept payment over the internet. In fact, many consumers prefer that their transactions go through these larger global companies because they trust these companies' security.

STEP 2: Activity

Visit PayPal's website (www.paypal.com). Click on the business link at the top of the page. You will find that PayPal offers easy solutions for both businesses and customers.

STEP 3: Deliverable

Create and submit a table that lists and describes the eight common types of e-commerce. Which ones are supported by PayPal and which are not? For the second group, can you explain why they are not supported? Should PayPal move into these areas of e-commerce as well?

Apply the Concept 7.2

LEARNING OBJECTIVE 7.2

Describe the various online services of business-to-consumer (B2C) commerce, along with specific examples of each.

STEP 1: Background

At this point in your “buying” career, you have probably purchased something online, visited an auction site (and possibly won a bid), and engaged in some form of online banking. Your generation is very comfortable with the retail side of e-commerce. While you were engaging in B2C e-commerce, you probably created accounts with a few vendors and received some email advertisements. No doubt you have also received some pop-up ads promoting products during your internet searches. Another aspect of modern business that has changed is that companies now want you to do their advertising for them. The text refers to this development as viral marketing.

STEP 2: Activity

Imagine that you and some friends decide to start a new online thrift store. To become a member, an individual has to donate to the thrift. For every 10 items a person donates, they are awarded a two-month membership. However, you have no IT platform for e-commerce. After some research, you determine that Shopify is your best provider. Shopify is an e-commerce platform that enables individuals and businesses to create online stores.

Visit Shopify’s website. Near the top of the page, you will see a link to “Examples.” Look through the examples to identify ideas you would like to incorporate into your store.

STEP 3: Deliverable

After reviewing the Shopify site, prepare a presentation or a document that describes the various online B2C commerce services provided by Shopify. Provide specific examples of services that attracted your attention and discuss how you would apply these services to your store.

Apply the Concept 7.3

LEARNING OBJECTIVE 7.3

Describe the three business models for business-to-business (B2B) electronic commerce.

STEP 1: Background

Section 7.3 describes forward auctions, reverse auctions, and exchanges. Forward auctions are used when a seller is trying to reach several buyers, and reverse auctions are used when a buyer is soliciting from several sellers. In an exchange, both buyers and sellers come to a central website to quickly and easily establish a B2B relationship. Some of these websites or exchanges are for materials involved in manufacturing a product; others involve materials that help run the business.

This activity requires visiting one or more external URLs. URL links are available within Wiley’s online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 2: Activity

Visit the link associated with this activity. This link will take you to one of the horizontal exchanges (an exchange for many buyers and sellers across industries) listed in the section. As you examine the available products, you should get a better understanding of the breadth of a horizontal exchange.

STEP 3: Deliverable

Describe the three business models for B2B e-commerce by comparing and contrasting them to Globalsources.com. Submit your description to your professor.

Apply the Concept 7.4

LEARNING OBJECTIVE 7.4

Discuss the ethical and legal issues related to electronic commerce along with examples.

STEP 1: Background

eBay is one of the world's largest online retailers. In fact, it is one of a kind in many ways. It competes with Apple, Google, Microsoft, and Walmart, some of the biggest names in the tech and retail universe (online and in-store).

However, for many years there has been controversy surrounding eBay Canada. Specifically, the retailer did not collect sales tax on all online sales. A ruling by the Government of Canada in 2021 has changed that.

STEP 2: Activity

Read the articles associated with this activity. They will give you a better understanding of tax collection by e-commerce marketplaces.

STEP 3: Deliverable

Take a little time to consider this controversy. Then, create a list of arguments for and against Canada Revenue Agency's new requirements. Make certain your argument identifies both the ethical and legal aspects of this issue.

Apply the Concept 8.1

LEARNING OBJECTIVE 8.1

Identify the advantages and disadvantages of wireless devices and each of the three main types of wireless transmission media.

STEP 1: Background

As stated in this section, mobile communication has changed our world more rapidly and dramatically than any other technology. Although several wireless transmission media are available, rarely will one technology meet all of a business's needs by itself. For example, several

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

industrial sites are too large for Wi-Fi but are not conducive to LTE or 5G cellular connections. Rajant (www.rajant.com) mesh networks provide access through mobile nodes or “bread-crumbs” to provide reliable network speeds in a cost-effective manner.

STEP 2: Activity

Visit the link associated with this activity and watch the video where Rajant demonstrates how its technology can overcome the limitations of cellular and Wi-Fi wireless connections.

STEP 3: Deliverable

As you watch the video, pay attention to the industrial illustrations depicted. Write a summary of the usefulness of mesh networks in these environments. Also, come up with and discuss at least one additional environment where a mesh network would be beneficial.

Apply the Concept 8.2

This activity requires visiting one or more external URLs. URL links are available within Wiley’s online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 8.2

Explain how businesses can use short-range, medium-range, and long-range wireless networks.

STEP 1: Background

Many cellular phones today, including both Apple and Android devices, contain multiple radios. These include cellular, Bluetooth, Wi-Fi, infrared, GPS, and NFC chips. With all of these radios embedded in one small mobile device, the possibilities of connectivity are nearly endless because one device can utilize short-range, mid-range, and wide-range connectivity.

STEP 2: Activity

Visit the link associated with this activity and view the video demonstration by Lightspeed. There is also a link to its website, where you will find several examples of wireless products intended for business use. Although most of these products are short-range devices, you must assume they will be connected to some mid-range and/or wide-range wireless networks. In fact, these devices support Windows, Mac, Android, iOS, BlackBerry, and other platforms.

STEP 3: Deliverable

Based on the video and the Lightspeed website (www.lightspeedhq.com), create and submit a table to explain how businesses can use the technologies employed by short-range, medium-range, and long-range networks to achieve their business purposes.

Apply the Concept 8.3

LEARNING OBJECTIVE 8.3

Provide a specific example of how each of the five major m-commerce applications can benefit a business.

STEP 1: Background

Section 8.3 introduced you to five of the most popular mobile commerce applications. These applications are location-based applications, financial services, intrabusiness applications, accessing information, and telemetry. Although you may not have had experience with each of these, it is likely that you have experienced some.

STEP 2: Activity

Read (or reread) the section and consider the following questions related to your personal experiences with mobile commerce: Do you use a mobile wallet? Has using a mobile wallet replaced your traditional wallet? What location-based services do you allow on your mobile device? Do you freely share your location, or are you more private? What types of intrabusiness applications do you utilize as an employee or customer of an organization? What types of information do you access on a regular basis? Do you utilize any telemetry information (such as a wireless connection to your vehicle computer to record information on your mobile phone)?

STEP 3: Deliverable

Based on your answers to the questions in Step 2, build a table that provides a brief discussion of how each of the five major m-commerce applications benefits businesses and describe your personal experiences with each.

Apply the Concept 8.4

LEARNING OBJECTIVE 8.4

Describe the Internet of Things, and provide examples of how organizations can use the Internet of Things.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 1: Background

Section 8.4 has introduced the concept of the Internet of Things (IoT) and provided several examples. There is no doubt that the IoT will continue to grow and shape our lives. Many industries will change from reactive (correcting problems after they happen) to proactive (acting to prevent problems before they happen) based on IoT data.

STEP 2: Activity

Visit the link associated with this activity and watch the YouTube video. It describes examples of personal applications of IoT and professional uses of IoT. After watching the video, let your mind wander into the future to a time when everything is connected via the IoT—not just the devices mentioned in the video (like your car) but also your coffee pot, bed, clothes, closet door, front door, toothbrush, and so much more.

STEP 3: Deliverable

Write a paragraph or two to first describe the IoT, and then provide current examples of how it has impacted your life and is currently making a difference for businesses and industries. Finally, provide a few ideas of how the IoT will shape the future.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

Apply the Concept 9.1

LEARNING OBJECTIVE 9.1

Describe six Web 2.0 tools and two major types of Web 2.0 sites.

STEP 1: Background

This section differentiates Web 1.0, which consists of places to visit, from Web 2.0, where users interact and share information. Whether or not you have thought of these media in these terms, you are familiar with these differences. No doubt you are much more accustomed to Web 2.0, and businesses have begun to integrate information sharing into their public sites.

STEP 2: Activity

Visit the link associated with this activity. This video provides a valuable overview of Web 2.0 technologies. Take notes of the various features that Web 2.0 makes available, and then click on the second link, which will take you to a page that provides a list of the top 10 Canadian companies by market capitalization. Visit the websites of 5 of the top 10 firms and identify the Web 2.0 technologies they employ on their sites.

STEP 3: Deliverable

Create a table that displays the following information about those five top companies:

- The company's name
- The company's rank
- The industry (e.g., retail, consulting services, communications)
- A description of the Web 2.0 technologies/applications that each company uses
- A description of the Web 2.0 tools the company does not use

Submit your table to your professor.

Apply the Concept 9.2

LEARNING OBJECTIVE 9.2

Describe the benefits and risks of social commerce to companies.

STEP 1: Background

Collaborative consumption has been fuelled by social networks because it allows owners to share their goods with those who would rather rent something than own it permanently. Sharing also makes items cheaper to own because the cost of ownership is spread across many users. The sharing economy has changed drastically in recent years as companies like Uber and Airbnb continue to gain in popularity, and social media has driven this rise.

STEP 2: Activity

Visit the link associated with this activity and read the 2017 critique, “Media and the Sharing Economy.” Now think about how you can apply these lessons to bike sharing. Look up a company called Bike Share Toronto.

STEP 3: Deliverable

Many of these companies, including Bike Share Toronto, got their start in big cities. Why do you think they started in such heavily populated areas? What advantages would a collaborative consumption business model have in a heavily populated area? What disadvantages would it face? In what ways might a college campus be a prime location to introduce users to collaborative consumption services? Create a table that compares the advantages and disadvantages of collaborative consumption for the biking industry. Submit your table to your instructor.

Apply the Concept 9.3

LEARNING OBJECTIVE 9.3

Identify the methods used for shopping socially.

STEP 1: Background

Section 9.3 defines shopping socially as taking the key aspects of social networks (e.g., groups, reviews, discussions) and applying them to shopping. This phenomenon is not new. People have shopped socially for years, through general conversation.

Today, most consumers conduct a lot of research before they make a purchase by reading reviews posted by other customers. Recently, however, the validity of these reviews has been questioned. As you learn about social shopping, you should also become aware of the potential fraud that takes place online.

STEP 2: Activity

Visit the links associated with this activity and read the article about how to spot falsified recommendations and ratings. Talk to some of your classmates about this topic and record their feedback. How did they respond to the fact that product ratings may not be legitimate? Ask them the following questions:

- What star rating do you rely on when you are considering a product?
- Do you read reviews or simply notice the number of stars?
- If you read reviews, do you read only the good ones, only the bad ones, or a mixture of both?
- Do you rely on reviews more than a third-party organization such as Consumer Reports?

STEP 3: Deliverable

Considering the material you have read and your conversations with your classmates, identify various methods of shopping socially and discuss the role that trust plays in each method. Prepare a paper or presentation for your professor documenting what you have learned.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

Apply the Concept 9.4

LEARNING OBJECTIVE 9.4

Discuss innovative ways to use social networking sites for advertising and market research.

STEP 1: Background

Section 9.4 presented the major uses of social computing in advertising and market research. Social advertising is simply a way of presenting information to potential customers via a social platform. Social market research makes use of these same social platforms to examine the ongoing communication between the company and its customer community for information that the company can use to improve products or services.

STEP 2: Activity

Access the links associated with this activity. First, read the article called "How Marketers Should Leverage Social Media in Canada." Some of these companies are not specifically related to advertising or market research, but you will still enjoy learning about them. Next, read the article on Hootsuite about "How to Do Social Media Marketing for Small Business."

STEP 3: Deliverable

After reviewing the examples in the articles linked in Step 2, prepare a discussion of the top three innovative ways that these companies are using social networking for advertising and the top three innovative ways that companies are using the information available on social networks as a mechanism for learning about their customers. Submit your discussion to your instructor.

Apply the Concept 9.5

LEARNING OBJECTIVE 9.5

Describe how social computing improves customer service.

STEP 1: Background

Social customer relationship management involves using social networks to maintain customer loyalty. One company that employs this strategy quite skillfully is ZAGG (Zealous About Great Gadgets; www.zagg.com). ZAGG makes and sells accessories for mobile devices such as smartphones and tablets. To help sell its products, the company has developed one of the best social customer relationship management plans around.

When ZAGG develops a new product, it not only posts notes about the product on its social networking page, but it also involves customers in the process. For example, when ZAGG was releasing its ZAGGFolio for the iPad, the company allowed fans to vote on the colours of the new product.

ZAGG is also proficient at monitoring the social network for product-related issues. It is not uncommon for a customer to complain and then receive feedback from a ZAGG employee. Not only does the company retain that individual customer, but it also develops a sense of trust with all of its customers, who are confident they would receive the same treatment.

STEP 2: Activity

Visit ZAGG's website. At the bottom of the page you will find a link to all of the company's social networks. Visit its Facebook page and review its timeline. Search for customer complaints and for how the company deals with them. Did you find a customer representative present on the social networking site? Does the site offer any competitions? Polls? Giveaways? Can you reverse-engineer the company's social customer relationship management methodology?

STEP 3: Deliverable

Imagine that you are a marketing manager, and you have been selected to present a report to the president to describe how social computing improves customer service. Create the outline that you would use to make your points and present it to the class and to your instructor.

Apply the Concept 9.6

LEARNING OBJECTIVE 9.6

Discuss different ways in which human resource managers make use of social computing.

STEP 1: Background

Social human resource management is redefining the ways we search and apply for jobs and make hiring decisions. Going digital was a natural step, but it was also an awkward one. When position announcements went from the bulletin board and local newspaper to Indeed.ca, the number of positions and applicants exploded. We are so connected today that it is impossible to go back. After you graduate, you will no doubt use social networks to find and apply for jobs.

STEP 2: Activity

Visit LinkedIn and create a profile that includes the college or university you currently attend. Connect to your classmates as they also complete this activity. You never know when you will need to call on one of these individuals.

Next, search the Web for "job search websites," and see which ones will allow you to connect with your LinkedIn profile. As you connect with these professional sites, consider the differences between a professional and a personal social network.

STEP 3: Deliverable

In a paper, discuss the various ways in which human resource managers can make use of social computing and how you can best present yourself online. Present your paper to your class and to your instructor.

Apply the Concept 10.1

LEARNING OBJECTIVE 10.1

Explain the purpose of transaction processing systems.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 1: Background

Section 10.1 has explained that transaction processing systems (TPSs) capture data and then automatically transmit those data to the various functional area systems. Most TPSs are designed based on an organization's existing processes. To better understand how a TPS operates, you should consider the flow of data through the student application process.

STEP 2: Activity

Access the link associated with this activity. This link will take you to a Web page that describes the process of creating data flow diagrams (DFDs). The page uses the example of a student application to demonstrate the flow of data through a university. Review this description and identify the transactions that take place throughout the process.

STEP 3: Deliverable

Consider your student application process. Are there any parts of your application that you feel were handled differently than the example described? Prepare a short description of the application process described on the Web page and discuss the potential role and purpose of a TPS for this process.

Apply the Concept 10.2

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 10.2

Explain the types of support that information systems can provide for each functional area of the organization.

STEP 1: Background

Section 10.2 introduced you to the concept of functional area information systems (FAISs). As you can see, every area of business has processes in place that define how data are stored, analyzed, applied, and distributed across the area. For example, inventory management is easy to manage with a computer system because it involves simply keeping track of your materials and products. However, when you integrate inventory management with production and operations management (POM), you have a very effective functional system that supports the internal production line.

STEP 2: Activity

Access the links associated with this activity. You will be directed to two websites that present real-world examples of the information systems discussed in this section. Read over them, and look for any specific material that you can tie back into the concepts covered in the chapter.

STEP 3: Deliverable

Prepare a report that explains the types of support the IS reviewed in Step 2 can provide for each functional area within an organization. Submit your report to your instructor.

Apply the Concept 10.3

LEARNING OBJECTIVE 10.3

Identify advantages and drawbacks to businesses of implementing an enterprise resource planning (ERP) system.

STEP 1: Background

Section 10.3 explained that enterprise resource planning (ERP) works toward removing information silos within an organization by implementing a single system to support all of the functional areas. One example of an ERP system is SAP Business One. SAP is an industry-leading ERP company. In this activity, you will consider the advantages and drawbacks of using an ERP such as SAP.

STEP 2: Activity

Access the link associated with this activity. This link will take you to a YouTube video titled *SAP-Business-One*. As you watch the video, consider how many departments the representative would have to contact to find the information that SAP Business One can present in just a few moments. If this organization operated out of silos, the representative would have to take extensive notes, visit multiple departments, and call the customer back later with the answers.

STEP 3: Deliverable

After considering how complicated it would be for OEC to handle the customer's requests without an ERP, identify the advantages and drawbacks to OEC of using the SAP Business One ERP. Submit your thoughts to your professor.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

Apply the Concept 10.4

LEARNING OBJECTIVE 10.4

Describe the three main business processes supported by ERP systems.

STEP 1: Background

We have discussed reports that you can receive from TPS, FAIS, and ERP systems earlier in this chapter. In particular, these reports truly represent the power of an ERP. Getting the right information to the right person at the right time to make the right decision is the underlying purpose for installing and utilizing an ERP. Recall from earlier in the text that managers need IT decision-support tools because decisions are becoming more complex, there is less time to make decisions, there are more options, and the costs of making incorrect decisions are increasing.

STEP 2: Activity

Access the link associated with this activity. This link will take you to a YouTube video titled *Phoebus ERP—Customized Dashboard*. This video will introduce you to the dashboard tool provided by Phoebus, which individual users can customize to provide the specific information

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

they need. This type of dashboard pulls together the many reports you have learned about in this chapter. As you watch the video, look for examples of the three major types of processes (procurement, fulfillment, and production) that are supported by ERP systems as discussed in this section.

STEP 3: Deliverable

Discuss the three major types of processes and the ways that an ERP can support them. Use what you learned in the dashboard video to discuss the types of information that could be presented in a dashboard to support these processes.

Apply the Concept 11.1

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 11.1

Identify the primary functions of both customer relationship management (CRM) and collaborative CRM strategies.

STEP 1: Background

Section 11.1 introduced the concept of a CRM system, and it suggested that it is better to focus on relationships than on transactions. The idea is that relationships create transactions, so if you grow the relationship, you keep the customers (and the transactions)!

STEP 2: Activity

Access the link associated with this activity. This link will take you to a YouTube video that illustrates how Recreational Equipment Incorporated (REI) uses CRM to service its customers.

STEP 3: Deliverable

In a report, identify the primary functions of both customer relationship management (CRM) and collaborative CRM strategies. What are REI's approaches to CRM? Can you make any suggestions to help it improve? Submit your report to your professor.

Apply the Concept 11.2

LEARNING OBJECTIVE 11.2

Describe how businesses might use applications of each of the two major components of operational CRM systems.

STEP 1: Background

Section 11.2 introduced you to the concept of customer-facing and customer-touching CRM applications, the two major components of operational CRM systems. Many organizations use a combination of both types of systems to establish, develop, and maintain relationships with consumers. This activity will help you to see these systems in action when you do business on a website or in a brick-and-mortar business.

STEP 2: Activity

Visit a physical store where you like to shop (or recall a recent visit and discuss it with some friends), and visit the store's website. Make certain to select a company that has both an internet site and a physical store so you can compare the two channels.

As you walked through the store, did you notice any cues that could tie a customer to a CRM? Did the business have a customer loyalty program? Are there any significant advantages to joining the program? Is the in-store membership tied to anything online? If so, how? Or, does the store seem to have separate in-store and online memberships?

STEP 3: Deliverable

After considering the points mentioned in Step 2, describe how businesses might utilize both the customer-facing and customer-touching applications of a CRM to integrate the online and traditional shopping experiences. Prepare a report and submit it to your instructor.

Apply the Concept 11.3

LEARNING OBJECTIVE 11.3

Explain the advantages and disadvantages of mobile CRM systems, on-demand CRM systems, open-source CRM systems, social CRM systems, and real-time CRM systems.

STEP 1: Background

Section 11.3 has outlined different CRM systems—not operational or analytical, but, instead, the different ways you can actually implement a CRM system. For example, you can run mobile CRM, open-source CRM, on-demand CRM (cloud), and more. You will have most—if not all—of these options with any system you plan to implement!

STEP 2: Activity

Access the links associated with this activity. One link will take you to a YouTube video that describes an on-demand CRM system (Salesforce). Another will take you to a video that highlights an open-source CRM (Sugar CRM). The final link will illustrate a hybrid approach, Sales Cloud (mobile-cloud CRM). Watch these videos, paying special attention to the advantages and disadvantages of each approach. The advantages will be easy to spot (these are promotional videos). The disadvantages of each one will become obvious as you compare the advantages of the others because you may notice particular functions that one system cannot perform but the others can.

STEP 3: Deliverable

Build a table that highlights the advantages and disadvantages of each approach. Do the differences reside in the software's capabilities or in the user experience? Submit your table to your instructor.

Apply the Concept 11.4

LEARNING OBJECTIVE 11.4

Describe the three components and the three flows of a supply chain.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 1: Background

Section 11.4 focused on supply chain flows, materials, and “positions” (upstream, internal, and downstream). It is important to understand how products move in the supply chain because data move along with them every step of the way. In fact, the data that travel with materials and products are more important to the efficiency of the operation than the products themselves!

STEP 2: Activity

Access the link associated with this activity. This link will take you to a YouTube video titled *What Is Supply Chain Management?* As you watch the video, consider the data that would be transferred with each product movement within the bottled water supply chain. Certain types of data, such as inventory updates, shipment information, quality checks, and supplier information, would deal just with the bottled water itself. In addition, there will be HR information, employee data, and machine data from the internal organization as well as from all of the suppliers!

STEP 3: Deliverable

Using the example you learned about in Step 2, describe the three components and the three flows of a water bottle supply chain in a report. Submit your report to your instructor.

Apply the Concept 11.5

This activity requires visiting one or more external URLs. URL links are available within Wiley’s online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 11.5

Identify popular strategies to solve the multiple challenges of supply chains.

STEP 1: Background

Section 11.5 explained that managing a supply chain is not a simple task because consumer demand is so uncertain. Although organizations can forecast demand with some accuracy, actual demand will almost inevitably differ from the organizations’ predictions. To manage demand fluctuations, organizations are moving toward JIT (just-in-time) inventory models. These data must be shared in a timely fashion if organizations are to remain flexible and capable of adapting to consumer demand.

STEP 2: Activity

Access the links associated with this activity. The first link will take you to an article that examines how the bullwhip effect wreaks havoc on the supply chain, and the second will take you to an activity in which you will manage a supply chain for beer. This latter task might not sound difficult until you consider that there are serious timing issues due to the perishable nature of the product. The simulation begins with your supply chain in equilibrium, but then it suddenly shifts. Your job is to put things back in order!

As you work through the simulation, pay attention to how much information needs to be shared across the supply chain to make the entire operation function smoothly.

STEP 3: Deliverable

Based on your experience, discuss how the popular strategies for dealing with supply chain challenges (building inventory, JIT inventory, vendor-managed inventory) would or would not work for this product. Write a report and submit it to your instructor.

Apply the Concept 11.6

LEARNING OBJECTIVE 11.6

Explain the utility of each of the three major technologies that support supply chain management.

STEP 1: Background

Electronic data interchange (EDI) is defined in this section as a communication standard that enables business partners to exchange routine documents, such as purchasing orders, electronically. You should understand the need for electronic sharing of information if you completed the activity in Apply the Concept 11.5. That activity required you to manage a supply chain on your own. Imagine the challenge of performing this function without being able to share data electronically!

STEP 2: Activity

Access the link associated with this activity, which will take you to a YouTube video titled *What is EDI*. You will also link to an article that defines EDI and discusses some of its standards.

As you watch the video, pay attention to the important components that are necessary to share information between two organizations. Then, consider the fact that suppliers rarely operate in only a single supply chain. In fact, suppliers typically have multiple customers, which means they are sharing information with many organizations via EDI.

STEP 3: Deliverable

Based on the content of this section and the video you watched in Step 2, explain the utility of each of the three major technologies (EDI, extranets, and corporate portals) that support supply chain management. In other words, how might these technologies interact to enable the participating parties to exchange data? Put your explanation in a report and submit it to your instructor.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

Apply the Concept 12.1

LEARNING OBJECTIVE 12.1

Use a decision-support framework to demonstrate how technology supports managerial decision making at each phase of the decision-making process.

STEP 1: Background

If you look back through this section, you will see that Henry Mintzberg's 1973 book, *The Nature of Managerial Work*, was referenced when the three basic roles of a manager were presented. This text focuses on the decisional role because that is the one that is most supported by information systems. However, Mintzberg's work goes well beyond the decisional role.

STEP 2: Activity

Access the link associated with this activity. The link will take you to a YouTube video titled *Data-Driven Decision Making*. This video mentions a strategic plan, operational control, and decisional control. As you view the video, make certain to watch for these key points, and pay special attention to how they are supported by data.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 3: Deliverable

Write a short paper (a couple of paragraphs is plenty) for your professor that will identify the phases in the decision-making process for Minnetonka Schools. Be sure to demonstrate how technology supports their decision making in each phase.

Apply the Concept 12.2

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 12.2

Describe each phase of the business analytics process.

STEP 1: Background

In this section, you learned that BA is a concept that encompasses everything from the collection, analysis, and dissemination of data to the technology tools that enable this process to take place. In particular, organizations use BA to support the following:

- Specific departmental needs
- Organizational change

STEP 2: Activity

There are several companies that provide data management and BA tools to help make decisions. Two of these companies are Avitas and Intricity. Access the link associated with this activity to watch a short YouTube video about BA by each of these companies. While you watch, look for examples of how their tools support departments, enterprises, and/or organizational change.

STEP 3: Deliverable

Write a short description of how Avitas and Intricity help users work through the BA process (see Figure 12.3). Try to show how the process is supported, but also be aware that there might be gaps. Make a note of any areas for improvement as well, if you find any.

Apply the Concept 12.3

LEARNING OBJECTIVE 12.3

Provide a definition and a use case example for descriptive analytics.

STEP 1: Background

This section explained that data are more abundant today than ever before. One thing we are learning is that there is much we can know that we do not know. In fact, there are many questions we are not even aware we should be asking! For such questions, we use multidimensional analysis and data-mining tools to extract valuable insights from the data. When we know the questions, we frequently employ decision-support systems to run sensitivity, what-if, or goal-seeking analysis.

STEP 2: Activity

Consider your university. Various departments focus on teaching, student academic support, financial aid, admissions, recruitment, administration, and much more. Each of these departments has its special purpose, but overall the enterprise exists to support student learning.

Visit your university's website, and look for these various functions. What can you learn about their purpose? Based on this knowledge, what can you infer about the types of descriptive BA applications they might use? How do you think these applications can help the university improve various functions (e.g., admission)?

STEP 3: Deliverable

Within the context of higher education, describe the various descriptive analytics tools and provide an example of how each could be used to support your campus. Submit your response to your instructor.

Apply the Concept 12.4

LEARNING OBJECTIVE 12.4

Provide a definition and a use case example for predictive analytics.

STEP 1: Background

According to the text, predictive analytics attempts to detect patterns that can be used to predict, or forecast, future events. While trends change, when you look at them over time, they can show periods of growth and decline. This information is invaluable to managers who are required to make decisions about resource allocation to prepare for the future.

STEP 2: Activity

Imagine that you work for a fast-food restaurant. You have been there for a long time, but the new boss is just figuring things out. Last week, your boss stopped you and asked for some help planning labour for various times of the day and days of the week. Obviously, once the crowd arrives, it is too late to bring in more labour. But the restaurant cannot afford to keep a full staff all of the time. What kind of analytics could help?

STEP 3: Deliverable

Put together a short report for your boss that defines predictive analytics and explains how you intend to use them in the restaurant. Use the example above to give context to the solution. Discuss ways that data from past weeks, months, and years can help inform patterns that can be used to determine labour needs for the future.

Apply the Concept 12.5

LEARNING OBJECTIVE 12.5

Provide a definition and a use case example for prescriptive analytics.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 1: Background

Section 12.5 discusses descriptive, predictive, and prescriptive analytics. Descriptive analytics describe what has happened, predictive analytics predict what might happen, and prescriptive analytics prescribe probabilities to future outcomes based on future activities.

STEP 2: Activity

Access the link associated with this activity. This link will take you to a video that describes prescriptive analytics to help a rock climber determine the best path to the top based on certain decisions. While this is a simple example, it illustrates the need to think past the next choice and to see how this choice will impact the overall probability of reaching the desired outcome.

STEP 3: Deliverable

Based on the video and any of your own Web research, describe and give examples of how a rock climber might use descriptive analytics, predictive analytics, and prescriptive analytics to determine the best path to the goal.

Apply the Concept 12.6

LEARNING OBJECTIVE 12.6

Identify and discuss two examples of presentation tools.

STEP 1: Background

Visual aids have been around for a long time. In fact, most of our communication is through visual aids. Letters represent sounds and from them, we can put together words and meaning. Additionally, today a growing number of messages are sent primarily using emojis! Liking pictures and images on Instagram or similar platform is a regular activity for many people. Sharing data is no different. Graphs and charts have been used for years to help viewers quickly grasp the meaning of data.

STEP 2: Activity

Imagine that you manage a children's clothing store. Each month you make decisions on products, quantities, prices, timing of sales, and much more. What kind of information do you think you would you like to see? Sales by department? Sales over time? Product line comparisons? What else?

STEP 3: Deliverable

Sketch an example of a dashboard that would provide at least six visual aids to understand the data you might want to see as a clothing store manager.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

Apply the Concept 13.1

LEARNING OBJECTIVE 13.1

Discuss the different cost-benefit analyses that companies must consider when they formulate an IT strategic plan.

STEP 1: Background

You may not realize it, but you perform cost–benefit analyses all the time. Imagine that you want to go to the beach for the weekend, but you decide not to because you would have to drive eight hours each way and therefore would not get to spend much time there. In this case, the costs outweigh the benefits. However, if you could extend your stay another day, then the benefits might outweigh the costs. The difficulty in this example is that the benefits are difficult to measure. A cost–benefit analysis is designed to quantify all of the key elements, and sometimes there are subjective benefits for which there are no clear-cut numerical values.

STEP 2: Activity

Access the links associated with this activity. You will watch three short videos that offer a financial explanation for net present value (NPV), return on investment (ROI), and break-even analysis. The business case approach is not a financial approach, and it does not require further explanation.

STEP 3: Deliverable

Imagine you are creating a website to sell promotional items. You have no experience developing a site, so you will have to pay someone to do this for you. You research this service and discover that the site you have in mind will cost \$3,500. (For this example, assume there are no monthly hosting fees.) This design will last five years, after which you will need to update it. You anticipate that you can make \$500 in year 1, \$750 in year 2, \$750 in year 3, \$1,000 in year 4, and \$1,500 in year 5 from the site. Calculate the NPV, ROI, and break-even analysis for this case, and discuss which metric is most helpful. Also, explain how a business case analysis would be helpful beyond what the numbers provide. Prepare a document with your figures and present it to your instructor.

Apply the Concept 13.2

LEARNING OBJECTIVE 13.2

Discuss the four business decisions that companies must make when they acquire new applications.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 1: Background

Section 13.2 discusses the many options available to acquire information systems. One of the more popular methods is software-as-a-service (SaaS). SaaS is popular because it eliminates the need for the company purchasing the software to maintain the hardware on which the software will run. They simply need an internet connection to access the software from the host company.

STEP 2: Activity

Access the links associated with this activity. There are two videos linked there that illustrate SaaS. As you watch these videos, consider the types of hardware that are required on both sides of the relationship. Also, give some thought to the legal nature of the relationship, given that the data will likely reside with the service provider.

STEP 3: Deliverable

Imagine that a company has decided to use an SaaS model to acquire a new piece of software. Prepare a paper discussing the four business decisions it has made in light of this type of acquisition. Submit your paper to your instructor.

Apply the Concept 13.3

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE 13.3

Enumerate the primary tasks and the importance of each of the six processes involved in the systems development life cycle.

STEP 1: Background

The systems development life cycle uses a very systematic approach in which each stage builds on work completed at an earlier stage. It is an excellent model to follow, assuming that the right decisions are made at each stage of the SDLC and are appropriately communicated to the next stage of the SDLC.

STEP 2: Activity

Access the link associated with this activity and watch the video titled *Software Development Life Cycle*. The video conveys a realistic (though perhaps a bit pessimistic) view of how poor communication can severely damage the software development process.

STEP 3: Deliverable

After watching the video, build an outline that specifies the primary tasks and the importance of each of the six processes involved in the SDLC. Make certain to discuss the importance of communication from one step to the next.

Apply the Concept 13.4

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please, ask your instructor to provide the link.

LEARNING OBJECTIVE 13.4

Describe alternative development methods and the tools that augment these methods.

STEP 1: Background

The systems development life cycle is a very thorough method of development. However, it is also very time-consuming and expensive. Section 13.4 discusses several alternative methods. Joint application design, rapid application development, and agile development are used in conjunction with several tools for systems development.

STEP 2: Activity

Access the link associated with this activity. It will take you to a Vimeo about prototyping. Imagine that you are a developer of iPhone apps. At lunch the other day, someone mentioned a very cool idea for a new camera app that would enable users to take pictures simply by opening the app and saying "click" rather than having to push a button.

Describe the idea to a couple of friends to develop a list of user needs and preferences. From this list, make a sketch of the app. Then let the same people review your design and make suggestions. Use the second set of suggestions to create your “final” drawings of the app.

STEP 3: Deliverable

Write a short report documenting the alternative development methods you have used and how the tools discussed in this section might help you to actually develop your app. Be sure to mention how you might use different tools at different stages of development.

Apply the Concept 14.1

LEARNING OBJECTIVE 14.1

Explain the potential value and the potential limitations of artificial intelligence.

STEP 1: Background

This section introduced you to several applications of artificial intelligence. One of these applications was the Google self-driving car. This innovation presents a scenario in which technology could potentially greatly enhance the safety of motorists, pedestrians, and passengers. However, there are also significant risks posed by turning over the keys to the computer.

STEP 2: Activity

Visit YouTube and watch the video titled *Self-Driving Car Test: Steve Mahan* that introduces the Google self-driving car. Although this innovation is very exciting, it can also be very scary! While you are watching the video, imagine the advantages and disadvantages of this type of intelligent system. Would it function best as a “pilot” or a very helpful “copilot”?

STEP 3: Deliverable

Build a table that displays both the potential value (advantages) and the potential limitations (disadvantages) of artificial intelligence for different scenarios illustrated in the example below.

	Advantages	Disadvantages
Tired driver		
Distracted driver (texting)		
Sick/stressed driver		
Ambulance driver		
School bus driver		
Soccer mom, minivan driver		

Apply the Concept 14.2

LEARNING OBJECTIVE 14.2

Differentiate among supervised, semi-supervised, unsupervised, reinforcement, and deep learning.

This activity requires visiting one or more external URLs. URL links are available within Wiley’s online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 1: Background

Throughout much of human history, expertise was transferred from a master to an apprentice through years of training. Only after the apprentice had mastered all of the “tricks of the trade” were they considered ready to perform on their own. We still employ a similar system for doctors, who must participate in a residency program under the guidance of the resident doctor before they can begin their own practice. This approach is not appropriate, however, for many non-life-threatening situations. In some cases, being able to make an expert decision is simply a matter of having access to the experts’ knowledge and experiences. If this knowledge can be captured in a computer-based information system, then it can be distributed for other people to use in similar scenarios. Although this sounds great, there are many challenges to developing this type of system.

STEP 2: Activity

Access the link associated with this activity. This video will show you a short demonstration of an expert cooking system. The video mentions that you are responsible for building and testing an expert system, but that is not part of this activity. As you watch the video, pay particular attention to the miscommunication between the cook and the computer. You will find this interaction to be quite comical.

STEP 3: Deliverable

Based on the video and material in this section, provide examples of the benefits, applications, and limitations of using artificial intelligence in the world of cooking. Create a Word document to submit to your instructor.

Apply the Concept 14.3

LEARNING OBJECTIVE 14.3

Describe the structure of a neural network, and discuss how that structure contributes to the purpose of neural networks in machine learning.

STEP 1: Background

This section describes the structure of a neural network using terms such as nodes, synapses, weights, biases, and functions. This structure parallels the structure of the human brain, allowing computer systems to recognize patterns and create a means for identifying and predicting the future.

STEP 2: Activity

Reread the section examples about convolutional neural networks. Pay special attention to the portion regarding the mistakes the system made. The system appeared to be learning and doing a good job identifying wolves and huskies. But in the end, it was not accurate at all.

STEP 3: Deliverable

Imagine a scenario where artificial intelligence is used to identify potential thieves. The system is given a series of videos, some of which include theft and some of which do not. What kind of potential problems do you anticipate? What limitations could exist in the outcomes? Answer these questions in an email to your instructor.

Apply the Concept 14.4

LEARNING OBJECTIVE 14.4

Provide use case examples of computer vision, natural language processing, robotics, image recognition, and intelligent agents.

STEP 1: Background

This section presented many interesting examples of AI. However, new technologies are being developed each day. As hard as authors try, the time it takes to print a textbook always leaves us a few months behind the latest and greatest examples of technology.

STEP 2: Activity

Use your favourite search engine and look up each of the use cases presented in the text (computer vision, natural language processing, robotics, speech recognition, and intelligent agents) and see what companies are making headlines in these areas.

STEP 3: Deliverable

Build a table like the one below and include the new examples you have discovered.

Technology	Company	Product/Progress
Computer Vision		
Natural Language Processing		
Robotics		
Speech Recognition		
Intelligent Agents		

Apply the Concept 14.5

LEARNING OBJECTIVE 14.5

Provide use case examples of artificial intelligence applications in accounting, finance, marketing, production and operations management, human resource management, and management information systems.

STEP 1: Background

This section presented many interesting examples of the functional use of artificial intelligence. However, as is stated in Apply the Concept from Section 14.4, new technologies are being developed each day. As hard as authors try, the time it takes to print a textbook always leaves us a few months behind the latest and greatest examples.

STEP 2: Activity

Use your favourite search engine and look up each of the use cases presented in the text (accounting, finance, marketing, production and operations management, human resource management, and management information systems) and see what companies are making headlines in these areas.

STEP 3: Deliverable

Build a table like the one below and include the new examples you have discovered.

Technology	Company	Product/Progress
Accounting		
Finance		
Marketing		
Production and Operations Management		
Human Resource Management		
Management Information Systems		

Apply the Concept Technology Guide 1.1

LEARNING OBJECTIVE TG 1.1

Identify the major hardware components of a computer system.

STEP 1: Background

At a basic level, a computer is a computer, just like an automobile is an automobile. The purpose of the automobile drives its size, design, build, price, and much more. Similarly, the purpose of a computer dictates its build requirements, storage capability, and price.

STEP 2: Activity

Imagine a colleague has been asked to create high-quality training videos for internal purposes. The project will take six months to complete and she has been given a \$1,500 budget to purchase any needed equipment. After searching, she finds out that a 4K webcam will cost \$150 and a high-quality USB microphone will cost \$125. This leaves \$1,225 for a new computer. Think of which features will be most important for your colleague’s uses and how they will function in conjunction with the webcam and microphone.

STEP 3: Deliverable

Review the definitions of central processing and primary and secondary storage that are detailed in this tech guide. Then visit Dell’s website and customize a computer that would meet your friend’s needs and stay within the budget. Write a memo to your professor describing your selection with a justification for the choices.

Apply the Concept Technology Guide 1.2

LEARNING OBJECTIVE TG 1.2

Discuss strategic issues that link hardware design to business strategy.

STEP 1: Background

In the modern business environment, computer hardware components are inextricably linked to business strategy. Put simply, computers are tools that allow businesses to automate some transactions and make others more efficient. As technology evolves, businesses need to change the ways they use that technology to execute their business strategies. The generally accepted rule is that technology should *not* drive business strategy, but business strategy *must* consider how the organization can implement new types of hardware to achieve its goals.

STEP 2: Activity

This Technology Guide presented augmented reality as an emerging solution to helping customers visualize what a product would look like in their space, or on them.

Visit the link associated with this activity and read about the current and potential applications of augmented reality.

STEP 3: Deliverable

After considering the examples in the article and the Technology Guide, prepare a table that lists five applications of augmented reality that you anticipate will become part of your life. Describe how you would use them for each example.

Apply the Concept Technology Guide 1.3

LEARNING OBJECTIVE TG 1.3

Describe the various types of computers in the computer hierarchy.

STEP 1: Background

All computers require processing power and storage capability. But as you move along the computer hierarchy, that processing and storage can sometimes be distributed to another location. We refer to this as fat and thin clients.

STEP 2: Activity

You are an inventory manager for a local tire shop. You have well over 2,000 SKUs (stock keeping units) that you are responsible for. Inventory management has been managed on paper by keeping up with invoices for items in stock and receipts of items sold. Monthly reconciliation has been sufficient, but now upper management is seeking daily clarity on inventory and there is a need for an up-to-date system.

STEP 3: Deliverable

Search the Web for inventory management software and review the type of computer that is used in the specific inventory management system. It is likely that it will have some type of server, desktop PC, and mobile devices. Prepare a list of those and describe each one relative to the computer hierarchy.

Apply the Concept Technology Guide 1.4

LEARNING OBJECTIVE TG 1.4

Differentiate the various types of input and output technologies and their uses.

STEP 1: Background

Computers in and of themselves are not very useful to us. They are usually boxes that make some noise and create some heat. However, it is our ability to interact with their power that makes them invaluable to us. Input and output technologies allow us to engage with the processing power of the computer and all the “knowledge” of the internet to be able to make decisions.

STEP 2: Activity

Traditional input and output technologies have relied heavily on keyboards, mice, and flat displays. However, this is changing rapidly. New technologies are allowing for more virtual interaction, which is changing what is possible with computers.

STEP 3: Deliverable

Search the Web for virtual and augmented reality. As you read about them, consider the different forms of input and output technologies. Prepare a table that describes these innovative tools for interacting with a computer.

Apply the Concept Technology Guide 1.5

LEARNING OBJECTIVE TG 1.5

Describe the design and functioning of the central processing unit.

STEP 1: Background

The **central processing unit** performs the actual computation or “number crunching” inside any computer. The CPU is a **microprocessor**. A microprocessor or central processing unit has different parts, which perform different functions.

STEP 2: Activity

The control unit sequentially accesses program instructions, decodes them, and controls the flow of data to and from the arithmetic logic unit, the registers, the caches, primary

storage, secondary storage, and various output devices. The arithmetic logic unit (ALU) performs the mathematical calculations and makes logical comparisons. However, not all CPUs are the same or perform the same way.

STEP 3: Deliverable

Search the Web for two different types of CPU manufacturers and review one example of a CPU for desktop computers and one for mobile devices. Prepare a table annotating the similarities and differences in terms of parts and performance and give it to your instructor.

Apply the Concept Technology Guide 2.1

LEARNING OBJECTIVE TG 2.1

Discuss the major software issues that confront modern organizations.

STEP 1: Background

Today's organizations deal with many decisions when it comes to technology. Will it meet our needs? Will it be flexible enough to meet our needs in the future? Will there be support for problems? Will it be user-friendly? Can we afford it? Will the licensing change in the future? Is there some technology that will make this useless in the next three to five years? These are just a few of the questions that will be considered when looking at software.

STEP 2: Activity

Imagine that you are meeting with your boss about a new software package for the human resources department of your organization. A focus group has created a list of user requirements for the new system to be functional and supportive, and your boss is meeting with them next week.

STEP 3: Deliverable

Help prepare a list of questions that the boss should discuss concerning the software from an administrative perspective. Remember, the group has focused on what they "want and need," not necessarily what is best for the organization (or what is feasible).

Apply the Concept Technology Guide 2.2

LEARNING OBJECTIVE TG 2.2

Describe the general functions of the operating system.

STEP 1: Background

There are a lot of computing terms that are commonly used in the wrong way. For example, most of the time when people say they have a "PC," they are referring to a computer that runs

some version of the Microsoft Windows OS. This was even used in the Mac versus PC commercials that Apple ran a few years ago. In reality, though, a PC is just a personal computer and could run any operating system.

STEP 2: Activity

Operating systems are a necessary part of the computer. Without them, the computer will not function. Imagine that you are helping your friend pick out a computer. He just wants to pick out the colour, shape, and size of the computer, but you are trying to help him understand the differences in computers.

STEP 3: Deliverable

One major difference is the type of operating system. Write a paragraph that describes what an operating system does and why it is important to be careful about your selection.

Apply the Concept Technology Guide 2.3

LEARNING OBJECTIVE TG 2.3

Differentiate between the major types of application software.

STEP 1: Background

There are two types of software (systems and application), two general ways of obtaining software licences (proprietary versus open-source), and two general types of uses (traditional versus mobile). You should be sufficiently familiar with software to be able to categorize programs that you use.

STEP 2: Activity

Visit the link associated with this activity. At this website, you should immediately notice one of the categories mentioned above. At the time of this writing, the site automatically recognized the type of computer operating system on the user's computer. For example, this author is writing on a Mac, and the system recognized the Mac OS and defaulted to the Mac software page. Review the available software and differentiate between the operating systems and the applications. Within applications, differentiate by method of obtaining a licence—some you have to pay for, and some are available by open-source or freeware licensing.

STEP 3: Deliverable

Build a table that differentiates between the two major types of software. To complete this task, list 10 applications you reviewed on the website mentioned in Step 2. Use the template provided below. Turn your completed table in to your instructor.

Application	Operating System	Licensing

Apply the Concept Technology Guide 3.1

LEARNING OBJECTIVE TG 3.1

Describe the problems that modern information technology departments face.

STEP 1: Background

This section discussed the evolution of computer infrastructure over time. Early computing models were called “terminal to host.” Today we have “cloud,” or “distributed computing,” models available. A knowledge of how infrastructure models have changed can help you understand the challenges confronting modern IT departments.

STEP 2: Activity

Review the evolution of IT infrastructure as presented in this section. It is likely that all businesses today have some form of a local area network (LAN) in the client/server model of computing. Beginning with that stage, consider the problems that modern IT departments face as their systems evolve.

Imagine that your boss has asked your advice on moving from traditional LAN computing, in which each department operates a separate network, toward enterprise or cloud computing. What type of challenges could you help your boss anticipate?

STEP 3: Deliverable

Write a letter to your boss (your instructor) that describes the problems that modern IT departments must address as they evolve toward enterprise and cloud computing.

Apply the Concept Technology Guide 3.2

LEARNING OBJECTIVE TG 3.2

Describe the key characteristics and advantages of cloud computing.

STEP 1: Background

One of the more popular virtual servers is a virtual Web server offered by Web hosting companies. Historically, someone would simply purchase and share space on a server that would host their files. However, many people today need dedicated servers that guarantee performance for their consumers.

STEP 2: Activity

Access the link associated with this activity. This link will take you to a case study on one of Canada’s top banks, Bank of Montreal (BMO), which migrated from in-house data centres to a virtual private cloud data centre. As you review the site, focus carefully on the advantages and concerns mentioned in the case study.

This activity requires visiting one or more external URLs. URL links are available within Wiley’s online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 3: Deliverable

In a Word document, describe the key characteristics and advantages of cloud computing for BMO. Submit your document to your instructor.

Apply the Concept Technology Guide 3.3

LEARNING OBJECTIVE TG 3.3

Describe each of the four types of clouds.

STEP 1: Background

This section describes four types of clouds: public, private, hybrid, and vertical. The common feature among all four types is that resources are hosted remotely and made available to a wide range of devices over high-speed internet connections. All four types display the basic features of the cloud that were presented in earlier sections. However, the applications of these features differ for each type.

STEP 2: Activity

Visit the link associated with this activity and read over the 15 examples of hybrid clouds. Look for commonalities in why they are used.

STEP 3: Deliverable

Select three of the examples from the link above and write a summary on how these three applications of hybrid cloud use are similar.

Apply the Concept Technology Guide 3.4

LEARNING OBJECTIVE TG 3.4

Explain the operational model of each of the three types of cloud services.

STEP 1: Background

Infrastructure-as-a-service, platform-as-a-service, and software-as-a-service are relatively new processing models made available by the rise in dependable, high-speed internet access and powerful “host-computer” processing capabilities. The three cloud models are differentiated by how users employ them and which services providers offer with each one.

STEP 2: Activity

Review the material in this section. For each operational model, consider who owns the infrastructure, the operating systems, and the applications.

STEP 3: Deliverable

In a Word document, explain the operational model for each of the three types of cloud services by highlighting the differences in who is responsible for the infrastructure, the operating systems, and the applications for each model. Submit your document to your instructor.

Apply the Concept Technology Guide 3.5

LEARNING OBJECTIVE TG 3.5

Identify the key benefits of cloud computing.

STEP 1: Background

This section has outlined the benefits that are driving many organizations to transition to cloud computing. Productivity, cost reductions, collaboration, more robust data mining, flexibility, and scope expansion are just the beginning. Cloud computing is a powerful tool that is changing the ways we do business.

STEP 2: Activity

Visit the Amazon Web Services (AWS) site (www.aws.amazon.com) and learn about the variety of cloud computing services Amazon provides. This site contains videos of several customer testimonials. As you watch them, look for common benefits the various customers receive from cloud computing.

STEP 3: Deliverable

Based on the videos and the material in this section, identify the key benefits of cloud computing that Amazon offers its business customers. Detail these benefits in a memo to your boss (instructor).

Apply the Concept Technology Guide 3.6

LEARNING OBJECTIVE TG 3.6

Discuss the concerns and risks associated with cloud computing.

STEP 1: Background

This section discussed why the risks associated with cloud computing outweigh the benefits for some organizations. The statistics provided early on showing that cloud computing will remain a small portion of IT spending reflect concerns regarding these risks.

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

STEP 2: Activity

Access the link associated with this activity. This link will take you to an article that addresses some of the risks of cloud computing that senior managers need to consider. As you read the article, try to organize the managers' thoughts according to the concerns presented in this section: legacy systems, costs, reliability, security, privacy, and regulatory and legal environment. Imagine you have just overheard a conversation about how wonderful cloud computing is that mentioned all of the positives and none of the negatives. How would you respond?

STEP 3: Deliverable

Based on the material contained in this section and the information conveyed in the article, write a response to the above scenario that discusses the concerns and risks associated with cloud computing.

Apply the Concept Technology Guide 3.7

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE TG 3.7

Describe the pros and cons for each of the Big Three cloud computing vendors.

STEP 1: Background

The "Big Three" public IaaS and PaaS cloud vendors are Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform. All the Big Three cloud vendors offer largely similar services.

STEP 2: Activity

Imagine you work for a bank, and you want to contract with a cloud computing service to manage your customer data. Visit the link associated with this activity. It will take you to a video that compares the Big Three cloud vendors.

STEP 3: Deliverable

Review the available information and consider how it would help you manage your bank's customer data.

Apply the Concept Technology Guide 3.8

This activity requires visiting one or more external URLs. URL links are available within Wiley's online course resources. If you do not have access to these course resources, please ask your instructor to provide the link.

LEARNING OBJECTIVE TG 3.8

Explain the role of Web services in building a firm's IT applications, providing examples.

STEP 1: Background

Web services allow companies to increase functionality with minimal effort by using standard protocols to access and share data. The advantage of using Web services is that they standardize the Web platform. Using the same Web protocols that allow you to access any website makes sharing data much easier.

STEP 2: Activity

Imagine you work for a bank and you want to display some financial data on your intranet to keep your employees up to date on major market trends. One option is to gather data, perform an analysis, build and share charts and graphs, and then keep everything current. This probably sounds like a lot of work. But, suppose someone else had done all of the work for you?

Access the link associated with this activity. This link will take you to a website that discusses the available “widgets” (another name for an embeddable Web service) that businesses can select to display on their sites. Review the available information and consider how it would help you add content to your bank’s intranet with minimal effort.

STEP 3: Deliverable

Write a summary that explains the role of Web services in building a firm’s IT applications. Include a few examples based on the options you viewed in Step 2.

A

Access controls Controls that restrict unauthorized individuals from using information resources and are concerned with user identification.

Accountability A tenet of ethics that refers to the act of accepting responsibility for your actions.

Ad hoc (on-demand) reports Nonroutine reports that often contain special information that is not included in routine reports.

Adware Alien software designed to help pop-up advertisements appear on your screen.

Affinity portal A website that offers a single point of entry to an entire community of affiliated interests.

Agile development A software development methodology that delivers functionality in rapid iterations, measured in weeks, requiring frequent communication, development, testing, and delivery.

Algorithm A problem-solving method expressed as a finite sequence of steps.

Alien software Clandestine software that is installed on your computer through duplicitous methods.

Analytical CRM system CRM system that analyzes customer behaviour and perceptions in order to provide actionable business intelligence.

Anti-malware systems (antivirus software) Software packages that attempt to identify and eliminate viruses, worms, and other malicious software.

Application (or app) A computer program designed to support a specific task or business process.

Application controls Security countermeasures that protect specific applications in functional areas.

Application portfolio The set of recommended applications resulting from the planning and justification process in application development.

Application service provider (ASP) An agent or vendor who assembles the software needed by enterprises and packages it with outsourced development, operations, maintenance, and other services.

Application software The class of computer instructions that directs a computer system to perform specific processing activities and provide functionality for users.

Arithmetic logic unit (ALU) Portion of the CPU that performs the mathematical calculations and makes logical comparisons.

Artificial intelligence (AI) A subfield of computer science concerned with studying the thought processes of humans and recreating the effects of those processes with machines such as computers.

Attribute Each characteristic or quality of a particular entity.

Auction A competitive process in which either a seller solicits consecutive bids from buyers or a buyer solicits bids from sellers, and prices are determined dynamically by competitive bidding.

Augmented analytics A type of analytics platform that integrates artificial intelligence (AI) and machine learning (ML) into the traditional analytics process to automate the selection and preparation of data, the generation of insights, and the communication of those insights.

Augmented reality (AR) A live, direct or indirect, view of a physical, real-world environment whose elements are enhanced by computer-generated sensory input such as sound, video, graphics, or GPS data.

Authentication A process that determines the identity of the person requiring access.

Authorization A process that determines which actions, rights, or privileges the person has, based on verified identity.

B

Backbone networks High-speed central networks to which multiple smaller networks (e.g., LANs and smaller WANs) connect.

Backpropagation A method of supervised learning to update the model's parameters to make its predictions more accurate.

Bandwidth A network's transmission capacity, stated in bits per second.

Batch processing Transaction processing system (TPS) that processes data in batches at fixed periodic intervals.

Big Data A collection of data so large and complex that it is difficult to manage using traditional database management systems.

Binary form The form in which data and instructions can be read by the CPU—only 0s and 1s.

Biometrics The science and technology of authentication (i.e., establishing the identity of an individual) by measuring the subject's physiological or behavioural characteristics.

Bit Short for *binary digit* (0s and 1s), the only data that a CPU can process.

Blacklisting A process in which a company identifies certain types of software that are not allowed to run in the company environment.

Blog (weblog) A personal website, open to the public, in which the site creator expresses their feelings or opinions in a series of chronological entries.

Blogosphere The term for the millions of blogs on the Web.

Bluetooth Chip technology that enables short-range connection (data and voice) between wireless devices.

Botnet A network of computers that have been compromised by, and are under the control of, a hacker, who is called the botmaster.

Bots A computer that has been compromised by, and is under the control of, a hacker.

Brick-and-mortar organizations Organizations in which the product, the process, and the delivery agent are all physical.

Broadband Transmission capacity of a communications medium that is faster than 25 Mbps.

Broadcast media (also called wireless media) Communications channels that use electromagnetic media (the "airwaves") to transmit data.

Browsers Software applications through which users primarily access the Web.

Bullwhip effect Erratic shifts in orders up and down the supply chain.

Business analytics (BA) The process of developing actionable decisions or recommendations for actions based on insights generated from historical data.

Business analytics (BA) systems See **business intelligence systems**.

Business continuity planning The chain of events linking planning to protection and to recovery.

Business environment The combination of social, legal, economic, physical, and political factors in which businesses conduct their operations.

Business intelligence (BI) A broad category of applications, technologies, and processes for gathering, storing, accessing, and analyzing data to help business users make more informed decisions.

Business intelligence (BI) systems Systems that provide computer-based support for complex, nonroutine decisions, primarily for middle managers and knowledge workers.

Business model The method by which a company generates revenue to sustain itself.

Business process A collection of related activities that create a product or a service of value to the organization, its business partners, and its customers.

Business process management (BPM) A management technique that includes methods and tools to support the design, analysis, implementation, management, and optimization of business processes.

Business process reengineering (BPR) A radical redesign of a business process that improves its efficiency and effectiveness, often by beginning with a “clean sheet” (i.e., from scratch).

Business rules Precise descriptions of policies, procedures, or principles in any organization that stores and uses data to generate information.

Business-information technology alignment The tight integration of the IT function with the strategy, mission, and goals of the organization.

Buy-side marketplace B2B model in which organizations buy needed products or services from other organizations electronically, often through a reverse auction.

Byte An eight-bit string of data, needed to represent any one alphanumeric character or simple mathematical operation.

C

Cable media (also called wireline media) Communications channels that use physical wires or cables to transmit data and information.

Cache memory A type of high-speed memory that enables the computer to temporarily store blocks of data that are used more often and that a processor can access more rapidly than main memory (RAM).

Cellular telephones (cell phones) Phones that provide two-way radio communications over a cellular network of base stations with seamless hand-offs.

Central processing unit (CPU) Hardware that performs the actual computation or “number crunching” inside any computer.

Certificate authority A third party that acts as a trusted intermediary between computers (and companies) by issuing digital certificates and verifying the worth and integrity of the certificates.

Channel conflict The alienation of existing distributors when a company decides to sell to customers directly online.

Chatbot A computer program that uses artificial intelligence and natural language processing to simulate human conversation, either by voice or text communication.

Clicks-and-mortar organizations Organizations that do business in both the physical and digital dimensions.

Client/server computing Form of distributed processing in which some machines (servers) perform computing functions for end-user PCs (clients).

Clients Computers, such as users’ personal computers, that use any of the services provided by servers.

Cloud computing A technology in which tasks are performed by computers that are physically removed from the user and accessed over a network, in particular the internet.

Coaxial cable Insulated copper wire; used to carry high-speed data traffic and television signals.

Code of ethics A collection of principles intended to guide decision making by members of an organization.

Collaboration Mutual efforts by two or more individuals who perform activities to accomplish certain tasks.

Collaborative consumption An economic model based on sharing, swapping, trading, or renting products and services, enabling access over ownership.

Collaborative CRM system A CRM system in which communications between the organization and its customers are integrated across all aspects of marketing, sales, and customer support processes.

Commercial (public) portal A website that offers fairly routine content for diverse audiences. It offers customization only at the user interface.

Communications channel Pathway for communicating data from one location to another.

Communications controls (also network controls) Controls that deal with the movement of data across networks.

Comparative reports Reports that compare the performances of different business units or times.

Competitive advantage An advantage over competitors in some measure such as cost, quality, or speed; leads to control of a market and to larger-than-average profits.

Competitive forces model A business framework devised by Michael Porter that analyzes competitiveness by recognizing five major forces that could endanger a company’s position.

Component-based development A software development methodology that uses standard components to build applications.

Computer network A system that connects computers and other devices through communications media so that data and information can be transmitted among them.

Computer programs The sequences of instructions for the computer, which comprise software.

Computer vision The ability of information systems to identify objects, scenes, and activities in images.

Computer-aided software engineering (CASE) Development approach that uses specialized tools to automate many of the tasks in the SDLC.

Computer-based information system

(CBIS) An information system that uses computer technology to perform some or all of its intended tasks.

Computer-integrated manufacturing (CIM) An information system that integrates various automated factory systems; also called *digital manufacturing*.

Containers A method of developing applications that run independently of the server’s base operating system.

Continuous application development The process of steadily adding new computer code to a software project as the new computer code is written and tested.

Control environment Controls that encompass management attitudes toward controls, as evidenced by management actions, as well as by stated policies and procedures that address ethical issues and the quality of supervision.

Control unit Portion of the CPU that controls the flow of information.

Controls Defence mechanisms (also called *countermeasures*). Actions used to safeguard assets, optimize the use of the organization’s resources, and prevent or detect errors or fraud.

Convolutional neural network A type of neural network designed to separate areas of image inputs by extracting features to identify edges, curves, and colour density and then recombine these inputs for classification and prediction.

Cookies Small amounts of information that websites store on your computer, temporarily or more or less permanently.

Copyright A grant from a governmental authority that provides the creator of intellectual property with ownership of it for a specified period of time, currently the life of the creator plus 70 years.

Corporate portal A website that provides a single point of access to critical business information located both inside and outside an organization.

Cross-departmental process A business process that originates in one department and ends in another department or originates and ends in the same department while involving other departments.

Cross-functional processes Processes for which no single functional area is responsible.

Crowdsourcing A process in which an organization outsources a task to an undefined, generally large, group of people in the form of an open call.

Customer identity management A marketing technology intended to complete a 360° view of a customer across an organization.

Customer interaction centre (CIC) A CRM operation in which organizational representatives use multiple communication channels to interact with customers in

functions such as inbound teleservice and outbound telesales.

Customer relationship management (CRM) A customer-focused and customer-driven organizational strategy that concentrates on addressing customers' requirements for products and services, and then providing high-quality, responsive services.

Customer touch point Any interaction between a customer and an organization.

Customer-facing CRM applications Areas in which customers directly interact with the organization, including customer service and support, sales force automation, marketing, and campaign management.

Customer-touching CRM applications Applications and technologies with which customers interact and typically help themselves.

Cybercrime Illegal activities executed on the internet.

Cyberterrorism A premeditated, politically motivated attack against information, computer systems, computer programs, and data that results in violence against noncombatant targets by subnational groups or clandestine agents.

Cyberwarfare War in which a country's information systems could be paralyzed by a massive attack by destructive software.

D

Dashboard A business analytics presentation tool that provides rapid access to timely information and direct access to management reports.

Data dictionary A collection of definitions of data elements; data characteristics that use the data elements; and the individuals, business functions, applications, and reports that use these data elements.

Data file (also table) A collection of logically related records.

Data governance An approach to managing information across an entire organization.

Data items Elementary descriptions of things, events, activities, and transactions that are recorded, classified, and stored but are not organized to convey any specific meaning.

Data lake A central repository that stores all of an organization's data, regardless of their source or format.

Data mart A low-cost, scaled-down version of a data warehouse that is designed for the end-user needs in a strategic business unit (SBU) or a department.

Data mining The process of searching for valuable business information in a large database, data warehouse, or data mart.

Data model A diagram that represents entities in the database and their relationships.

Data silo A collection of data held by one group that is not easily accessible by other groups.

Data warehouse A repository of historical data that are organized by subject to support decision makers in the organization.

Database A collection of related files or tables containing data.

Database management system (DBMS) The software program (or group of programs) that provide access to a database.

Decision A choice that individuals and groups make among two or more alternatives.

Decision-support systems (DSSs) Business intelligence systems that combine models and data in an attempt to solve semi-structured and some unstructured problems with extensive user involvement.

Deep learning A subset of machine learning where artificial neural networks learn from large amounts of data.

Demilitarized zone (DMZ) A separate organizational local area network that is located between an organization's internal network and an external network, usually the internet.

Departmental information system The business strategy that leverages IT to dramatically improve employee, customer, and business partner relationships; support continuous improvement in business operations and business processes; and develop new business models and businesses.

Descriptive analytics A type of business analytics that summarizes what has happened in the past and allows decision makers to learn from past behaviours.

Digital certificate An electronic document attached to a file certifying that the file is from the organization it claims to be from and has not been modified from its original format or content.

Digital divide The gap between those who have access to information and communications technology and those who do not.

Digital dossier An electronic description of an individual and their habits.

Digital transformation The business strategy that leverages IT to dramatically improve employee, customer, and business partner relationships; support continuous improvement in business operations and business processes; and develop new business models and businesses.

Direct conversion Implementation process in which the old system is cut off and the new system is turned on at a certain point in time.

Disintermediation Elimination of intermediaries in electronic commerce.

Distance learning (DL) Learning situations in which teachers and students do not meet face to face.

Distributed processing Network architecture that divides processing work

among two or more computers that are linked together in a network.

Distribution portals Corporate portals that automate the business processes involved in selling or distributing products from a single supplier to multiple buyers.

Documentation Written description of the functions of a software program.

Domain name The name assigned to an internet site, which consists of multiple parts, separated by periods, that are translated from right to left.

Domain name system (DNS) The system administered by the Internet Corporation for Assigned Names (ICANN) that assigns names to each site on the internet.

Drill-down reports Reports that show a greater level of detail than is included in routine reports.

E

E-learning Learning supported by the Web; can take place inside traditional classrooms or in virtual classrooms.

E-procurement Procurement using electronic support.

Electronic business (e-business) A broader concept than electronic commerce, including buying and selling of goods and services, servicing customers, collaborating with business partners, conducting e-learning, and conducting electronic transactions within an organization.

Electronic commerce (e-commerce) systems A type of interorganizational information system that enables organizations to conduct transactions, called business-to-business (B2B) electronic commerce, and customers to conduct transactions with businesses, called business-to-consumer (B2C) electronic commerce.

Electronic commerce (EC or e-commerce) The process of buying, selling, transferring, or exchanging products, services, or information through computer networks, including the internet.

Electronic CRM (e-CRM) Applications and technologies with which customers interact and typically help themselves.

Electronic data interchange (EDI) A communication standard that enables business partners to transfer routine documents electronically.

Electronic mall A collection of individual shops under one internet address; also known as a *cybermall* or an *e-mall*.

Electronic marketplace A virtual market space on the Web where many buyers and many sellers conduct electronic business activities.

Electronic payment mechanisms Computer-based systems that allow customers to pay for goods and services electronically, rather than writing a cheque or using cash.

Electronic retailing (e-tailing) The direct sale of products and services through storefronts or electronic malls, usually designed around an electronic catalogue format and auctions.

Electronic storefront The website of a single company, with its own internet address, at which orders can be placed.

Electronic surveillance Tracking people's activities with the aid of computers.

Employee monitoring systems Systems that monitor employees' computers, email activities, and internet surfing activities.

Encryption The process of converting an original message into a form that cannot be read by anyone except the intended recipient.

End-user development Approach in which the organization's end users develop their own applications with little or no formal assistance from the IT department.

Enterprise application integration (EAI) system A system that integrates existing systems by providing layers of software that connect applications together.

Enterprise network An organization's network, which is composed of multiple interconnected LANs and WANs.

Enterprise resource planning (ERP) systems Information systems that take a business process view of the overall organization to integrate the planning, management, and use of all of an organization's resources, employing a common software platform and database.

Entity Any person, place, thing, or event of interest to a user.

Entity-relationship (ER) diagram Document that shows data entities and attributes and relationships among them.

Entity-relationship (ER) modelling The process of designing a database by organizing data entities to be used and identifying the relationships among them.

Entry barrier Product or service feature that customers expect from organizations in a certain industry; an organization trying to enter this market must provide this product or service at a minimum to be able to compete.

ERP II systems Interorganizational ERP systems that provide Web-enabled links among key business systems (e.g., inventory and production) of a company and its customers, suppliers, distributors, and others.

Ethernet A common local area network protocol.

Ethics The principles of right and wrong that individuals use to make choices to guide their behaviours.

Exception reports Reports that include only information that exceeds certain threshold standards.

Exchanges See **public exchanges**.

Expert systems (ESs) Systems that attempt to duplicate the work of human experts by

applying reasoning capabilities, knowledge, and expertise within a specific domain.

Explicit knowledge The more objective, rational, and technical types of knowledge.

Exposure The harm, loss, or damage that can result if a threat compromises an information resource.

Extensible markup language (XML) A computer language that makes it easier to exchange data among a variety of applications and to validate and interpret these data.

Extranet A network that connects parts of the intranets of different organizations.

F

Fat clients Computers that offer full functionality without having to connect to a network.

Feasibility study Investigation that gauges the probability of success of a proposed project and provides a rough assessment of its feasibility.

Fibre-optic cable A communications medium consisting of thousands of very thin filaments of glass fibres, surrounded by cladding, that transmit information through pulses of light generated by lasers.

Field A characteristic of interest that describes an entity.

File server (also called network server) A computer that contains various software and data files for a local area network as well as the network operating system.

Fintech An industry composed of companies that use technology to compete in the marketplace with traditional financial institutions and intermediaries in the delivery of financial services, which include banking, insurance, real estate, and investing.

Firewall A system (either hardware, software, or a combination of both) that prevents a specific type of information from moving between untrusted networks, such as the internet, and private networks, such as your company's network.

Flash memory devices Nonvolatile electronic storage devices that are compact, are portable, require little power, and contain no moving parts.

Foreign key A field (or group of fields) in one table that uniquely identifies a row (or record) of another table.

Forward auctions Auctions that sellers use as a selling channel to many potential buyers; the highest bidder wins the items.

Front-office processes Those processes that directly interact with customers; that is, sales, marketing, and service.

Functional area information system (FAISs) Systems that provide information to managers (usually mid-level) in the functional areas to better support the managerial tasks of planning, organizing, and controlling operations.

Functional dependency A means of stating that the value of one particular

attribute is associated with, or determines, a specific single value of another attribute.

Functions-as-a-service (XaaS) A category of cloud computing services that provides a platform allowing customers to develop, run, and manage applications' functions without the complexity of building and maintaining the infrastructure typically associated with developing and deploying an app.

G

General controls Controls that apply to more than one functional area.

Generative adversarial network A type of neural network that has two parts: (a) The generator, which learns to generate plausible data, and (b) the discriminator, which learns to distinguish the generator's fake data from real data.

Geographic information system (GIS) A computer-based system for capturing, integrating, manipulating, and displaying data using digitized maps.

Gesture recognition An input method that interprets human gestures, in an attempt for computers to begin to understand human body language.

Global positioning system (GPS) A wireless system that uses satellites to enable users to determine their position anywhere on Earth.

Globalization The integration and interdependence of economic, social, cultural, and ecological facets of life, enabled by rapid advances in information technology.

Graphical user interface (GUI) Systems software that allows users to have direct control of the hardware by manipulating visible objects (such as icons) and actions, which replace command syntax.

Grid computing A technology that applies the unused processing resources of many geographically dispersed computers in a network to form a virtual supercomputer.

Group purchasing The aggregation of purchasing orders from many buyers so that a volume discount can be obtained.

H

Hardware A device such as a processor, monitor, keyboard, or printer. Together, these devices accept, process, and display data and information.

Hotspot A small geographical perimeter within which a wireless access point provides service to a number of users.

HTML5 A page-description language that makes it possible to embed images, audio, and video directly into a document without add-ons. It also makes it easier for Web pages to function across different display devices, including mobile devices as well as desktops. It supports the storage of data offline.

Hybrid clouds Clouds composed of public and private clouds that remain unique entities but are bound together, offering the benefits of multiple deployment models.

Hyperlink A connection from a hypertext file or document to another location or file, typically activated by clicking on a highlighted word or image on the screen or by touching the screen.

Hypertext Text displayed on a computer display with references, called hyperlinks, to other text that the reader can immediately access.

Hypertext markup language (HTML) A page-description language for specifying how text, graphics, video, and sound are placed on a Web page document.

Hypertext Transfer Protocol (HTTP) The communications standard used to transfer pages across the WWW portion of the internet; it defines how messages are formulated and transmitted.

I

Identity theft Crime in which someone uses another person's personal information to create a false identity and then uses it fraudulently.

Implementation The process of converting from an old computer system to a new one.

Industrywide portal A Web-based gateway to information and knowledge for an entire industry.

Information Data that have been organized so that they have meaning and value to the recipient.

Information privacy The right to determine when, and to what extent, personal information can be gathered by or communicated to others.

Information security Protecting an organization's information and information systems from unauthorized access, use, disclosure, disruption, modification, or destruction.

Information system (IS) A system that collects, processes, stores, analyzes, and disseminates information for a specific purpose.

Information systems audit An evaluation and examination of management control systems for information systems, their inputs, outputs, and processing. It can also include an assessment of the efficiency and effectiveness of the system.

Information technology (IT) Any computer-based tool that people use to work with information and support an organization's information and information-processing needs.

Information technology components Hardware, software, databases, and networks.

Information technology infrastructure IT components plus IT services.

Information technology platform The name given to the combination of the IT components of hardware, software, networks (wireline and wireless), and databases.

Information technology services

Activities performed by IT personnel using IT components; specifically, developing information systems, overseeing security and risk, and managing data.

Informed user A person who is knowledgeable about information systems and information technology.

Infrastructure-as-a-service (IaaS)

A model with which cloud computing providers offer remotely accessible servers, networks, and storage capacity.

Instance Each row in a relational table, which is a specific, unique representation of the entity.

Integrated CASE (ICASE) tools CASE tools that provide links between upper CASE and lower CASE tools.

Intellectual capital (or intellectual assets) Other terms for knowledge.

Intellectual property The intangible property created by individuals or corporations, which is protected under trade secret, patent, and copyright laws.

Internet (the Net) A massive global WAN that connects approximately 1 million organizational computer networks in more than 200 countries on all continents.

Internet backbone The primary network connections and telecommunications lines that link the computers and organizational nodes of the internet.

Internet of Things (IoT) A scenario in which objects, animals, and people are provided with unique identifiers and the ability to automatically transfer data over a network without requiring human-to-human or human-to-computer interaction.

Internet Protocol (IP) A set of rules responsible for disassembling, delivering, and reassembling packets over the internet.

Internet Protocol (IP) address An assigned address that uniquely identifies a computer on the internet.

Internet service provider (ISP)

A company that provides internet connections for a fee.

Internet telephony (Voice-over-Internet Protocol, or VoIP) The use of the internet as the transmission medium for telephone calls.

Interorganizational information systems (IOS) An information system that supports information flow among two or more organizations.

Intranet A private network that uses internet software and TCP/IP protocols.

IS operational plan Consists of a clear set of projects that the IS department and the functional area managers will execute in support of the IT strategic plan.

IT steering committee A committee composed of a group of managers and staff representing various organizational units

that is set up to establish IT priorities and to ensure that the MIS function is meeting the enterprise's needs.

IT strategic plan A set of long-range goals that describe the IT infrastructure and major IT initiatives needed to achieve the organization's goals.

J

Join operation A database operation that combines records from two or more tables in a database.

Joint application design (JAD) A group-based tool for collecting user requirements and creating system designs.

Just-in-time (JIT) An inventory system in which a supplier delivers the precise number of parts to be assembled into a finished product at precisely the right time.

K

Key indicator reports Reports that summarize the performance of critical activities.

Knowledge Data and/or information that have been organized and processed to convey understanding, experience, accumulated learning, and expertise as they apply to a current problem or activity.

Knowledge management (KM)

A process that helps organizations identify, select, organize, disseminate, transfer, and apply information and expertise that are part of the organization's memory and that typically reside within the organization in an unstructured manner.

Knowledge management systems (KMSs) Information technologies used to systematize, enhance, and expedite intra- and interfirm knowledge management.

Knowledge workers Professional employees such as financial and marketing analysts, engineers, lawyers, and accountants, who are experts in a particular subject area and who create information and knowledge, which they integrate into the business.

L

Laptop computers (notebook computers) Small, easily transportable, lightweight microcomputers.

Least privilege A principle that users be granted the privilege for some activity only if there is a justifiable need to grant this authorization.

Liability A legal concept that gives individuals the right to recover the damages done to them by other individuals, organizations, or systems.

Local area network (LAN) A network that connects communications devices in a limited geographic region, such as a building, so that every user device on the network can communicate with every other device.

Location-based commerce (L-commerce) Mobile commerce transactions targeted to

individuals in specific locations, at specific times.

Logical controls Controls that are implemented by software.

Lower CASE tools Tools used to automate later stages in the SDLC (programming, testing, operation, and maintenance).

Loyalty programs Programs that offer rewards to customers to influence future behaviour.

M

Machine learning (ML) An application of artificial intelligence that provides systems with the ability to automatically learn and improve from experience without being explicitly programmed.

Machine learning systems The ability of information systems to accurately perform new, unseen tasks, built on known properties learned from training or historical data that are labelled.

Magnetic disks (or hard drives or fixed disk drives) A form of secondary storage on a magnetized disk divided into tracks and sectors that provide addresses for various pieces of data.

Magnetic tape A secondary storage medium on a large open reel or in a smaller cartridge or cassette.

Mainframes Relatively large computers used in large enterprises for extensive computing applications that are accessed by thousands of users.

Make-to-order The strategy of producing customized products and services.

Malware Malicious software such as viruses and worms.

Management A process by which organizational goals are achieved through the use of resources.

Mashup A website that takes different content from a number of other websites and mixes them together to create a new kind of content.

Mass customization A production process in which items are produced in large quantities but are customized to fit each customer's desires.

Master data A set of core data, such as customer, product, employee, vendor, geographic location, and so on, that spans an enterprise's information systems.

Master data management A process that provides companies with the ability to store, maintain, exchange, and synchronize a consistent, accurate, and timely "single version of the truth" for the company's core master data.

Metasearch engine A computer program that searches several engines at once and integrates the findings of the various search engines to answer queries posted by users.

Microblogging A form of blogging that allows users to write short messages (or

capture an image or embedded video) and publish them.

Microcomputers The smallest and least expensive category of general-purpose computers, also called micros, personal computers, or PCs.

Microprocessor The CPU, made up of millions of transistors embedded in a circuit on a silicon wafer or chip.

Microwave transmission A wireless system that uses microwaves for high-volume, long-distance, point-to-point communication.

Mixed reality (MR) Technology that integrates the virtual and physical world into one experience.

Mobile commerce (or m-commerce)

Electronic commerce transactions that are conducted with a mobile device.

Mobile computing A real-time connection between a mobile device and other computing environments, such as the internet or an intranet.

Mobile CRM system An interactive CRM system in which communications related to sales, marketing, and customer service activities are conducted through a mobile medium for the purpose of building and maintaining customer relationships between an organization and its customers.

Mobile wallet (m-wallet) A technology that allows users to make purchases with a single click from their mobile devices.

Moore's law Prediction by Gordon Moore, an Intel cofounder, that microprocessor complexity would double approximately every two years.

Multichannelling A process in which a company integrates its online and off-line channels.

Multidimensional data analysis See **online analytical processing (OLAP)**.

Multidimensional structure Storage of data in more than two dimensions; a common representation is the data cube.

N

Narrow AI See **weak AI**.

Natural language processing The ability of information systems to work with text the way that humans do.

Near-field communication (NFC) The short-range wireless network with the smallest range; it is designed to be embedded in mobile devices like cellphones and credit cards.

Network A connecting system (wireline or wireless) that enables multiple computers to share resources.

Network access points (NAPs)

Computers that act as exchange points for internet traffic and determine how traffic is routed.

Network controls See **communications controls**.

Network server See **file server**.

Neural network (NN) A set of virtual neurons, placed in layers, which work in parallel in an attempt to simulate the way the human brain works, although in a greatly simplified form.

Node Software unit in a neural network that has one or more weighted connections, a transfer function that combines the inputs in some way, and an output connection.

Normalization A method for analyzing and reducing a relational database to its most streamlined form to ensure minimum redundancy, maximum data integrity, and optimal processing performance.

Notebook computer See **laptop computers**.

O

Object-oriented development A systems development methodology that begins with aspects of the real world that must be modelled to perform a task.

On-demand CRM system A CRM system that is hosted by an external vendor in the vendor's data centre.

On-premise computing A model of IT management in which companies own their IT infrastructure (their software, hardware, networks, and data management) and maintain it in their data centres.

Online analytical processing (OLAP) (or multidimensional data analysis) A set of capabilities for "slicing and dicing" data using dimensions and measures associated with the data.

Online transaction processing (OLTP) Transaction processing system (TPS) that processes data after transactions occur, frequently in real time.

Open systems Computing products that work together by using the same operating system with compatible software on all the computers that interact in an organization.

Open-source CRM system CRM software whose source code is available to developers and users.

Open-source software Software made available in source-code form at no cost to developers.

Operating system (OS) The main system control program, which supervises the computer's overall operations, allocates CPU time and main memory to programs, and provides an interface between the user and the hardware.

Operational CRM systems The component of CRM that supports the front-office business processes that directly interact with customers (i.e., sales, marketing, and service).

Opt-in model A model of informed consent in which a business is prohibited from collecting any personal information unless the customer specifically authorizes it.

Opt-out model A model of informed consent that permits a company to collect personal information until the customer

specifically requests that the data not be collected.

Optical storage devices A form of secondary storage in which a laser reads the surface of a reflective plastic platter.

Order fulfillment process A cross-functional business process that originates when the company receives a customer order and concludes when it receives a payment from the customer.

Organizational social responsibility (also individual social responsibility) Efforts by organizations to solve various social problems.

Outsourcing Use of outside contractors or external organizations to acquire IT applications or services.

P

Package Common term for an integrated group of computer programs developed by a vendor and available for purchase in prepackaged form.

Packet switching The transmission technology that divides blocks of text into packets.

Parallel conversion Implementation process in which the old and new systems operate simultaneously for a time.

Passphrase A series of characters that is longer than a password but is still easy to memorize.

Password A private combination of characters that only the user should know.

Patent A document that grants the holder exclusive rights to an invention or process for a specified period of time, currently 20 years.

Peer-to-peer (P2P) processing A type of client/server distributed processing that allows two or more computers to pool their resources, making each computer both a client and a server.

Personal application software General-purpose, off-the-shelf application programs that support general types of processing, rather than being linked to any specific business function.

Personal area network A computer network used for communication among computer devices close to one person.

Phased conversion Implementation process that introduces components of the new system in stages, until the entire new system is operational.

Physical controls Controls that restrict unauthorized individuals from gaining access to a company's computer facilities.

Pilot conversion Implementation process that introduces the new system in one part of the organization on a trial basis. When the new system is working properly, it is introduced in other parts of the organization.

Piracy Copying a software program (other than firmware, demo software, etc.) without making payment to the owner.

Platform-as-a-service (PaaS) A model in which customers rent servers, operating systems, storage, a database, software development technologies such as Java and .NET, and network capacity over the internet.

Portal A Web-based personalized gateway to information and knowledge that provides information from disparate information systems and the internet, using advanced searching and indexing techniques.

Predictive analytics A type of business analytics that examines recent and historical data to detect patterns and predict future outcomes and trends.

Prescriptive analytics A type of business analytics that recommends one or more courses of action and shows the likely outcome of each decision.

Primary activities Those business activities related to the production and distribution of the firm's products and services, thus creating value.

Primary key A field (or attribute) of a record that uniquely identifies that record so that it can be retrieved, updated, and sorted.

Primary storage (also called main memory) High-speed storage located directly on the motherboard that stores data to be processed by the CPU, instructions telling the CPU how to process the data, and operating system programs.

Privacy The right to be left alone and to be free of unreasonable personal intrusions.

Privacy codes See **privacy policies**.

Privacy policies (or privacy codes) An organization's guidelines for protecting the privacy of customers, clients, and employees.

Private clouds (also known as internal clouds or corporate clouds) IT infrastructures that are accessible only by a single entity or by an exclusive group of related entities that share the same purpose and requirements, such as all the business units within a single organization.

Privilege A collection of related computer system operations that can be performed by users of the system.

Procedures The set of instructions for combining hardware, software, database, and network components in order to process information and generate the desired output.

Procurement portals Corporate portals that automate the business processes involved in purchasing or procuring products between a single buyer and multiple suppliers.

Procurement process A cross-functional business process that originates when a company needs to acquire goods or services from external sources and concludes when the company receives and pays for them.

Production process A cross-functional business process in which a company produces physical goods.

Productivity The ratio between the inputs to a process and the outputs from that process.

Profiling The process of forming a digital dossier.

Programmers IS professionals who modify existing computer programs or write new computer programs to satisfy user requirements.

Programming The translation of a system's design specifications into computer code.

Propagation delay Any delay in communications from signal transmission time through a physical medium.

Proprietary software Software that has been developed by a company and has restrictions on its use, copying, and modification.

Protocol The set of rules and procedures that govern transmission across a network.

Prototype A small-scale working model of an entire system or a model that contains only the components of the new system that are of most interest to the users.

Prototyping An approach that defines an initial list of user requirements, builds a prototype system, and then improves the system in several iterations based on users' feedback.

Public clouds Shared, easily accessible, multicustomer IT infrastructures that are available non-exclusively to any entity in the general public (individuals, groups, and organizations).

Public exchanges (or exchanges) Electronic marketplaces in which there are many sellers and many buyers, and entry is open to all; frequently owned and operated by a third party.

Public-key encryption (also called *asymmetric encryption*) A type of encryption that uses two different keys: a public key and a private key.

Pull model A business model in which the production process begins with a customer order and companies make only what customers want, a process closely aligned with mass customization.

Push model A business model in which the production process begins with a forecast, which predicts the products that customers will want as well as the quantity of each product. The company then produces the amount of products in the forecast, typically by using mass production, and sells, or "pushes," those products to consumers.

Q

Query by example A method to obtain information from a relational database by filling out a grid or template—also known as a form—to construct a sample or a description of the data desired.

R

Radio transmission Uses radio-wave frequencies to send data directly between transmitters and receivers.

Radio-frequency identification (RFID)

technology A wireless technology that allows manufacturers to attach tags with antennas and computer chips on goods and then track their movement through radio signals.

Random access memory (RAM)

The part of primary storage that holds a software program and small amounts of data when they are brought from secondary storage.

Ransomware (or digital extortion)

Malicious software that blocks access to a computer system or encrypts an organization's data until the organization pays a sum of money.

Rapid application development (RAD)

A development method that uses special tools and an iterative approach to rapidly produce a high-quality system.

Read-only memory (ROM)

Type of primary storage in which certain critical instructions are safeguarded; the storage is nonvolatile and retains the instructions when the power to the computer is turned off.

Real-time CRM system

A CRM system enabling organizations to respond to customer product searches, requests, complaints, comments, ratings, reviews, and recommendations in near real time, 24/7/365.

Really Simple Syndication (RSS)

A technology that allows users to receive the information they want, when they want it, without having to surf thousands of websites.

Record

A characteristic of interest that describes an entity.

Recurrent neural network

A type of neural network which uses sequential data or time series data and is used when the network's decision must be based on previous output.

Registers High-speed storage areas in the CPU that store very small amounts of data and instructions for short periods.

Reinforcement learning

A type of machine learning where the system learns to achieve a goal in an uncertain, potentially complex environment.

Relational database model Data model based on the simple concept of tables in order to capitalize on characteristics of rows and columns of data.

Relationships Operators that illustrate an association between two entities.

Responsibility A tenet of ethics in which you are able to recognize and act upon principles based on ethical standards.

Reverse auctions Auctions in which one buyer, usually an organization, seeks to buy a product or a service, and suppliers submit bids; the lowest bidder wins.

Risk The likelihood that a threat will occur.

Risk management A process that identifies, controls, and minimizes the impact of threats, in an effort to reduce risk to manageable levels.

Router A communications processor that routes messages from a LAN to the internet, across several connected LANs, or across a wide area network such as the internet.

Routine reports Reports produced at scheduled intervals.

S

Sales force automation (SFA) The component of an operational CRM system that automatically records all the aspects of a sales transaction process.

Satellite radio (or digital radio)

A wireless system that offers uninterrupted, near CD-quality sound that is beamed to your radio from satellites.

Satellite transmission A wireless transmission system that uses satellites for broadcast communications.

Scope creep Adding functions to an information system after the project has begun.

Search engine A computer program that searches for specific information by keywords and reports the results.

Secondary key A field that has some identifying information, but typically does not uniquely identify a record with complete accuracy.

Secondary storage Technology that can store very large amounts of data for extended periods.

Secure socket layer (SSL) See **transport layer security**.

Security The degree of protection against criminal activity, danger, damage, or loss.

Security-as-a-service (SECaaS) A category of cloud services where an external provider handles and manages cybersecurity for an organization including services like data loss prevention, antivirus management, and intrusion detection among others.

Sell-side marketplace B2B model in which organizations sell to other organizations from their own private e-marketplace or from a third-party site.

Semi-supervised learning A type of machine learning that combines a small amount of labelled data with a large amount of unlabelled data during training.

Server Computers that support networks, enabling users to share files, software, and other network devices.

Server farms Massive data centres, which may contain hundreds of thousands of networked computer servers.

Server virtualization A technology that uses software-based partitions to create multiple virtual servers (called *virtual machines*) on a single physical server.

Servers Computers that provide access to various network services, such as printing, data, and communications.

Service-oriented architecture An IT architecture that makes it possible to

construct business applications using Web services.

Shadow IT Technology implemented by end users without receiving proper approvals from the organizational IT department.

Social advertising Advertising formats that make use of the social context of the user viewing the ad.

Social capital The number of connections a person has within and between social networks.

Social commerce The delivery of electronic commerce activities and transactions through social computing.

Social computing A type of information system that combines social behaviour and information technology to create value.

Social CRM The use of social media technology and services to enable organizations to engage their customers in a collaborative conversation in order to provide mutually beneficial value in a trusted and transparent manner.

Social engineering Getting around security systems by tricking computer users inside a company into revealing sensitive information or gaining unauthorized access privileges.

Social graph A map of all relevant links or connections for one member of a social network.

Social intelligence The monitoring, collection, and analysis of socially generated data and the resultant strategic decisions.

Social marketplaces Websites that act as online intermediaries that harness the power of social networks for introducing, buying, and selling products and services.

Social network A social structure composed of individuals, groups, or organizations linked by values, visions, ideas, financial exchange, friendship, kinship, conflict, or trade.

Social networking Activities performed using social software tools (e.g., blogging) or social networking features (e.g., media sharing).

Social shopping A method of electronic commerce that takes all of the key aspects of social networks (friends, groups, voting, comments, discussions, reviews, etc.) and focuses them on shopping.

Software A program or collection of programs that enable the hardware to process data.

Software suite See **package**.

Software-as-a-service (SaaS) A method of delivering software in which a vendor hosts the applications and provides them as a service to customers over a network, typically the internet.

Solid-state drives (SSDs) Data storage devices that serve the same purpose as a hard drive and store data in memory chips.

Spam Unsolicited email.

Spamming Indiscriminate distribution of email without the recipient's permission.

Spamware Alien software that uses your computer as a launch platform for spammers.

Speech recognition The ability of information systems to automatically and accurately transcribe human speech.

Speech-recognition software Software that recognizes and interprets human speech, either one word at a time (discrete speech) or in a stream (continuous speech).

Spyware Alien software that can record your keystrokes or capture your passwords.

Strategic information systems (SISs) Systems that help an organization gain a competitive advantage by supporting its strategic goals and increasing performance and productivity.

Strong AI Hypothetical artificial intelligence that matches or exceeds human intelligence and could perform any intellectual task that humans can.

Structured data Highly organized data in fixed fields in a data repository such as a relational database that must be defined in terms of field name and type (e.g., alphanumeric, numeric, and currency).

Structured query language The most popular query language for requesting information from a relational database.

Supervised learning A type of machine learning where the system is given labelled input data and the expected output results.

Supply chain The coordinated movement of *resources* from organizations through *conversion* to the end consumer.

Supply chain management (SCM) An activity in which the leadership of an organization provides extensive oversight for the partnerships and processes that compose the supply chain and leverages these relationships to provide an operational advantage.

Supply chain visibility The ability of all organizations in a supply chain to access or view relevant data on purchased materials as these materials move through their suppliers' production processes.

Support activities Business activities that do not add value directly to a firm's product or service under consideration but support the primary activities that do add value.

Systems analysis The examination of the business problem that the organization plans to solve with an information system.

Systems analysts IS professionals who specialize in analyzing and designing information systems.

Systems design Describes how the new system will resolve the business problem.

Systems development life cycle (SDLC) Traditional structured framework, used for large IT projects, that consists of sequential

processes by which information systems are developed.

Systems investigation The initial stage in the traditional SDLC that addresses the business problem (or business opportunity) by means of a feasibility study.

Systems software The class of computer instructions that serve primarily as an intermediary between computer hardware and application programs; provides important self-regulatory functions for computer systems.

Systems stakeholders All people who are affected by changes in information systems.

T

Table A grouping of logically related records.

Tacit knowledge The cumulative store of subjective or experiential learning, which is highly personal and hard to formalize.

Tag A keyword or term that describes a piece of information.

Technical specialists Experts on a certain type of technology, such as databases or telecommunications.

Telecommuting A work arrangement whereby employees work at home, at a customer's premises, in special workplaces, or while travelling, usually using a computer linked to their place of employment.

Teleconferencing The use of electronic communication that allows two or more people at different locations to have a simultaneous conference.

Telemetry The wireless transmission and receipt of data gathered from remote sensors.

Thin client A computer that does not offer the full functionality of a *fat client*.

Threat Any danger to which an information resource may be exposed.

Thumb drive Storage device that fits into the USB port of a personal computer and is used for portable storage.

Trade secret Intellectual work, such as a business plan, that is a company secret and is not based on public information.

Transaction Any business event that generates data worth capturing and storing in a database.

Transaction processing system (TPS) Information system that supports the monitoring, collection, storage, and processing of data from the organization's basic business transactions, each of which generates data.

Transactional data Data generated and captured by operational systems that describe the business's activities, or transactions.

Transmission Control Protocol/Internet Protocol (TCP/IP) A file transfer protocol that can send large information files across sometimes unreliable networks

with the assurance that the data will arrive uncorrupted.

Transport layer security (TLS) An encryption standard used for secure transactions such as credit card purchases and online banking.

Tunnelling A process that encrypts each data packet to be sent and places each encrypted packet inside another packet.

Twisted-pair wire A communications medium consisting of strands of copper wire twisted together in pairs.

U

Ultra-wideband (UWB) A high-bandwidth wireless technology with transmission speeds in excess of 100 Mbps that can be used for applications such as streaming multimedia from, say, a personal computer to a television.

Unified communications Common hardware and software platform that simplifies and integrates all forms of communications—voice, email, instant messaging, location, and videoconferencing—across an organization.

Uniform resource locator (URL) The set of letters that identifies the address of a specific resource on the Web.

Unstructured data Data that do not reside in a traditional relational database.

Unsupervised learning A type of machine learning that looks for previously undetected patterns in a data set with no pre-existing labels and with a minimum of human supervision.

Upper CASE tools Tools that are used to automate the early stages of the SDLC (systems investigation, analysis, and design).

User experience The experience a user or customer has when interacting with an app or website.

Utility computing A technology whereby a service provider makes computing resources and infrastructure management available to a customer as needed.

V

Value chain A sequence of activities through which the organization's inputs, whatever they are, are transformed into more valuable outputs, whatever they are.

Value chain model Model that shows the primary activities that sequentially add value to the profit margin; also shows the support activities.

Value system A stream of activities that includes the producers, suppliers, distributors, and buyers, all of whom have their own value chains.

Vendor-managed inventory (VMI) An inventory strategy where the supplier monitors a vendor's inventory for a product or group of products and replenishes products when needed.

Vertical cloud A set of cloud computing services optimized for use in a particular industry.

Vertical integration Strategy of integrating the upstream part of the supply chain with the internal part, typically by purchasing upstream suppliers, so as to ensure timely availability of supplies.

Videoconference A virtual meeting in which participants in one location can see and hear participants at other locations and can share data and graphics by electronic means.

Virtual (or pure play) organizations Organizations in which the product, the process, and the delivery agent are all digital.

Virtual collaboration The use of digital technologies that enable organizations or individuals to collaboratively plan, design, develop, manage, and research products, services, and innovative information systems and electronic commerce applications.

Virtual group (team) A workgroup whose members are in different locations and meet electronically.

Virtual private network (VPN) A private network that uses a public network (usually the internet) to securely connect users by using encryption.

Virtual reality (VR) A term that describes a realistic, three-dimensional, computer generated environment that replicates sight, touch, hearing, and in some cases, smell.

Virtual universities Online universities in which students take classes on the internet at home or at an offsite location.

Vulnerability The possibility that an information resource will be harmed by a threat.

W

Weak AI (also called narrow AI) Artificial intelligence that performs a useful and specific function that once required human intelligence to perform and does so at human levels or better.

Wearable computer A miniature computer worn by a person allowing the user to multitask.

Web 2.0 Websites that emphasize user-generated content, ease of use, participatory culture, and compatibility with other products, systems, and devices for end users.

Web services Applications delivered over the internet that IT developers can select and combine through almost any device, from personal computers to mobile phones.

Website Collectively, all the Web pages of a particular company or individual.

Whitelisting A process in which a company identifies acceptable software and permits it to run, and either prevents anything else from running or lets new software run in a quarantined environment until the company can verify its validity.

Wide area network (WAN) A network, generally provided by common carriers, that covers a wide geographical area.

Wiki A website on which anyone can post material and make changes to other material.

Wireless Telecommunications in which electromagnetic waves carry the signal between communicating devices.

Wireless access point An antenna connecting a mobile device to a wired local area network.

Wireless Fidelity (Wi-Fi) A set of standards for wireless local area networks based on the IEEE 802.11 standard.

Wireless local area network (WLAN) A computer network in a limited geographical area that uses wireless transmission for communication.

Wireless media See **broadcast media**.

Wireless sensor An autonomous device that monitors its own condition as well as physical and environmental conditions around it, such as temperature, sound, pressure, vibration, and movement.

Wireline media See **cable media**.

Workflow The movement of information as it flows through the sequence of steps that make up an organization's work procedures.

World Wide Web (the Web or WWW) A system of universally accepted standards for storing, retrieving, formatting, and displaying information through a client/server architecture; it uses the transport functions of the internet.

X

X (formerly Twitter) A free microblogging service that allows its users to send messages and read other users' messages and updates.

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