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 nonmanagerial 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

Case 1.1 The Digital Transformation of the Canadian Imperial Bank of Commerce (CIBC)

The Background and the Problem

Canadian Imperial Bank of Commerce (CIBC) is the fifth largest bank by total assets in Canada. CIBC (**www.cibc.com**) was formed on June 1, 1961 as a result of the merger of two chartered Canadian banks: Canadian Bank of Commerce (est. 1867) and the Imperial Bank of Canada (est. 1875). Despite being an old institution, CIBC has a history of embracing technology. For instance, it was the first Canadian bank to introduce a 24-hour cash dispenser in 1969 and the first to offer automated telephone banking in 1992. In addition, CIBC was the first among the five large Canadian banks to introduce an app for mobile banking and to offer eDeposit.

In early 2010, CIBC realized that to be successful in the financial services industry, it needs to up its digital innovation even further. The industry was, and still is, facing numerous threats from startups and established players like Apple and Google that are luring away customers from traditional banks by providing more convenient payment and banking options. Such options are especially appealing to millennials, 71 percent of whom would rather go to the dentist than to hear from their bank and 33 percent believe that in five years they will not need a bank. In fact, 73 percent of millennials are more excited about a financial product from companies like Google Inc. and PayPal Holdings Inc. and a third are open to switching banks in the next 90 days.

Digital Solutions

To address the concerns and to enable nimble responses to the technologically evolving environment, CIBC decided to undergo a digital transformation. So, unlike the common practice in many banks, CIBC did not want to run the digital channel as only one service channel alongside branches, ATMs, and telephone banking. However, maintaining a high level of digital engagement requires continuous innovation. Although such innovation was not new to CIBC, the bank knew that it needed a dedicated effort to succeed in the digital channel.

One project that had a particularly positive impact on CIBC's endeavour to attain digital transformation was *Live Labs*. Located in Toronto's MaRS Discovery District, CIBC Live Labs, an innovation and digital technology centre, strives to build, test, and launch digital

solutions to enhance customers' experience. Some of their most successful solutions released to date are:

- Apple watch banking app: CIBC was the first Canadian bank to launch a mobile banking Apple Watch™ App that enables customers to check their balance and transactions, transfer funds between accounts, locate a CIBC branch or ATM, etc.
- CIBC Hello Home: This is a new iOS app that makes mortgage applications easier and more convenient. The app allows users to apply, negotiate, track, and receive approval of their mortgage from their iPhone.
- Natural language voice search for mobile banking: This is an in-app voice command that allows users of the CIBC mobile banking app to access various features and to explore products with a simple voice prompt. For instance, if a user says "send money," a list of options, such as e-transfers, is presented.

Results

CIBC's efforts did not go unnoticed. In 2016, CIBC earned the highest overall score in the Forrester Research Canadian mobile functionality benchmark. According to the Forrester Research report, CIBC stands out by supporting diverse mobile touch-points and excelling at marketing and sales with features such as pre-approved offers and pre-filled applications in the mobile app. Subsequently, in March 2017, CIBC was recognized as the leader in mobile banking services and experience in Canada by Surviscor. Surviscor is a North American firm specializing in the analysis and ranking of Canadian digital customer experiences provided by service firms.

CIBC also won the prestigious award of IT World Canada Digital Transformation in 2017 mainly as a result of its launch of CIBC Live Labs.

In terms of return on investment (ROI), before embarking on its digital transformation, CIBC's sales from its digital channels made up 2 percent or less of its revenue. This number increased to 12 percent in three years after the bank engaged in digital transformation. The bank also saw a growth in digital transactions to 85 percent of day-to-day banking. In addition, CIBC's sales of digital products and services increased from 250,000 units in 2014 to 1.1 million units in 2017.

Sources: Compiled from "Inside CIBC's Award-Winning Digital Transformation Strategy," CIBC Online Banking, April 17, 2019; The Economist Intelligence Unit, "2019: The Year of Digital Decisions," *The Economist*, 2019; "CIBC Innovation Banking Launches to Serve North American Companies," PRNewswire, January 8, 2018; E. Wood, "CIBC Targets Tech-Savvy Businesses with New Innovation Banking Arm," ITBusiness.ca, January 8, 2018; "Retail Banking Vulnerability Study," cg42, 2018; J. Horn, "CIBC, Then and Now," *Strategy*, September 22, 2017; D. Bradbury, "CIBC Takes Digital Transformation to the Bank," *IT World Canada*, June 14, 2017; "Excellence in Digital Transformation Recognized," ITBusiness.ca, June 14, 2017; E. Wood, "Live Labs Illustrates CIBC's Commitment to Digital Transformation," ITBusiness.ca, May 11, 2017; J. Marous, "Is This the Most Innovative Digital Bank in North America?" *The Financial Brand*, April 7, 2017; "How CIBC Is Winning the Mobile Banking Competition," *Future Digital Finance*, 2017; J. Castaldo, "CIBC CEO Victor Dodig on Banking's Tech Revolution," *Canadian Business*, January 14, 2016; "There's No Slowing Down Millennials-Capitalizing on a Growing and Influential Generation," *First Data*, 2016; C. Pellegrini, "How One of Canada's Oldest Banks Is Acting Like a Young Tech Company: 'We're Becoming Cooler,'" *Financial Post*, August 21, 2015.

Questions

1. Explain why embracing a digital transformation strategy was necessary for CIBC.
2. Can you think of other digital initiatives CIBC might use to increase customer satisfaction and enhance its bottom line?

Introduction

Before we proceed, we need to define information technology and information systems. **Information technology (IT)** refers to any computer-based tool that people use to work with information and to support an organization's information and information-processing needs. An **information system (IS)** collects, processes, stores, analyzes, and disseminates information for a specific purpose.

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. In addition, IT is making our world smaller, enabling more and more people to communicate, collaborate, and compete, thereby levelling the competitive playing field.

This text focuses on the successful applications of IT in organizations; that is, how organizations can use IT to solve business problems and achieve a 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?

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 are bombarded with more information, than any generation in history. The *MIT Technology Review* refers to you as *Homo conexus*. Information technologies are so deeply embedded in your lives that your daily routines would be almost unrecognizable to a student just 20 years ago.

Essentially, you practise *continuous computing*, surrounded by a movable information network. This network is created by constant co-operation among the digital devices you carry (for example, laptops, tablets, and smartphones); 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 (and 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; take, edit, and print 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; 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?

The Informed User—You!

So, the question is: Why you should 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 years, and you feel confident that you can manage any IT application that your organization's Management Information Systems (MIS) department installs. Let's look at three reasons why you should learn about ISs and IT.

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 in a position to enhance the quality of your organization's IT applications with your input.
- 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.
- 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.

The second reason to learn about ISs 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. The Data Warehousing Institute (**www.tdwi.org**) predicted that by the end of 2017, approximately two-thirds of CEOs of the *Forbes* Global 2000 companies would have digital transformation at the centre of their corporate strategy. (The Global 2000 is a list of the 2,000 largest public companies in the world, ranked by *Forbes* magazine.)

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

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)
- Social computing (see Chapter 9)
- Mobile computing (see Chapter 8)
- The Internet of Things (see Chapter 8)
- Agile systems development methods (see Chapter 13)
- Cloud computing (see Technology Guide 3)
- Artificial intelligence (see Technology Guide 4)

You see examples of digital transformation in this chapter's opening case and IT's About Business 1.1.

IT's About Business 1.1

A Variety of Digital Transformations

Wendy's

Fast food restaurant chain Wendy's (**www.wendys.com**) is undergoing a digital transformation with the goal of putting digital technologies at the centre of its customer experience. The company initiated its digital transformation process when it realized that many of its customers, both millennials and non-millennials, expect to interact with companies via digital channels. Therefore, Wendy's was going to be judged on the digital experience that it provided for these customers. To implement this transformation, Wendy's created a laboratory called 90 Degree Labs, which it staffed with engineers, customer experience experts, and user experience experts. The lab produces three products: the company website, apps, and self-order kiosks.

Wendy's became one of the first companies to use self-ordering kiosks to control labour costs, deploying this technology in about 300 of its restaurants by August 2018. Today, stores with the kiosks are seeing higher average sales and higher customer satisfaction scores. As such, the kiosks remain integral to Wendy's strategy to provide a superior digital customer experience.

Wendy's noted that its customers are already familiar with mobile apps and that its kiosks were an intermediate step in providing a mobile digital experience for them. The company believes that once its customers become comfortable using the in-store kiosks, they can transition more easily to ordering via a mobile app.

Utilizing kiosks and mobile apps will enable Wendy's to manage lines, plan kitchen capacity, and order the correct amount of supplies at the right times. Mobile apps also enable customers to get customized orders at the right place and time.

Professional Golf

Golf is having difficulties as the baby-boomer generation ages and millennials do not seem to be as interested in the game. In order to try to prevent closures, an initiative called "connected course" has been started. Connected course is a way for golf to broaden its appeal to younger people who are rarely without their computing devices.

First, golf courses must be prepared for the daily technology demands of a modern golf tournament. Each course must support the demands of television broadcasters, the tour's own scoring and operational systems, as well as wireless connectivity for spectators.

Preparing courses typically requires laying 10 to 15 kilometres of fibre in the ground as well as deploying sensors with 5G wireless technology. The goal of this technology is for it to generate better insights for staff, players, coaches, business partners, advertisers, and spectators.

The sensors will provide location data that will bring new insights into how spectators move around a course. These data provide tournament sponsors with relevant information on spectator location and movement to increase their potential engagement. For example, spectators could access information relating to a sponsor-operated event or sales concession.

The Freight Forwarding Industry

Freight forwarders assist their clients in shipping goods and raw materials by rail, ship, or plane. Significantly, this industry has conducted business the same way for many years. Freight forwarders employ a global network of agents who possess a thorough knowledge of duties, taxes, penalties, and port requirements around the world. In return for a fee from their clients, they negotiate rates with trucking companies, airlines, and ship owners, and they make deals based on large volumes of cargo.

This global business has lagged behind many other industries in adapting to digital transformation. Startup Freightos (**www.freightos.com**), an online marketplace, is addressing that problem. Freightos allows shippers to book online, receiving bids from multiple freight forwarders within seconds rather than days, and often for lower prices than offline alternatives offer.

Another startup, Windward (**www.windward.eu**), combines location data with other information about each vessel's size, owner, and other factors to map the paths and behaviours of ships

at sea. More than 90 percent of world trade moves by sea. Once cargo is on a ship, however, little information is available regarding the path the ship is taking or the stops it makes. Only in recent years have the largest ships regularly transmitted location data. However, even these ships may stop transmitting and "go dark" at any time.

To analyze the myriad data points coming in from each ship, Windward has constructed artificial intelligence systems using natural language processing to identify unusual or important patterns of behaviour. These systems generate maps that might reveal ships meeting mid-ocean to transfer cargo or crossing in and out of a country's territorial waters in patterns that can be associated with illegal fishing or smuggling. Most of Windward's customers are fishing authorities, coast guards, and navies. However, the company is confident that its information can be valuable to ship owners, cargo owners, and insurance companies as well.

Significantly, Amazon (**www.amazon.com**) is entering the freight forwarding business. For a detailed look at Amazon's efforts in this area, see the closing case in Chapter 11.

Canada's Olympic and Paralympic Teams

To win more games, Canada's Olympic and Paralympic teams are drawing on valuable insights and information obtained from data analysis. Own the Podium, a not-for-profit organization, was founded in 2004 to support national sport organizations in an effort to deliver more Olympic and Paralympic medals for Canada. Recently, Own the Podium partnered with Canadian Tire, a leading supporter of sports in Canada, and is using its best-in-class data analytics division and decades-long history in predictive modelling.

There are two distinct phases in, and goals for, the analysis and modelling: talent identification and finding a performance edge for them.

Canadian Tire's data analysts use various data from international sports competitions from several decades ago to the present date to build predictive models and to provide insights as to which athletes should be supported. Specifically, based on the available global data and athletes' current performance, data analysts determine who is most likely to achieve medals in future events, and therefore, should receive developmental resources and funding.

Data analysis also provides teams and coaches with insights into what matters in a quicker manner so they can incorporate them into the daily training and athlete preparation programs. For instance, in short-track speed skating, the analysis focuses on where the individuals must be on the second or third last lap. An athlete only has a chance to win if they are the first or they are in a position to be in first place. In other words, if a skater is in second or third in the last laps, they are unlikely to win.

As another example, consider swimming, where the sports analysts map the performance of top international swimmers from around the world using data that go back a few decades. From this analysis, the curve of race times in the future international competitions required for a Canadian swimmer to be on the right path for an Olympic medal in the Summer Olympics in Tokyo is determined.

Sources: Compiled from "Can Digitisation Help Golf out of Bunker?" *Computer Weekly*, August 7–13, 2018; B. Sozzi, "Wendy's CEO: Future of Fast Food Will Include Kiosks and Fast Pass Drive-Thrus," *The Street*, June 11, 2018; D. Barnes, "How Canada's Olympians Are Using Data Analysis to Build a Platform to the Podium," *National Post*, December 6, 2017; A. Bruno, "Technology and Its Impact on the Freight Forwarding Industry," *ICAT Logistics*, June 12, 2017; A. Glaser, "The U.S. Will Be Hit Worse by Job Automation than Other Major Economies," *Recode*, March 25, 2017; "One Fast Food Chain Is Adding Automated Kiosks to 1,000 of Its Restaurants in 2017," *Futurism*, March 3, 2017; L. Dignan, "Wendy's Cooks Up Digital Transformation Plans with Kiosks, Mobile Apps, Customer Experience Lab," *TechRepublic*, March 1, 2017; "Digital Transformation in the U.S.," *IDC InfoBrief*, January 2017; C. McDonald, "Unilever Puts Digital Transformation in the Hands of IT," *Computer Weekly*, November 2, 2016; N. Byrnes, "This $1 Trillion Industry Is Finally Going Digital," *MIT Technology Review*, October 24, 2016; D. Kline, "Are Robots Taking Over Fast Food Restaurants?" *Newsweek*, September 5, 2016; D. Newman, "Top 10 Trends for Digital Transformation in 2017," *Forbes*, August 30, 2016; M. Castillo, "Technology Could Soon Be Replacing Fast Food Workers," PSFK.com, April 21, 2016; "Wendy's Opens 90 Degree Labs to Fuel Future Technology Innovation," PRNewswire, May 26, 2015; "Canadian Tire Data Analysts to Help Put Athletes on the Podium," Canadian Sport Institute Ontario, April 27, 2015.

Questions

This case presents digital transformations in four organizations across four industries.

1. For which organization is digital transformation the most critical? Why? Support your answer.
2. For which organization is digital transformation the least critical? Why? Support your answer.
3. Would your university be a good candidate for digital transformation? Why or why not? Support your answer.
4. If you responded yes, then what types of digital initiatives should your university undertake to transform itself?

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

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 who is 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, they actively participate 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 **https://ca.linkedin.com**, **www.computerworld.com/category/careers/**, and **www.monster.ca**.

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, hot lines, 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

Career opportunities in IS are strong and are projected to remain strong over the next 10 years. In fact, *Canadian Business* listed its 100 "Best Jobs of 2019," MSN listed its "Highest Paying In-Demand Jobs in Canada for 2019," and *Forbes* listed its "20 Best Jobs" for 2018. Let's take a look at these rankings. (Note that the rankings differ because the media outlets used different criteria in their research.) As you can see, jobs suited for MIS majors appear in all three lists, many of them quite high. The media outlets with their job rankings are as follows:

Canadian Business (out of 100)
#26 Computer Systems Manager
#46 Software Engineer
#54 Database Analyst
#56 Computer Engineer
#65 Telecommunication Manager
#84 Information Systems Analyst
#94 Web Designers & Developers

MSN (out of 20)
#2 Software Engineer
#8 IT Project Manager

Forbes (out of 20)
#2 Software Engineer
#4 IT Solutions Architect
#11 IT Manager
#13 Data Engineer
#14 Frontend Engineer (User Experience Designer)

Not only do IS careers offer strong job growth, but the pay is excellent as well. Employment and Social Development Canada notes that a "computerized management information systems manager" in Canada has an hourly wage between $27.50 and $75.90, with a median of $49.45.

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 in 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.

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.

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.

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 the 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.
- Educating the MIS staff about the business
  - Communications 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 advisor on various issues, including hardware and software compatibility, implementing extranets, communications, and security.

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 advisor.

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

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 to 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**).

Data items refer to an elementary description 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	Information	Knowledge
[No context]	[Professional baseball pitcher context]	
3.16	3.16 + Ken Rice = ERA	* Keep pitcher, trade pitcher, or send pitcher to minor leagues
2.92	2.92 + Ed Dyas = ERA	* Salary/contract negotiations
1.39	1.39 + Hugh Carr = ERA	
3.95	3.95 + Nick Ford = ERA	

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 mean entirely different things in different contexts.

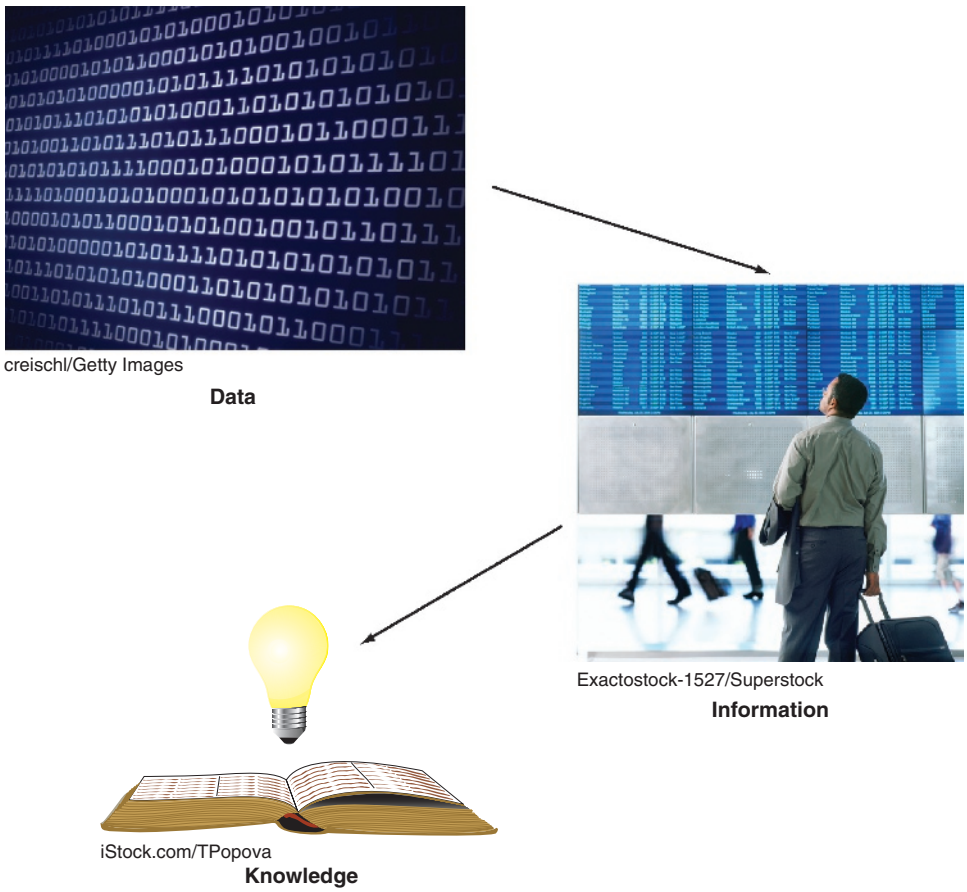

FIGURE 1.2 **Data, information, and knowledge.**

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 here. 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 enables the hardware to process data.
- A **database** is a collection of related files or tables containing data.
- A **network** is a connecting system (wireline or wireless) that enables multiple computers to share resources.
- **Procedures** are the instructions for combining these 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 compose the organization's **information technology infrastructure**. At the top of the pyramid are the various organizational information systems.

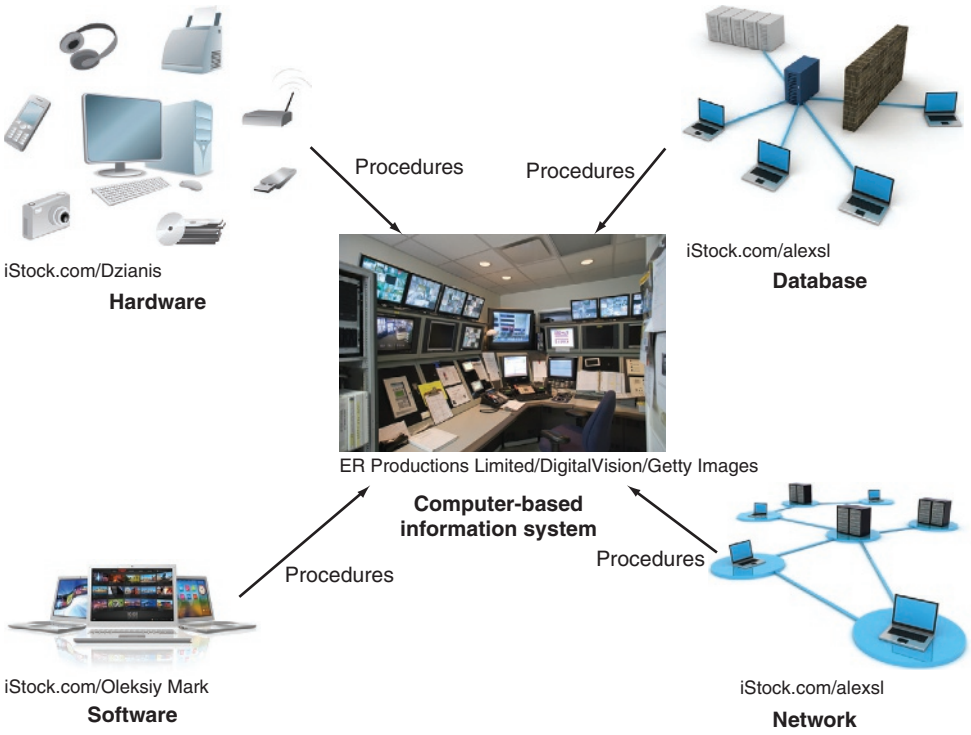

FIGURE 1.3 **Computer-based information systems consist of hardware, software, databases, networks, procedures, and people.**

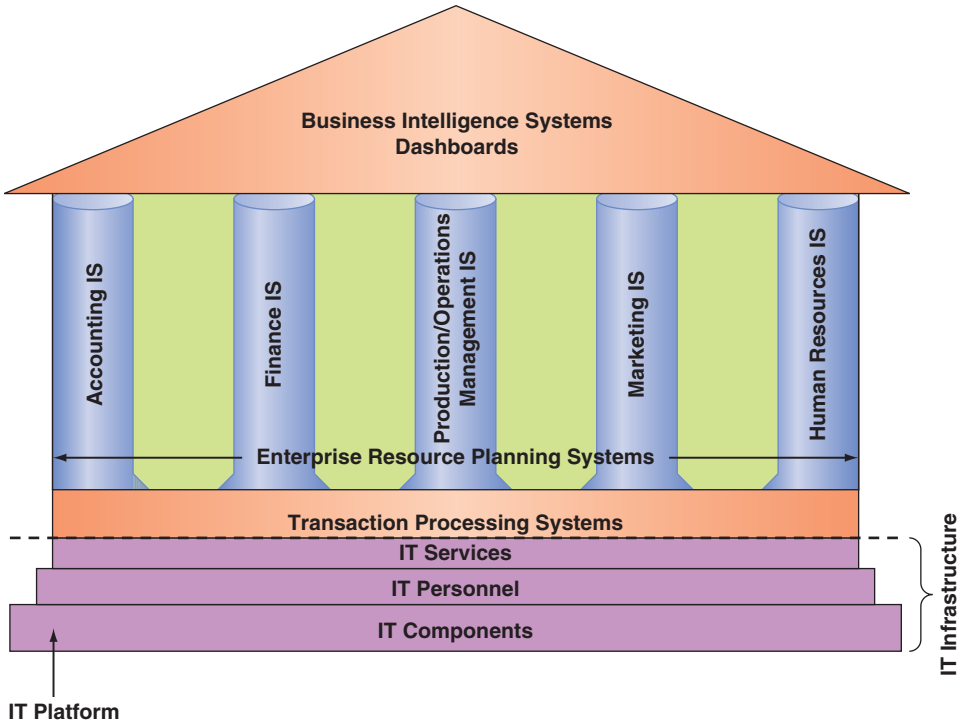

FIGURE 1.4 **Information technology inside your organization.**

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 a single department is usually referred to as a **functional area information system** (also known as a **departmental information system**). 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,

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 semi-automatic business processes and manual tasks.

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 customer relationship management (CRM) systems in Chapter 11 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 (FAISs) 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.

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

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. In *manufacturing*, managers use IT to process customer orders, develop production schedules,

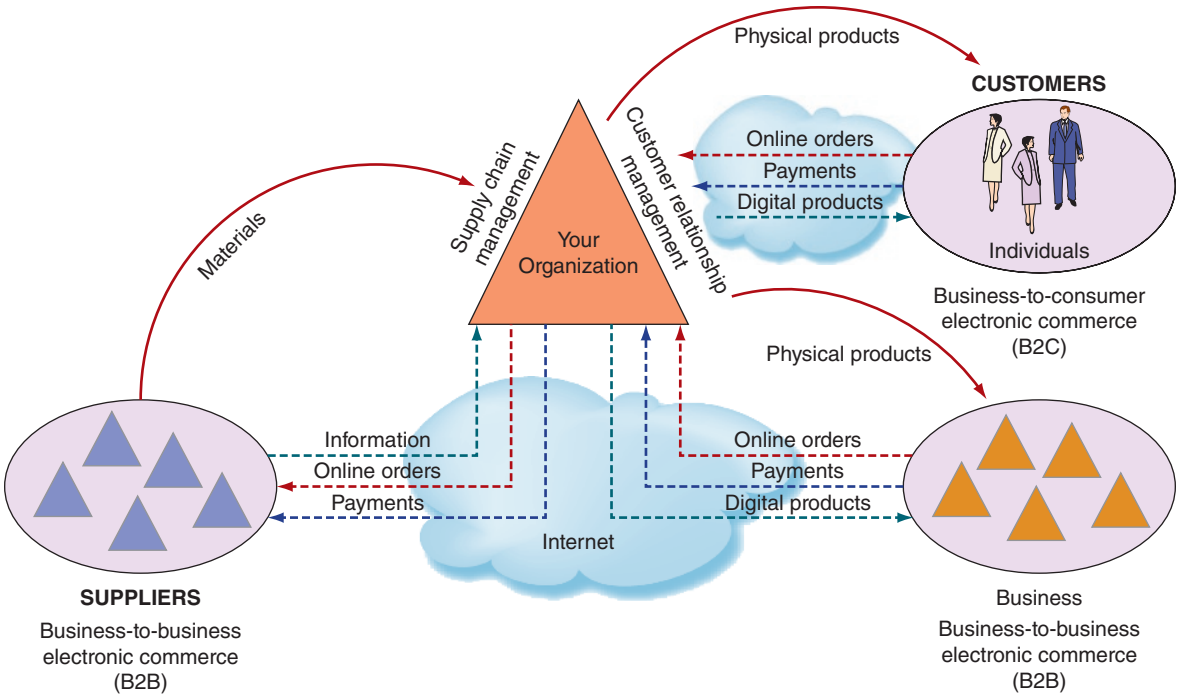

FIGURE 1.5 **Information systems that function among multiple organizations.**

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).*

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 standalone 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 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 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 shows how information systems have enabled the Toronto Region Immigrant Employment Council (TRIEC) to better help newcomers to Canada find jobs that are in line with their expertise.

IT's About Business 1.2

TRIEC Helps Canada Newcomers Find a Job

The main objective of the Toronto Region Immigrant Employment Council (TRIEC) is to ensure that immigrants in the Greater Toronto Area (GTA) can enter the labour market and find work in their field. TRIEC was founded in 2003. As its first steps, TRIEC held an immigrant success award ceremony. It also launched an advertising campaign using outdoor advertising media as well as television to raise awareness of immigrant talent being wasted in the GTA. For example, to show the problem that the experience and credentials of many immigrants were not being recognized, the campaign used an eponymous tale of a doctor who drove a cab.

In order to better help newcomers to find jobs that are in line with their expertise, TRIEC has designed a flagship program called TRIEC Mentoring Partnership that matches newcomers with a mentor who is established in Canada and shares their professional background. To do that TRIEC makes use of a Customer Relationship Management (CRM; see Chapter 11) application developed by Salesforce but customized to meet the specific requirements of the mentoring program. The CRM application helps TRIEC perform and manage the clients of the program (i.e., mentees) and volunteers (i.e., mentors) throughout the mentorship process from registration to outcome surveys. It enables TRIEC to create and access participants' records, add case management notes, and send email reminders or run campaigns to recruit mentors.

More specifically, both mentors and mentees are required to register and speak with a mentoring coach. Then based on the information they provide, TRIEC matches a mentor and a mentee who share professional backgrounds. Mentoring coaches (who guide the mentor–mentee journey) can check at any time the phase (e.g., registration, waiting for intervention, in partnership, or post-partnership) in which participants are in and what their next tasks should be. Also, since the Salesforce CRM application is in the cloud (see Technology Guide 3), the coaches do not have to necessarily be onsite and can check how the mentoring partnerships are progressing anytime and from anywhere.

At specific points of time during the partnership journey, the CRM application sends auto-generated emails with check-in surveys to participants and asks whether they need support from their coach. Then, if the answer is yes, the coach is notified to check in and offer their help to participants. Also, the software sends automated survey emails to participants at partnership completion, and 3, 6, and 12 months after partnership completion to collect both feedback and information about the employment outcomes.

According to TRIEC, investing in a powerful CRM software has enabled them to reduce matching time, making more matches at a greatly reduced cost, scale their mentoring partnership, centralize their data, and have a 360-view of all the engagement points for all the parties involved. They are also empowered with timely and easily accessible data and therefore can review outcomes and other program-related reports to evaluate their performance.

By using the Salesforce CRM software, TRIEC completed 1,802 mentoring matches in the partnership program in 2017–2018. Out of this number, 77 percent of the mentees managed to find meaningful employment in their field or a related field within six months of completing the program.

Sources: Compiled from "State of Immigrant Inclusion in the Greater Toronto Area Labour Market," TRIEC, November 2018; T. Ma and L. Peerlings, "Case Study: How TRIEC Leverages Its CRM Software as an Effective Program Delivery Tool," Techsoup Canada, October 31, 2018; TRIEC, "Become a Mentor," **www.mentoringpartnership.ca/join-us/become-a-mentor/**, accessed August 8, 2019; TRIEC, "Become a Mentee," **www.mentoringpartnership.ca/join-us/find-a-mentor/**, accessed August 8, 2019; TRIEC, "Leading Inclusion: Annual Report 2017-2018," **http://triec.ca/AR-2017-2018/**, accessed August 8, 2019.

Questions

1. Provide two examples of how TRIEC uses information technology to support its clients.
2. How might TRIEC further use information technology to help newcomers to Canada find a job that is in line with their professional background? Support your answer.

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.

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 advisors 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 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 standalone systems or be embedded in other applications. We examine ESs in greater detail in Technology Guide 4.

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.

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 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?

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.

- In mid-January 2016, a software update for the Nest smart thermostat (owned by Google) experienced a problem. The update forced the device's batteries to drain and left it unable to control temperature. As a result, customers were unable to heat their homes or get hot water on one of the coldest weekends of the year.
- In August 2016, Delta Airlines experienced a worldwide computer network failure, causing the airline to cancel 2,000 flights over three days. The cost of lost revenue, accommodating passengers on other flights, and other related issues was approximately US $150 million.

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

IT Impacts Entire Industries

As of mid-2018, 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 startups without investing in new infrastructure or training new employees. For example, in 2000, operating a basic Internet application cost businesses approximately US $150,000 per month. In mid-2018, operating that same application in Amazon's cloud (see cloud computing in Technology Guide 3) cost less than US $1,000 per month.

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 mid-2018, the largest book retailer 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 eBooks. In the fall of 2018, electronic books were gaining popularity, although roughly 80 percent of book sales were still for print books. (Interestingly, according to the 2018 Academic Student Ebook Experience Survey, 74 percent of respondents said that they preferred print books when reading for pleasure. Further, 68 percent said that they preferred print books for assigned readings.)

Consider the Borders U.S. bookstore chain. In 2001, Borders agreed to hand over its online business to Amazon because it was convinced that online book sales were nonstrategic and unimportant. Ten years later, Borders filed for bankruptcy.

The Music Industry Dramatic changes in the music industry resulted from the emergence of digital music-streaming technologies over the Internet. Two digital-streaming business models emerged: (1) Internet radio companies such as iHeartRadio (**www.iheartradio.ca**) that allow subscribers to passively listen to music that is customized for their tastes and (2) interactive companies such as Spotify (**www.spotify.com**) and Apple's iTunes (**www.apple.com/itunes**) that allow users to pick songs. Internet radio companies can operate under

a government-mandated licence that dictates how much they have to pay to recording artists. In contrast, interactive companies must make deals with labels and music publishers in order to license music for legal use.

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, 2018, Netflix had the largest subscriber base of any video service, with 125 million subscribers. Meanwhile, Blockbuster declared bankruptcy in February 2011 and was acquired by satellite television provider Dish Network (**www.dish.com**) a month later. On July 16, 2018, the last two Blockbuster stores closed.

The Software Industry Incumbent software companies such as Oracle and Microsoft are increasingly threatened by software-as-a-service (SaaS) products—for example, Salesforce.com—and Android, an open-source operating system developed by the Open Handset Alliance (**www.openhandsetalliance.com**). (We discuss operating systems in Technology Guide 2 and SaaS in Technology Guide 3.)

The Videogame Industry Today, the fastest growing entertainment companies are videogame 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 This industry was disrupted by software 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 Shutterfly (**www.shutterfly.com**), Snapfish (**www.snapfish.com**), Flickr (**www.flickr.com**), and Instagram (**www.instagram.com**). Meanwhile, Kodak, the long-time market leader—whose name was almost synonymous with cameras—declared bankruptcy in January 2012.

The Marketing Industry Today's largest direct marketing companies include Facebook (**www.facebook.com**), Google (**www.google.com**), and Foursquare (**https://foursquare.com**). All of these companies are using software to disrupt the retail marketing industry.

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 resumés on a publicly accessible website that interested parties can search in real time.

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. Also, many of the leading innovators in financial services are software companies. For example, Square (**https://squareup.com**) allows anyone to accept credit card payments with a smartphone.

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.dreamworksanimation.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 engines; controlling safety features; entertaining passengers; guiding drivers 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, which 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: self-driving or driverless cars. The creation of software-powered driverless cars is already being undertaken at Google, Tesla (**www.tesla.com**), and Apple, as well as at all major automobile companies.
- *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 (e.g., 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 beginning to use a new artificial intelligence software package called ROSS (**www.rossintelligence.com**). For example, law firm BakerHostetler has hired ROSS to serve as a legal researcher in bankruptcy cases.

IT Reduces the Number of Middle Managers

IT makes managers more productive, and it increases the number of employees who can report to a single manager. Thus, IT ultimately decreases the number of managers and experts. 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 managers make their decisions. In this way, IT ultimately has changed managers' jobs.

IT often provides managers with near real-time information, meaning that managers 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 to 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.

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 non-computerized systems.

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

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. To illustrate this point, we 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 also has 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


Media Bakery


Media Bakery


Media Bakery


Media Bakery

FIGURE 1.6 **Ergonomic products protect computer users.**

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.

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 the functionality of computers to the way it was before GUIs become 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.

Before You Go On . . .

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

1.4 Importance of Information Systems to Society

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.

From the opposite perspective, however, 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.

The Robot Revolution Is Here Now

Once restricted largely to science fiction, robots that can perform practical tasks are now a reality. Around the world, autonomous devices have become increasingly common on factory floors, in hospital corridors, and in farm fields. Let's look at several examples.

Baxter Baxter is a new kind of industrial robot created by Rethink Robotics (**www.rethinkrobotics.com**) that sells for US $30,000. Baxter can handle a variety of repetitive tasks on a factory floor normally performed by humans. These tasks include packing and unpacking items to and from boxes, putting products into retail blister packaging, squeezing and crimping tubes, putting caps on jars, and many other functions.

Humans share a workspace with Baxter, making it an excellent example of a social, collaborative robot. Baxter works right out of the box, and it can be integrated into a factory's workflow in about one hour. Another benefit of Baxter is that other factory workers can train it.

In November 2014, Rethink Robotics announced its new Robot Positioning System for Baxter. This system enables Baxter to adapt to changing, real-world environments, such as tables and benches being moved. The new system highlights a huge advantage for companies that acquire Baxter. Because so much of Baxter's capabilities are contained in its software, when the robot is upgraded, it tends to increase in value.

However, Baxter does raise the question of the future of low-skilled labour in North America: How fast will Baxter replace these workers, and what will they do after they are replaced?

LoweBots In August 2016, Lowe's announced that 11 of the firm's store locations in San Francisco will employ LoweBots, which are multilingual, autonomous customer assistance robots.

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

Uber is using drones in an interesting way. The company is so successful that it feels comfortable using drones to tease drivers who are stuck in gridlocked traffic in Mexico City. One drone carried an ad saying, "Driving by yourself?" The idea was to guilt the driver into carpooling with UberPOOL.

Drones are being employed in many different ways. Two different uses are in the winemaking industry and in law enforcement. IT's About Business 1.3 discusses both applications.

IT's About Business 1.3

Diverse Uses for Drones

Canadian Vineyards

In the past, experienced winemakers had to physically inspect the vines and grapes. They also took samples back to send off to the lab. However, doing so is not feasible if one has hundreds of acres. Today, vineyards launch drones and deploy sensors to map areas of vines with GPS coordinates, and they proceed directly to those vines that exhibit problems. Specifically, drones equipped with sensors detect moisture by evaluating the colours of the vegetation. The wrong colour can indicate nutritional deficiencies in the crops or irrigation leaks.

Drones can also examine plant growth; detect areas under stress from disease, rot, insect damage, or lack of water; and help assess when pickers should have the next load of grapes ready to send to the winery. Normalized difference vegetation index (NDVI) maps, which highlight areas of high and low vegetation density, provide visual information on how to improve uniformity of growth within a vineyard and when to harvest vineyard areas for optimal grape quality.

Drones are used in vineyards in various parts of Canada like Niagara and Vineland regions, Greater Toronto Area, and the Thompson Okanagan region in British Columbia.

Drones made by Sky Squirrel Technologies Inc., a Nova Scotia-based start-up, can take as many as 500 images during a single flight. The images are then sent to Sky Squirrel to be combined into a map. A specialized image algorithm then assesses the crop health. The system has proven 97 percent effective at detecting diseases like flavesence dorée, which mainly affects European vineyards. It also detects leafroll, a disease that can devastate vineyards, wiping out 30 to 50 percent of the crop. In another application, one client of Sky Squirrel managed to reduce their water usage by a third.

As a result of its tremendous success in producing quality drones, Sky Squirrel recently closed a $3-million investment round and merged with its Northern California research partner VineView Scientific Aerial Imaging.

Law Enforcement Agencies

In July 2018, approximately 350 U.S. agencies were using drones as part of their law enforcement activities. In fact, there has been a dramatic 500 percent increase in law enforcement drone use since 2016. These are the most common uses for drones in these agencies:

- search and rescue,
- traffic collision reconstructions,
- active shooter scenarios,
- crime scene analysis, and
- general surveillance.

Remotely controlled drones often arrive on crime scenes before officers in cars. Drones allow police officers to survey a scene prior to their physical arrival, enabling them to track a suspect's movements if one has been identified. Drones are more effective monitoring tools than fixed security cameras and more cost effective to operate than helicopters with on-board cameras. Let's look at a few examples of law enforcement agencies using drones:

- The use of a single, quadcopter drone in the city of Ensenada, Mexico, has helped to reduce overall crime by some 10 percent, including a 30 percent decrease in burglaries. DJI's Inspire I quadcopter helped police officers in the city make over 500 arrests in four months.
- In the United Kingdom, Devon, Cornwall, and Dorset police officers teamed up in 2017 to launch a drone unit for assistance with missing person searches, gathering images from crime scenes and major traffic accidents, and taking part in coastal and woodland searches to fight wildlife crime.
- Police officers in the Bordeaux area of Southwest France are using drones to catch drivers violating traffic laws. The drones are much cheaper than helicopter surveillance that the police sometimes use to catch traffic offenders. Drone surveillance does have one limitation. While drones can reveal dangerous driving, such as cars zigzagging through traffic for example, it is not suitable for detecting speeding.
- Amazon has filed a patent for tiny drones that would be useful for a number of law enforcement tasks. For instance, Amazon envisages these drones travelling with officers to assist them in their work. In this capacity, the drones could record video, meaning that they could replace the dashboard cameras in many police cars. Specifically, the drones could hover just above or behind officers, taking photos of licence plates and drivers, then feeding those data back to the police department for facial recognition. In a chase of two people, the officer could direct the drone to follow one person while they follow the other.

There are, however, many opponents of the use of drones by law enforcement agencies. For example, the city of Seattle, Washington donated their drones to the city of Los Angeles because Seattle citizens objected so strongly to their deployment.

Public unease with law-enforcement drones is occurring at the same time as overwhelming support for the use of police body cameras. This discrepancy raises the question of who, or what, can surveil and record a city's citizens and under what investigative circumstances.

Sources: Compiled from J. Stewart, "A Single Drone Helped Mexican Police Drop Crime 10 Percent," *Wired*, June 11, 2018; G. Manaugh, "Drone Cops Take Flight in Los Angeles," *The Atlantic*, June 8, 2018; "Like It or Not, Camera-Equipped Police Drones Will Soon Patrol the Skies," *Digital Trends*, June 6, 2018; C. Cornell, "Farmers Use Drones and Data to Boost Crop Yields," *The Globe and Mail*, May 15, 2018; M. Uleski, "How Unmanned Aerial Systems Can Assist Police Pursuits," PoliceOne.com, March 19, 2018; G. Friese, "Research: Drone Video Effective in Identifying Multiple Vehicle Collision Hazards," PoliceOne.com, March 14, 2018; V. Masters, "How a Washington PD Is Leveraging Drone Technology to Serve Citizens," PoliceOne.com, February 22, 2018; P. Moreira, "SkySquirrel in $3M Raise and Merger," *Entervestor*,

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Questions

1. Compare and contrast the non-technological and technological methods that wineries are using to combat global warming.
2. What other uses for drones would you suggest to wineries?
3. Describe other applications for drones in law enforcement.
4. Describe potential problems that drone use by law enforcement agencies could cause for citizens.

Autonomous Vehicles When you think about autonomous vehicles, consider these statistics:

- Human error accounts for more than 90 percent of automobile accidents.
- Each year more than 150,000 vehicle accidents are reported to law enforcement.
- Each year approximately 1,900 Canadians and 1.25 million people worldwide die in automobile accidents.

These statistics offer compelling reasons for autonomous vehicles, and the development of these vehicles is proceeding rapidly. Fully automated, all-electric, public, 24-seat, driverless cabs are operating in Singapore. In October 2016, an Uber self-driving truck (with a driver onboard) delivered 50,000 cans of beer at the end of a nearly 200-kilometre, two-hour journey.

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 was 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.

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 also has 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 video conferencing. 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. For example, consider IBM Watson (**www.ibm.com/watson**), an IT system that uses natural language processing and machine learning (discussed in Technology Guide 4) to reveal insights from vast collections of data. We take a closer look at Watson in the next section.

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. Despite the fact that 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.

The Emergence of Cognitive Computing: IBM Watson

IBM (**www.ibm.com**) developed Watson specifically to answer questions on the quiz show *Jeopardy!* In February 2011, Watson competed on *Jeopardy!* against former winners Brad Rutter and Ken Jennings. Watson won the game series and received the first prize of US $1 million. (In *Jeopardy!* the host reads the answer, and the contestants must then provide the correct question.)

Watson is an application of advanced natural language processing, information retrieval, knowledge representation and reasoning, and machine learning technologies to the field of answering open-domain (general) questions. IBM has labelled the type of processing demonstrated by Watson as *cognitive computing*. Four primary capabilities distinguish Watson as a cognitive system:

- 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; and
- the ability to understand the context of a question.

There are many different applications for Watson. Let's consider some of them here.

- *Medicine*: 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 doctors. Rather, its purpose is to assist them in avoiding medical errors and fine-tuning their medical diagnoses.

  By mid-2018, Watson had digested millions of medical and scientific articles as well as information about thousands of clinical trials collected from Clinicaltrials.gov, the U.S. government's public database. The system can read—and remember—patient histories, monitor the latest drug trials, examine the potency of new therapies, and closely follow state-of-the-art guidelines that help doctors choose the best treatments. Watson can also analyze images such as MRIs and EKGs. IBM and Hamilton Health Sciences have recently announced a collaborative research initiative to establish a new centre in downtown Hamilton, Ontario, home to McMaster University's world-class medical school, focused on health care innovation.

- *Customer service*. The Watson Engagement Advisor is designed to help customer representatives assist consumers with deeper insights more quickly than was previously possible. Engagement Advisor's "Ask Watson" feature can quickly address customers' questions, offer feedback to guide their purchase decisions, and troubleshoot their problems. Companies employing the Advisor include USAA (**www.usaa.com**), Genesys (**www.genesys.com**), DBS Bank of Singapore (**www.dbs.com.sg**), and many others.
- *Financial services.* Many financial organizations have integrated Watson into their business processes. As one example, Royal Bank of Canada (RBC, **www.rbcroyalbank.com**) employs Watson to more efficiently experiment and to get services to market much faster. RBC has recently launched an application using artificial intelligence that enables its customers to transfer money using the Siri voice assistant.
- *Travel services*. Terry Jones, founder of Travelocity (**www.travelocity.com**) and Kayak (**www.kayak.com**), has launched WayBlazer (**www.wayblazer.ai**), a new travel company powered by Watson. Watson engages and advises users through a natural language interface to help create the best travel experience.
- *Other interesting applications*:
  - Tax preparation firm H&R Block (**www.hrblock.com**) is using IBM Watson to assist the firm's clients with their taxes. Clients interact with Watson via natural language

processing, answering questions from Watson pertinent to their tax returns. H&R Block hopes that by feeding Watson this tax-return data (along with answers provided by human tax preparers), the company can improve the performance of all of their tax preparers. In essence, Watson will act as a central repository for tax experts' knowledge. The company asserts that they are not using Watson to replace human workers.

- BNSF Railway (**www.bnsf.com**) is using Watson to help detect faulty sections in the company's more than 52,000 kilometres of track before they break.
- Repsol (**www.repsol.com**), a global energy company, is using Watson to improve its strategic decision making in crucial areas such as optimizing oil reservoir production and discovering new oilfields.
- Hilton Worldwide (**www.hilton.com**) introduced a robot concierge, called Connie, that is powered by Watson.
- Edge Up Sports teamed with Watson to bring analytical capabilities to fantasy football. The company's app can analyze the vast amounts of available data about football and its players, thereby enabling fantasy league players to make better decisions.
- General Motors (**www.gm.com**) began rolling out smarter vehicles in 2017 with its new cognitive mobility platform OnStar Go, powered by Watson. OnStar Go is capable of identifying information about the car and its surroundings. For example, OnStar Go will immediately call the driver when airbags are deployed. If the system does not receive an immediate answer, it will call 911 and direct first responders to the car's location.
- The 2017 Wimbledon tennis tournament introduced a voice-activated digital assistant named "Fred," powered by Watson. Fred helped attendees find their way around the All England Lawn Tennis Club and informed them as to who was playing on Centre Court. Fred also compiled highlight videos of the matches.

By mid-2018, thousands of companies in at least 20 industries were using Watson. Recognizing Watson's increasing popularity, IBM is moving the technology to smartphones.

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, then 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?

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.

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. 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" those applications.
- You will be able to provide input into your organization's IT applications, thus improving the quality of those applications.
- 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 technologies.
- 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 use IT if you decide to start your own business.

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

- Transaction processing systems (TPS) 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.

3. Discuss ways in which information technology can affect managers and nonmanagerial 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 managers will have less time to make decisions; and
- IT will increase the likelihood that managers will have to supervise geographically dispersed employees and teams.

Potential IT impacts on nonmanagerial workers:

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

4. Identify 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; and
- IT will enable improvements in health care.

Negative societal effects:

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

Chapter Glossary

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

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

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

dashboards (or digital dashboards) A special form of IS that supports all managers of the organization by providing rapid access to timely information and direct access to structured information in the form of reports.

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

database A collection of related files or tables containing data.

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.

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.

enterprise resource planning (ERP) systems Information systems that correct a lack of communication among the functional area ISs by tightly integrating the functional area ISs via a common database.

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

functional area information systems (FAISs) (or departmental information system) ISs that support a particular functional area within the organization.

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

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

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

information technology (IT) Any computer-based tool that people use to work with information and support the information and information-processing needs of an organization.

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

information technology infrastructure IT components plus IT services.

information technology platform 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.

interorganizational information systems (IOSs) Information systems that connect two or more organizations.

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 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.

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.

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

supply chain The flow of materials, information, money, and services from suppliers of raw materials through factories and warehouses to the end customers.

transaction processing system (TPS) A system that supports the monitoring, collection, storage, and processing of data from the organization's basic business transactions, each of which generates data.

Discussion Questions

1. 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.

2. 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.

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

4. 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).

5. 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?

6. Is it possible to endanger yourself by accessing too much medical information on the Web? Why or why not? Support your answer.

7. Describe other potential impacts of IT on societies as a whole.

8. What are the major reasons why it is important for employees in all functional areas to become familiar with IT?

9. Given that information technology is impacting every industry, what does this mean for a company's employees? Provide specific examples to support your answer.

10. Given that information technology is impacting every industry, what does this mean for students attending a school of business? Provide specific examples to support your answer.

11. 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.dice.com**, **www.monster.ca**, **www.collegerecruiter.com**, **www.careerbuilder.ca**, **www.career.com**, and **www.simplyhired.com**. Compare the 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. Enter the website of Canada Post (**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. Do they make this process easier when you are a business customer?
3. Surf the Internet for information about the federal government department Public Safety Canada. Examine the available information and comment on the role of information technologies in the department.
4. Access **www.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.

Chapter Closing Case

Case 1.2 John Deere Becomes a Technology Company and It Is Not All Good News

Farming is highly land- and labour-intensive. In the past, farmers managed all the plants in a field approximately the same way. To do this, they had to assume that all plants in a field were at the same growth stage, all in the same health, and all needed the same nutrients.

Today, farmers are able to treat individual plants using precision agriculture. Precision agriculture is a farm management approach that uses a number of technologies, including global positioning systems (GPS; see Chapter 8), sensors (see Chapter 8), and robotics, drones, autonomous vehicles, artificial intelligence, and computer vision (see Technology Guide 4) to increase efficiency and ensure profitability, while protecting the environment. Communications among these technologies will be improved with fifth generation (5G) wireless technology, expected to be widely deployed by 2020.

Founded in 1837, John Deere (**www.deere.com**) is the largest agricultural equipment manufacturer in the world, with 2017 global revenues of US $30 billion. Deere is changing its business model by undergoing digital transformation. In the past, Deere generated revenue one time, with each sale. Today, Deere embeds the precision-agriculture technologies noted previously into its equipment. With these technologies, machines communicate with each other, with the farmer, and with external services such as satellite-mapping and image generation. The machines also generate data that Deere can help the farmer analyze. As a result, Deere can provide additional services after each sale, creating more continuous revenue flows from each customer.

The company began its transformation in 1999 with the acquisition of NavCom Technology for its GPS system. Consequently, Deere began embedding GPS receivers into its large farm equipment such as tractors and combines, thereby turning the machines into nodes on the Internet of Things (see Chapter 8). The GPS receivers allowed the machines to steer themselves, enabling them to steer more accurate paths within fields with less overlap. As a result, farmers could work longer with less fatigue.

Deere then connected its machines into the company's own cloud computing platform, called the John Deere Operations Center (see Technology Guide 3). Through Deere's Center, farmers can monitor and operate machinery, check the health of crops, and monitor environmental conditions. Deere's platform can gather and analyze data from onboard sensors to offer predictive maintenance on machines, thereby reducing the possibility of expensive downtime on the machines (see Chapter 12).

By July 2018, Deere had more than 70 business partners that could access Deere's platform to help farmers analyze their data. These companies provide satellite imagery, drone integration, visualization, and other tools to which farmers can apply their data. The companies range from smaller drone startups such as Precision Hawk (**www.precisionhawk.com**) and Green Aero Tech (**www.greenaerotech.com**), to giants such as Monsanto (**www.monsanto.com**), Syngenta (**www.syngenta.com**), and DuPont (**www.dupont.com**). As part of its continuing effort to change the strategy of Deere beyond acquiring technology companies, Deere opened up its own innovation lab in San Francisco in 2017.

In September 2017, Deere purchased Blue River Technology (**www.bluerivertechnology.com**), a developer of crop-spraying robots that utilize computer vision and machine learning to differentiate between weeds and crops so that farmers spray herbicides only on weeds. Because the robot can target weeds with squirts of herbicide the size of a postage stamp, it can reduce the amount of herbicide that farmers use by some 90 percent. Blue River is also developing a robot (called LettuceBot) for precision lettuce thinning and a drone imaging system that collects data from fields.

A Negative Consequence of John Deere's Digital Transformation

Unfortunately, Deere's transformation has led to a serious, negative consequence. The company is making it difficult for consumers and independent repair shops to repair today's equipment, which operates on copyright-protected software.

As a result, farmers who buy Deere tractors cannot repair their equipment themselves. Instead, they must work with company-approved

technicians, who may take time to arrive and can be expensive. For instance, Deere charges US $230, plus US $130 per hour for a technician to come to a farm and plug a USB connector between the tractor and the technician's computer to authorize the repair and any needed parts. Essentially, Deere sells their tractors to farmers and uses software to control every aspect of the tractors' use after the sale.

Consequently, many farmers are supporting "right to repair" legislation. Such bills, which have been proposed in 19 U.S. states, would allow owners to repair their equipment themselves without voiding warranties or agreements and require equipment manufacturers such as Deere to offer the diagnostic tools, manuals, and other supplies that farmers need to fix their own machines. As expected, Deere opposes the right to repair legislation.

Interestingly, Apple also opposes the right to repair legislation. Apple argues that the bills could result in poor repair work or make consumers vulnerable to hackers. Right to repair advocates say that Apple, which offers iPhone repair services at every Apple store, wants to maintain control of its share of the approximately $4 billion smartphone-repair business.

The Deere controversy had its beginning in the debate over jailbreaking iPhones and other high-tech devices. The legal question underlying this controversy centres on the Digital Millennium Copyright Act.

The Digital Millennium Copyright Act (DMCA) is a United States copyright law that criminalizes production and dissemination of technology, devices, or services intended to circumvent measures that control access to copyrighted works and also criminalizes the act of circumventing an access control. The DMCA was originally meant to stop people from pirating music and movies, but has arguably been taken advantage of by companies selling a wide variety of devices containing software.

After the passage of the DMCA, regulators considered whether there should be exceptions to the law. In such cases, consumers might have the right to circumvent technical protection measures (TPMs) intended to protect intellectual property and protect the rights of intellectual property holders. The U.S. Copyright Office subsequently exempted 27 classes of intellectual property from TPMs. Class 21 covers a variety of types of motor vehicles, including mechanized farm equipment.

Deere pointed out that the Class 21 exemption is for the equipment owners themselves but prevents owners from transferring the right to modify software "to third parties, such as repair shops or hackers." Deere argued further that the manufacturer needed to control access to their equipment's software to ensure machine functionality, safety, and emissions compliance, and to preserve product warranties.

After the Class 21 exemption, Deere began requiring its customers to sign an updated End User Licensing Agreement (EULA) that restricted their ability to repair or modify their equipment, in essence requiring them to use Deere-certified diagnostic and repair software. Despite the Class 21 exemption, farmers say that Deere still keeps tight control over how its customers service their equipment. In fact, Deere locks the engine control module reading function, which forces farmers to use its services. Violation of the EULA would be considered a breach of contract, meaning that Deere would have to sue its own customers if it wants to enforce the EULA.

Farmers note that this problem poses a threat to their livelihood if their tractor breaks at an inopportune time. One farmer stated that he does not have time to wait for a dealership employee to come to his farm and repair his tractor, particularly at harvest time. The farmer went on to say that most all repairs on new equipment require software downloads. Ultimately, farmers fear that Deere could remotely shut down a tractor and there would be nothing that they could do about it.

The controversy has led to a growing market where farmers and independent repair shops can buy unlicensed alternative software and associated diagnostic equipment on invitation-only, paid online forums. Much of the software comes from Ukraine. The software being traded on various forums includes:

- John Deere Service Advisor: A diagnostic program used by Deere technicians that recalibrates tractors and can diagnose broken parts.
- John Deere Payload files: These files specifically program certain parts of the tractor. For instance, the files can customize and fine-tune the performance of the chassis, engine, cab, etc.
- John Deere Electronic Data Link drivers: This software allows a computer to communicate with a tractor.
- Also for sale on the forums are licence key generators, speed-limit modifiers, and cables that allow farmers to connect a tractor to a computer. On YouTube, there are demonstrations of all this software in operation.

Sources: Compiled from D. Swinhoe, "How Tractor Seller John Deere Became a Technology Company," *IDG Connect*, June 5, 2018; D. Newman, "Top Six Digital Transformation Trends in Agriculture," *Forbes*, May 14, 2018; N. Gagliordi, "How 5G Will Impact the Future of Farming and John Deere's Digital Transformation," *ZDNet*, February 2, 2018; T. Simonite, "Why John Deere Just Spent $305 Million on a Lettuce-Farming Robot," *Wired*, September 6, 2017; M. Lev-Ram, "John Deere Is Paying $305 Million for This Silicon Valley Company," *Fortune*, September 6, 2017; J. Hightower, "John Deere Is Against the Right to Repair Its Equipment," *AlterNet*, August 1, 2017; J. Roberts, "One Controversial Thing Tractors and iPhones Have in Common," *Fortune*, June 29, 2017; A. Fitzpatrick, "Hand Me that Wrench: Farmers and Apple Fight over the Toolbox," *Time*, June 22, 2017; A. Ebrahimzadeh, "Will Farmers or 3rd Party Repair Shops Sue John Deere for Allegedly Contractually Prohibiting Unlicensed Tractor Repairs?" Aeesq.com, May 8, 2017; J. Bloomberg, "John Deere's Digital Transformation Runs Afoul of Right-to-Repair Movement," *Bloomberg BusinessWeek*, April 30, 2017; R. Schmaltz, "What Is Precision Agriculture?" *AgFunder News*, April 24, 2017; D. Grossman, "There's a Thriving John Deere Black Market as Farmers Fight for 'Right to Repair'," *Popular Mechanics*, March 22, 2017; M. Reilly, "A Fight over Tractors in America's Heartland Comes Down to Software," *MIT Technology Review*, March 22, 2017; J. Koebler, "Why American Farmers Are Hacking Their Tractors with Ukrainian Firmware," *Motherboard*, March 21, 2017; D. Drinkwater, "John Deere Ploughs Furrow as Industrial Internet Pioneer," **https://internetofbusiness.com**, March 16, 2017; C. Perlman, "From Product to Platform: John Deere Revolutionizes Farming," *Harvard Business School Digital Innovation and Transformation*, February 26, 2017; "How John Deere Turned Technology into Business Transformation," **www.digitalsocialstrategy.org**, December 10, 2016; D. Puri, "John Deere Leads the Way with IoT-Driven Precision Farming," *Network World*, November 30, 2016; K. Wiens, "How Copyright Law Stifles Your Right to Tinker with Tech," *MIT Technology Review*, July 26, 2016; K. Wiens, "We Can't Let John Deere Destroy the Very Idea of Ownership," *Wired*, April 21, 2015; "John Deere Opens the MyJohnDeere Platform to Collaborating Software Developers and Companies," **www.deere.com**, November 14, 2013; **www.deere.com**, accessed September 23, 2019.

Questions

1. Describe how Deere's digital transformation changed its business model.

2. Describe the various applications that Deere employed in its digital transformation.
3. Discuss why Deere's digital transformation is "not all good news."

Look ahead to Chapter 3 for the next three questions:

4. Discuss the ethics and the legality of John Deere's end-user licensing agreement that it requires its customers to sign.
5. Discuss the ethics and the legality of John Deere customers who use unlicensed repair shops to repair their equipment using hacked software.
6. The fundamental tenets of ethics include responsibility, accountability, and liability. Discuss each of these tenets as it applies to John Deere's actions toward its customers.