LEARNING OBJECTIVES

- Identify the reasons why being an informed user of information systems is important in today's world.
- Describe the various types of computer-based information systems in an organization.
- Discuss ways in which information technology can affect managers and nonmanagerial workers.
- Identify positive and negative societal effects of the increased use of information technology.

TODAY, EVERY COMPANY IS A TECHNOLOGY COMPANY

The Business Problem

Sixty years into the computer revolution, 40 years into the age of the microprocessor, and 20 years into the rise of the modern Internet, all of the technology required to transform industries through software has been developed and integrated and can be delivered globally. Billions of people now access the Internet via broadband connections. Worldwide, more than 5 billion people use cell phones. Of those users, 1 billion have smartphones that provide them with instant access to the Internet at all times from multiple locations.

In addition, software programming tools and Internet-based services allow 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 $150,000 per month. Today, operating that same application in Amazon's cloud (we discuss cloud computing in detail in Appendix C) costs about $1,000 per month.

In essence, software is disrupting every industry, and every organization must prepare for this disruption. Numerous companies have attempted to meet the disruption challenge; some have succeeded and some have failed.

Software Disruptions

Let's look at 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: A dramatic example of software disruption is the fate of Borders bookstore. In 2001, Borders agreed to hand over its online business to Amazon because the bookstore was convinced that online book sales were nonstrategic and unimportant. Ten years later, Borders filed for bankruptcy. That same year, the www.borders.com Web site was replaced with a redirect link to the Barnes & Noble Web site (www.bn.com). Then, in January 2012, Barnes & Noble warned analysts that it would lose twice as much money in 2012 as it had previously predicted. On April 30, 2012, the bookstore entered into a partnership with Microsoft that will spin off the Nook and college businesses into a subsidiary.

Today, the world’s largest bookseller, Amazon, is a software company. Its core capability is its software engine, which can sell virtually anything online without building or maintaining any retail stores. Amazon has even reorganized its Web site to promote its Kindle digital books over physical books. (In August 2012, Amazon announced that it sold more electronic books than hardback books and paperback books combined.) Now, even the books themselves are software products.

- The music industry: As with publishing, today’s dominant music companies are software companies: Apple’s iTunes (www.apple.com/itunes), Spotify (www.spotify.com), and Pandora (www.pandora.com). Traditional record labels now exist largely to provide those software companies with content. In mid-2013, the Recording Industry Association of America (RIAA) continues to fight battles over copyright infringement and the illegal download and sharing of digital music files.

- 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). In mid-2013, Netflix has the largest subscriber base of any video service with some 33 million subscribers. Meanwhile, Blockbuster declared bankruptcy in February 2011 and was acquired by satellite television provider Dish Networks in March 2011.

- The software industry: Incumbent software companies such as Oracle and Microsoft are increasingly threatened by software-as-a-service products (e.g., Salesforce.com) and Android, an open-source operating system developed by the Open Handset Alliance (www.openhandsetalliance.com). (We discuss operating systems in Appendix B and software-as-a-service in Appendix C.)

- The videogame industry: Today, the fastest-growing entertainment companies are videogame makers—again, software. Examples are
  - Zynga (www.zynga.com), which makes FarmVille, delivers its games entirely online.
  - Rovio (www.rovio.com), the maker of Angry Birds, made almost $195 million in 2012. The company was nearly bankrupt when it launched Angry Birds on the iPhone in late 2009.
  - Minecraft (www.minecraft.net), another video game delivered exclusively over the Internet, was first released in 2009. By January 2013, more than 20 million people had downloaded it. Interestingly, the creator of Minecraft, Markus Persson, has never spent any money to market his game. Instead, sales resulted entirely from word of mouth.
Today, Every Company Is a Technology Company

- 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. The leading photography companies include Shutterfly (www.shutterfly.com), Snapfish (www.snapfish.com), Flickr (www.flickr.com), and Instagram (www.instagram.com). Meanwhile, the long-time market leader, Kodak—whose name was almost synonymous with cameras—declared bankruptcy in January 2012.
  - Each day people upload more than 350 million digital photos just to Facebook. Snapchat (www.snapchat.com) is a smartphone app that enables users to send a photo (or video) to someone and have it “self-destruct” within seconds. Snapchat users are now sharing more than 100 million “snaps” daily.

- The marketing industry: Today’s largest direct marketing companies include Facebook (www.facebook.com), Google (www.google.com), Groupon (www.groupon.com), Living Social (www livingsocial.com), and Foursquare (www.foursquare.com). All of these companies are using software to disrupt the retail marketing industry.

- The recruiting industry: LinkedIn (www.linkedin.com) is a fast-growing company that is disrupting the traditional job recruiting industry. For the first time, employees and job seekers can maintain their own resumes on LinkedIn for recruiters to search in real time.

- The financial services industry: Software has transformed the financial services industry. Practically every financial transaction 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 mobile phone.

- Fundraising: In early 2013, Joel Silver and Rob Thomas, the producers of Veronica Mars, a feature film, used Kickstarter (www.kickstarter.com) to raise money to produce the film. They achieved their goal of $2 million in just 10 hours. Kickstarter takes a 5 percent cut of every transaction.

- Genomics: Illumina (www.illumina.com) has reduced the cost of sequencing a human genome from more $1 million in 2007 to $4,000 in 2013. Illumina’s technology has helped medical researchers develop cancer drugs that target specific genetic mutations that can cause cancer.

- The motion picture industry: Making feature-length computer-generated films has become incredibly IT intensive. Studios require state-of-the-art information technologies, including massive numbers of servers (described in Appendix A), sophisticated software (described in Appendix B), and an enormous amount of storage (described in Appendix A).
  - Consider DreamWorks Animation (www.dreamworksanimation.com), a motion picture studio that creates animated feature films, television programs, and online virtual worlds. The studio has released 26 feature films, including the franchises of Shrek, Madagascar, Kung Fu Panda, and How to Train Your Dragon. By late 2012, its feature films had grossed more than $10 billion globally.
  - For a single motion picture such as The Croods, 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 Appendix A) 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 the following 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 in modern cars 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 driverless cars. The creation of software-powered driverless cars is already being undertaken at Google as well as several major car companies.

- **The logistics industry:** Today's leading real-world retailer, Walmart, uses software to power its logistics and distribution capabilities. This technology has enabled Walmart to become dominant in its industry.

- **The postal industry:** FedEx, which early in its history adopted the view that "the information about the package is as important as the package itself," now employs hundreds of developers who build and deploy software products for 350,000 customer sites to help customers with their mailing and shipping needs.

- **The oil and gas industry:** Companies in this industry were early innovators in supercomputing and data visualization and analysis, which are critically important to oil and gas exploration efforts.

- **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 and software.

- **National defense:** Even national defense is increasingly software based. The modern combat soldier is embedded in a web of software that provides intelligence, communications, logistics, and weapons guidance. Software-powered drone aircraft launch airstrikes without placing human pilots at risk. (We discuss drone technology later in the chapter.) Intelligence agencies perform large-scale data mining with software to uncover and track potential terrorist plots.

- **The retail industry:** Women have long "borrowed" special-occasion dresses from department stores, buying them and then returning them after one night wearing them. 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 pull floor merchandise if it ever shows up on that company's Web site.

  Rent the Runway employs 200 people, including one of the nation's largest dry-cleaning operations. Their Web site has more than 3 million members, and it features 35,000 dresses and 7,000 accessories created by 170 designers.

- **Education:** College graduates owe approximately $1 trillion in student debt, a crippling burden for many recent graduates. UniversityNow (www.unow.com) was founded to make college more accessible to working adults by offering online, self-paced degrees.
Two key characteristics distinguish UniversityNow from an increasing number of rivals: (1) very low fees (as little as $2,600, which includes tuition and books for as many courses students can complete in one year) and (2) fully accredited degrees, from an associate's degree to an M.B.A.

- **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 $100,000. That company estimated that the process would have cost $1.5 million if performed by lawyers.

  E-discovery applications go beyond simply finding documents rapidly using relevant terms. They can also extract relevant concepts, even in the absence of specific terms, and they can deduce peoples’ patterns of behavior that would have eluded lawyers examining millions of documents. These applications can also analyze documents for information pertaining to the activities and interactions of people—who did what and when, and who talked to whom.

**The Results**

Clearly, then, an increasing number of major businesses and industries are being run on software and delivered as online services—from motion pictures to agriculture to national defense. Regardless of the industry, companies face constant competitive threats from both established rivals and entrepreneurial technology companies that are developing disruptive software. These threats will force companies to become more agile and to respond to competitive threats more quickly, efficiently, and effectively.


**Reflect**

1. If every company is now a technology company, then what does this mean for the company's employees? Provide specific examples to support your answer.

**What We Learned from This Case**

The chapter-opening case illustrates that the impacts of information technology are wide-ranging, global, and disruptive. You will encounter many other examples of the societal and environmental effects of information technology throughout this text. The opening case
underscores how important it is for you to have an understanding of information technology, regardless of your career choice.

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 the information and information-processing needs of an organization. An **information system (IS)** collects, processes, stores, analyzes, and disseminates information for a specific purpose.

The opening case is a dramatic example of the far-reaching effects of IT on individuals, organizations, and our planet. Although this text is largely devoted to the many ways in which IT has transformed 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 leveling the digital playing field.

When you graduate, you either 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 what area of business you major in, what 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!

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 will also have to make effective use of IT.

Accordingly, this chapter begins with a discussion of why you should become knowledgeable about IT. It also 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.

As you see in the following IT's About [Small] Business, small business owners do not need to be experts in information technology to be successful. The core competency of Warby Parker's business is not technology. Rather, the company's business model is its core competency. However, the firm is effectively using IT to support its business model and, thus, to create a successful business.

### 1.1 Why Should I Study Information Systems?

You are 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 college student just 20 years ago.

Essentially, you practice continuous computing, surrounded by a movable information network. This network is created by constant cooperation between the digital devices you carry (e.g.,
Warby Parker (www.warbyparker.com) is an online eyewear retailer that was founded in 2010. The idea for the company was conceived when the firm's founders (MBA students at the time) observed that glasses—uncomplicated, easily breakable, and mass-produced—were typically quite expensive ($500 or more, for example). Significantly, the founders were convinced they knew the reason why glasses cost so much. They perceived the optical industry as an oligopoly, meaning that a small number of companies dominate the business and are making large margins.

Consider, for example, Luxottica (www.luxottica.com), based in Milan, Italy. This company owns LensCrafters, Pearle Vision, Sunglass Hut, Ray-Ban, Oakley, and Oliver Peoples, in addition to the optical shops in Target and Sears. In addition, as a result of a series of license agreements, Luxottica manufactures eyewear for more than 20 top brands, including Chanel, Burberry, Prada, and Stella McCartney. Warby Parker's founders realized that Luxottica had "created the illusion of choice," when in fact they practically monopolized the industry.

Warby Parker devised a strategy to compete with Luxottica. The company uses the same materials and the same Chinese factories as Luxottica. It then sells its glasses at a lower price because it does not have to pay licensing fees, which can amount to as much as 15 percent of the $100 wholesale cost of a pair of glasses. In addition, because Warby Parker markets and sells its products directly to its customers, it does not have to deal with retailers, whose markups can double prices.

Warby Parker's business model allows customers to test the company's retro-style glasses via a mail-order, try-it-at-home program. The glasses (including prescription lenses) cost mere $95, and customers may test up to five frames at a time. In addition, the Warby Parker Web site enables shoppers to upload photos and "try on" frames virtually. Such large-scale individualized shopping experiences have attracted a devoted following. Warby Parker earned $37 million. It has 113 employees, and it opened a 2,500-square-foot store in New York City.

In addition to enjoying great commercial success, Warby Parker has a social mission. For every pair of glasses it sells, it provides subsidies to help someone in need to buy a pair—although not one of Warby's creations.

The company's success is inspiring competition from more established eyeglass retailers. For example, discount fashion site Bluefly (www.bluefly.com) has introduced EyeFly (www.eyefly.com), which sells custom, vintage-looking glasses for $99.

Another competitor is Ditto (www.ditto.com), where shoppers use a computer webcam to record a video of their faces and create a virtual, three-dimensional "you." Then, shoppers can virtually try on different frames, look side to side, and blink. They can also solicit feedback from friends on Facebook by sharing shots of their virtual selves wearing different frames.

Google wants to avoid making users of its Google Glass product look like an actor in a science fiction movie. As a result, the company is working with Warby Parker to design more fashionable frames for Google Glass.

laptops, media players, 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 buy products from companies or 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 video casts to it; design your own page on Facebook; make and upload videos to YouTube; take, edit, and print your own digital photographs; “burn” your own custom-music CDs and DVDs; use RSS feeds to create your personal electronic newspaper; text and tweet your friends and family throughout your day; 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.)

The Informed User—You!

So, the question is: Why should you learn about information systems and information technologies? 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 MIS department installs.

The answer lies in your becoming an informed user; that is, a person knowledgeable about information systems and information technology. There are several reasons why you should be an informed user.

In general, informed users tend to get more value from whatever technologies they use. You will enjoy many benefits from being an informed user of IT.

- First, you will benefit more from your organization’s IT applications because you will understand what is “behind” those applications. That is, what you see on your computer screen is brought to you by your MIS department, who are operating “behind” your screen.
- Second, you will be in a position to enhance the quality of your organization’s IT applications with your input.
- Third, even as a new graduate, you will quickly be in a position to recommend—and perhaps help select—the IT applications that your organization will use.
- Fourth, 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 on the adoption and use of these technologies.
- Fifth, you will understand how using IT can improve your organization’s performance and teamwork as well as your own productivity.
- Finally, if you have ideas of becoming an entrepreneur, then being an informed user will help you use IT when you start your own business.

Going further, 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, the goal is to help you become a very informed user!
IT Offers Career Opportunities

Because information technology 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 information systems 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, he or she actively participates in the organization’s strategic planning process. In today’s digital environment, the IS function has become increasingly strategic within organizations. As a result, although most CIOs still rise from the IS department, a growing number are coming up through the ranks in the business units (e.g., marketing, finance, etc.). So, regardless of your major, you could become the CIO of your organization one day. This is another reason to be an informed user of information systems!

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

<table>
<thead>
<tr>
<th>Position</th>
<th>Job Description</th>
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<tbody>
<tr>
<td>Chief Information Officer</td>
<td>Highest-ranking IS manager; is responsible for all strategic planning in the</td>
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<tr>
<td></td>
<td>organization</td>
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<tr>
<td>IS Director</td>
<td>Manages all systems throughout the organization and the day-to-day operations of</td>
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<tr>
<td></td>
<td>the entire IS organization</td>
</tr>
<tr>
<td>Information Center Manager</td>
<td>Manages IS services such as help desks, hot lines, training, and consulting</td>
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<tr>
<td>Applications Development Manager</td>
<td>Coordinates and manages new systems development projects</td>
</tr>
<tr>
<td>Project Manager</td>
<td>Manages a particular new systems development project</td>
</tr>
<tr>
<td>Systems Manager</td>
<td>Manages a particular existing system</td>
</tr>
<tr>
<td>Operations Manager</td>
<td>Supervises the day-to-day operations of the data and/or computer center</td>
</tr>
<tr>
<td>Programming Manager</td>
<td>Coordinates all applications programming efforts</td>
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<tr>
<td>Systems Analyst</td>
<td>Interfaces between users and programmers; determines information requirements</td>
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<td></td>
<td>and technical specifications for new applications</td>
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<tr>
<td>Business Analyst</td>
<td>Focuses on designing solutions for business problems; interfaces closely with</td>
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<td></td>
<td>users to demonstrate how IT can be used innovatively</td>
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<tr>
<td>Systems Programmer</td>
<td>Creates the computer code for developing new systems software or maintaining</td>
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<tr>
<td></td>
<td>existing systems software</td>
</tr>
<tr>
<td>Applications Programmer</td>
<td>Creates the computer code for developing new applications or maintaining existing</td>
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<tr>
<td></td>
<td>applications</td>
</tr>
<tr>
<td>Emerging Technologies Manager</td>
<td>Forecasts technology trends; evaluates and experiments with new technologies</td>
</tr>
<tr>
<td>Network Manager</td>
<td>Coordinates and manages the organization’s voice and data networks</td>
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<tr>
<td>Database Administrator</td>
<td>Manages the organization’s databases and oversees the use of database-management</td>
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<td></td>
<td>software</td>
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<tr>
<td>Auditing or Computer Security Manager</td>
<td>Oversees the ethical and legal use of information systems</td>
</tr>
<tr>
<td>Webmaster</td>
<td>Manages the organization’s World Wide Web site</td>
</tr>
<tr>
<td>Web Designer</td>
<td>Creates World Wide Web sites and pages</td>
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</table>
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 cooperation.

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

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

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 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
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 center
- 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 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 this task.
- 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
  - Communication between the MIS department and the business units is a two-way street. You will be responsible for educating the MIS staff on your business, its needs, 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 a "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, security, etc.
- Proactively using business and technical knowledge to seed innovative ideas about IT
  - Your business needs often will 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.

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.

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 his or her 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 students with GPAs over 3.0. This example presents 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:

<table>
<thead>
<tr>
<th>Data [No context]</th>
<th>Information [University context]</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.16</td>
<td>3.16 + John Jones = GPA</td>
<td>* Job prospects</td>
</tr>
<tr>
<td>2.92</td>
<td>2.92 + Sue Smith = GPA</td>
<td>* Graduate school prospects</td>
</tr>
<tr>
<td>1.39</td>
<td>1.39 + Kyle Owens = GPA</td>
<td>* Scholarship prospects</td>
</tr>
<tr>
<td>3.95</td>
<td>3.95 + Tom Elias = GPA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data [No context]</th>
<th>Information [Professional baseball pitcher context]</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.16</td>
<td>3.16 + Ken Rice = ERA</td>
<td>* Keep pitcher, trade pitcher, or send pitcher to minor leagues</td>
</tr>
<tr>
<td>2.92</td>
<td>2.92 + Ed Dyas = ERA</td>
<td>* Salary/contract negotiations</td>
</tr>
<tr>
<td>1.39</td>
<td>1.39 + Hugh Carr = ERA</td>
<td></td>
</tr>
<tr>
<td>3.95</td>
<td>3.95 + Nick Ford = ERA</td>
<td></td>
</tr>
</tbody>
</table>

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.

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

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

- **Hardware** consists of devices such as the processor, monitor, keyboard, and printer. Together, these devices accept, process, and display data and information.
- **Software** is a program or collection of programs that enable the hardware to process data.
- A **database** is a collection of related files or tables containing data.
• A **network** is a connecting system (wireline or wireless) that permits different computers to share resources.

• **Procedures** are the instructions for combining the above components to process information and generate the desired output.

• **People** are those individuals who use the hardware and software, interface with it, or utilize its output.

Figure 1.1 illustrates how these components are integrated to form the wide variety of information systems found within an organization. Starting at the bottom of the figure, you see that the IT components of hardware, software, networks (wireline and wireless), and databases form the **information technology platform**. IT personnel use these components to develop information systems, oversee security and risk, and manage data. These activities cumulatively are called **information technology services**. The IT components plus IT services comprise the organization's **information technology infrastructure**. At the top of the pyramid are the various organizational information systems.

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

Information systems perform these various tasks via a wide spectrum of applications. An **application** (or **app**) is a computer program designed to support a specific task or business process. (A synonymous term is **application program**.) Each functional area or department within a business organization uses dozens of application programs. For instance, the human resources department sometimes uses one application for screening job applicants and another for monitoring employee turnover. The collection of application programs in a single department is usually referred to as a **departmental information system** (also known as a **functional area information system**). For example, the collection of application programs in the human resources area is called **FIGURE 1.1 Information technology inside your 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.
Interpret vast amounts of data quickly and efficiently.
Automate both semiautomatic business processes and manual tasks.

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 1.1 illustrates the different types of information systems that function within a single organization, and Figure 1.2 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 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.

FIGURE 1.2  Information systems that function among multiple organizations.
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 supporting pillars for the information systems located at the top of Figure 1.1, 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, 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 support the entire organization: enterprise resource planning systems and transaction processing systems. **Enterprise resource planning (ERP) systems** are designed to correct a lack of communication among the functional area ISs. For this reason Figure 1.1 shows ERP systems spanning the FAISs. ERP systems were an important innovation because the various functional area ISs were often developed as standalone systems and 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 barcode 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 1.2 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 (i.e., 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. E-commerce systems typically are Internet-based. Figure 1.2 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.

**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 done. Examples of executive decisions are introducing a new product line, acquiring other businesses, and relocating operations to a foreign country.

Office automation systems (OASs) typically support the clerical staff, lower and middle managers, and knowledge workers. These employees use OASs to develop documents (word processing and desktop publishing software), schedule resources (electronic calendars), and communicate (e-mail, voice mail, videoconferencing, and groupware).

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.
Table 1.4 Types of Organizational Information Systems

<table>
<thead>
<tr>
<th>Type of System</th>
<th>Function</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional area IS</td>
<td>Supports the activities within specific functional area.</td>
<td>System for processing payroll</td>
</tr>
<tr>
<td>Transaction processing system</td>
<td>Processes transaction data from business events.</td>
<td>Walmart checkout point-of-sale terminal</td>
</tr>
<tr>
<td>Enterprise resource planning</td>
<td>Integrates all functional areas of the organization.</td>
<td>Oracle, SAP system</td>
</tr>
<tr>
<td>Office automation system</td>
<td>Supports daily work activities of individuals and groups.</td>
<td>Microsoft® Office</td>
</tr>
<tr>
<td>Management information system</td>
<td>Produces reports summarized from transaction data, usually in one functional area.</td>
<td>Report on total sales for each customer</td>
</tr>
<tr>
<td>Decision support system</td>
<td>Provides access to data and analysis tools.</td>
<td>“What-if” analysis of changes in budget</td>
</tr>
<tr>
<td>Expert system</td>
<td>Mimics human expert in a particular area and makes decisions.</td>
<td>Credit card approval analysis</td>
</tr>
<tr>
<td>Executive dashboard</td>
<td>Presents structured, summarized information about aspects of business important to executives.</td>
<td>Status of sales by product</td>
</tr>
<tr>
<td>Supply chain management system</td>
<td>Manages flows of products, services, and information among organizations.</td>
<td>Walmart Retail Link system connecting suppliers to Walmart</td>
</tr>
<tr>
<td>Electronic commerce system</td>
<td>Enables transactions among organizations and between organizations and customers.</td>
<td><a href="http://www.dell.com">www.dell.com</a></td>
</tr>
</tbody>
</table>

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 BI 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 Appendix D.

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.

1.3 How Does IT Impact Organizations?

Throughout this text you will encounter numerous examples of how IT affects various types of organizations. 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 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 noncomputerized 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 antiglare screens that alleviate problems of fatigued or damaged eyesight and chairs that contour the human body to decrease backaches.

**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.

### 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, and 100 percent took their cell phones. Going further, the majority of respondents did some work while vacationing, and almost all of them checked their e-mail regularly.

**The Robot Revolution Is Here Now**

Once restricted largely to science fiction movies, robots that can perform practical tasks are becoming more common. In fact, “cyberpooches,” “nursebots,” and other mechanical beings may be our companions before we know it. Around the world, quasi-autonomous devices have become increasingly common on factory floors, in hospital corridors, and in farm fields. For
home use, iRobot (www.irobot.com) produces the Roomba to vacuum our floors, the Scooba to wash our floors, the Dirt Dog to sweep our garages, the Verro to clean our pools, and the Looj to clean our gutters. Robots are becoming widely used in many other areas, for example, telepresence robots and autonomous cars.

Telepresence robots are designed to help companies save money on travel and on expensive teleconferencing technology. They enable people in remote offices or locations to have a rich communications experience without using a complicated video conference system.

These robots enable an individual to maintain a consistent connection with co-workers, customers, or clients. The user places the robot at a remote location and directs it to move around, for example, a conference room during a meeting, broadcasting what is going on to the human controlling it from afar. Telepresence robots are used for purposes other than conducting business. For example, they let homebuyers virtually tour distant properties, they enable doctors to conduct bedside consultations from a distance (telemedicine), they provide an inexpensive method to patrol workplaces at night, and they allow parents who are out to dinner to stay in touch with their children at home. Other examples are

- Business managers are using telepresence robots to virtually walk factory floors.
- Healthcare organizations are employing robots for home care.
- In the retail environment, a robot could wander the floor with a customer who asks it purchasing or support questions. The person controlling the robot could answer the questions, essentially making the robot a mechanical sales clerk.

Autonomy is commonly defined as the ability of a machine to make decisions without human intervention. The best-known example of an autonomous, or self-driving, car is the Google driverless car. In August 2012, Google announced that its autonomous car team had completed more than 300,000 accident-free, self-driving miles. As of September 2012, four states had passed laws permitting driverless cars: Nevada, Florida, Texas, and California.

As of mid-2013, Google had not announced any plans to commercially develop the system. An attorney for the California Department of Motor Vehicles raised concerns that Google’s technology is “ahead of the law in many areas,” citing state laws that “all presume to have a human being operating the vehicle.”

Audi, Toyota, and Cadillac, among other car brands, are developing autonomous cars as well. It is worth noting that each of Google’s driverless test cars contains about $150,000 in equipment. With so many automobile manufacturers developing autonomous cars, the price will undoubtedly drop quickly.

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.

**Improvements in Healthcare**

IT has brought about major improvements in healthcare 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 videoconferencing. New computer simulations recreate the sense of touch, allowing doctors-in-training to perform virtual procedures without risking harm to an actual patient.
Among the thousands of other healthcare applications, administrative systems are critically important. These systems perform functions ranging from detecting insurance fraud, to creating nursing schedules, to financial and marketing management.

The Internet contains vast amounts of useful medical information (see www.webmd.com, for example). In an interesting study, researchers at the Princess Alexandra Hospital in Brisbane, Australia, identified 26 difficult diagnostic cases published in the New England Journal of Medicine. They selected three to five search terms from each case and then conducted a Google search. Next, they recorded the three diagnoses that Google ranked most prominently and that appeared to fit the symptoms and signs. Finally, they compared these results with the correct diagnoses as published in the journal. The researchers discovered that their Google searches had found the correct diagnosis in 15 of the 26 cases, a success rate of 57 percent. Despite these results, the research team cautions against self-diagnosis. They maintain that people should use diagnostic information gained from Google and medical Web sites such as WebMD (www.webmd.com) only to ask questions of their physicians.

**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:
   - 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 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 and therefore 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).
   - Office automation systems (OASs) typically support the clerical staff, lower and middle managers, and knowledge workers, by enabling them to develop documents (word processing and desktop publishing software), schedule resources (electronic calendars), and communicate (e-mail, voice mail, videoconferencing, and groupware).
   - 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;
   - 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;
- IT can cause job stress and physical problems, such as repetitive stress injury.

4. List positive and negative societal effects of the increased use of information technology.
Positive societal effects:
- IT can provide opportunities for people with disabilities;
- IT can provide people with flexibility in their work (e.g., work from anywhere, anytime);
- Robots will take over mundane chores;
- IT will enable improvements in healthcare.
Negative societal effects:
- IT can cause health problems for individuals;
- IT can place employees on constant call;
- IT can potentially misinform patients about their health problems.

PROBLEM-SOLVING ACTIVITIES

1. Visit some Web sites in your region that offer employment opportunities in IT. Compare the IT salaries to salaries offered to accountants, marketing personnel, financial personnel, operations personnel, and human resources personnel.

2. Access www.irobot.com, and investigate the company’s Education and Research Robots. Surf the Web for other companies in your country that manufacture robots, and compare their products with those of iRobot.

CLOSING CASE: BAXTER: COMING TO WORK RIGHT NEXT TO YOU

The Problem
Manufacturing constitutes a $2 trillion sector of the U.S. economy. For the past 60 years, worker productivity in the manufacturing sector has increased by about 3.7 percent per year.

In the past, the United States has retained higher-value-added manufacturing jobs while allowing lower-value-added jobs go elsewhere. Interestingly, the definition of “elsewhere” has changed over time. The manufacture of simple goods (e.g., toys) is constantly moving to the location with the lowest wages. After the end of World War II, there was an abundance of low-cost labor in Japan, so manufacturing moved there. As the Japanese economy recovered, however, the standard of living rose, and with it the costs of producing goods. As a result, low-cost manufacturing moved to South Korea, where a scenario similar to Japan took place. Manufacturing simple goods then moved to Taiwan, to mainland China, and, most recently, to Vietnam.

From the perspective of a manufacturing company, a more highly educated and skilled workforce typically has less interest in low-skilled jobs designed to manufacture simple goods. As a result, the world will eventually run out of places where low-cost labor is available. Therefore, the question is: What will it take to break out of the cycle of making inexpensive goods by hand with unskilled, inexpensive labor? Perhaps robots are the answer.

The Initial Solution: Industrial Robots
The first industrial robot developed in the United States was put to work in 1961 in the Unimate, a General Motors factory located in Ewing, New Jersey. The Unimate placed hot, forged car parts into a liquid bath to cool them. At the time, companies could not place a computer on an industrial robot, because computers cost millions of dollars and were room-sized. Sensors were also extremely expensive. As a result, early industrial robots were effectively blind and very dumb, and they performed repeated actions only by following a closely defined physical path dictated by a computer program.

Today’s industrial robots still perform well on very narrowly defined, repeatable tasks. However, they are not adaptable, flexible, or easy to use. In addition, most industrial robots are not safe for people to be around. Moreover, it typically takes 18 months to integrate an industrial robot into a factory operation.

As of mid-2013, 70 percent of all industrial robots were being utilized in automobile factories. These machines are often thought of as money savers for companies. However, the cost to integrate one of today’s industrial robots into a factory operation is often 3 to 5 times the cost of the robot itself. Such integration requires the services of computer programmers and machine specialists. In addition, companies must place safety cages around the robots so that they do not strike people while they are operating. Further, most industrial robots have no sensors or means to detect what is happening in their environment.

There are some 300,000 small manufacturing companies in the United States that have fewer than 500 employees. Almost none of these firms have an industrial robot, for the reasons we have just discussed. In addition, almost all of these firms have relatively small production runs, meaning that they are constantly changing the design and manufacturing procedures for what they produce. Some of these companies, called job shops, produce a wide variety of goods for other companies. They specialize in manufacturing a type of product that can be highly customized to an individual client’s needs. In a typical factory that uses an industrial robot, a production run is rarely less than four months long. For a job shop, a production run can be as short as one hour. Clearly, then, small manufacturing firms need a different kind of robot.
A Next-Generation Solution: Baxter

Rethink Robotics (www.rethinkrobotics.com) may have an answer with Baxter, a new kind of industrial robot that sells for $22,000. Baxter is very different from existing industrial robots. It does not need an expensive or elaborate safety cage, and factory operators do not need to segregate it from human workers. In fact, humans can actually share a workspace with Baxter.

Unlike other industrial robots, Baxter works right out of the box. It can be integrated into a factory’s work flow in about an hour. Baxter also requires no special programming. In addition, engineers can go deeper into Baxter’s menu system to adjust and optimize settings for different tasks.

Interacting with Baxter is more like working with a person than operating a traditional industrial robot. If Baxter picks up something it shouldn’t on the assembly line, for instance, workers can take its arm and move the robot to put the object down.

Baxter also contains a variety of sensors, including depth sensors as well as cameras in its wrists, so it “sees” with its hands. It is constantly building and adjusting a mathematical model of the world in front of it, enabling it to recognize different objects.

Another benefit of Baxter is that other factory workers can train it. In fact, a factory worker who has never seen a robot before can learn to train Baxter to do simple tasks in five minutes. For example, a worker can show Baxter a part of the task she is asking the robot to perform, and Baxter can infer the rest of the task. Also, if a human is interacting with Baxter or doing part of the task, the robot can figure out how to perform the rest of the task.

The Results

Rethink Robotics launched Baxter on September 18, 2012. It is therefore too early to evaluate this technology. It is worth noting, however, that by mid-2013 Baxter had been “hired” by one company and was being tested by several others.

Specifically, Baxter was working at a K’Nex (www.knex.com) plant outside Philadelphia, helping to stack Super Mario toys and ship them to China. Later in 2013, Baxter is scheduled to begin working at three plastics companies: Rodon (www.rodongroup.com), Nypro (www.nypro.com), and Vanguard Plastics Corporation (www.vanguardplastics.com).

Let’s take a closer look at Vanguard Plastics, a small company with $6 million in annual revenue. Vanguard operates state-of-the-art automated electric presses that crush plastic pellets into different shapes under 1,000 atmospheres of pressure. Custom-built industrial robots—running on overhead tracks—swing down to collect the finished parts and place them on a conveyor.

Vanguard’s key statistic is sales divided by man-hours. Vanguard executives claim that for the company to stay in business, this statistic must improve by 1 percent or more every year. The only way to accomplish this goal is to increase productivity.

One routine job that is still performed by hand is packing parts. Coming off one of the presses are small, textured, plastic cups, which Vanguard sells for 2 cents each to a medical company that uses them to package liquid medicines. A worker from a temporary agency, earning $9 per hour, stacks the cups and then flicks a plastic bag over the stacks.

This is the job for which Vanguard is testing Baxter. Vanguard claims that if Baxter can eliminate one temporary worker—a move that would earn back the company’s investment in a single year—then the company will buy Baxter. However, for the cup-stacking job, Baxter will need a specially designed gripper, which Rethink Robotics is developing. The company is also developing software that will enable Baxter to communicate with other machines. For example, Baxter would be able to tell the conveyor when to move forward or stop.


Reflect

1. Rethink Robotics claims that Baxter will not necessarily replace workers; rather, it will enable workers to transition into higher-paying jobs. Will Baxter replace workers in small manufacturing companies? Why or why not? Support your answer.
2. Discuss the possible reactions of labor unions to Baxter.
3. Discuss additional potential applications for Baxter.