CHAPTER

# 1 Business Information Systems in Your Career

## LEARNING OBJECTIVES

After reading this chapter, you will be able to answer the following questions:

**1-1** Why are information systems so essential for running and managing a business today?

**1-2** What exactly is an information system? How does it work? What are its people, organizational, and technology components?

**1-3** How will a four-step method for business problem solving help you solve information system–related problems?

**1-4** What information systems skills and knowledge are essential for business careers?

**1-5** How will MIS help my career?



## CHAPTER CASES

- PCL Construction: The New Digital Firm
- UPS Competes Globally with Information Technology
- Will Automation Steal Our Jobs?
- New Technology at UPS Clashes with Outdated Ways of Working

## VIDEO CASES

- Business in the Cloud: Facebook, Google, and eBay Data Centers
- UPS Global Operations with the DIAD and Worldport

*Instructional Video:*

- Tour IBM's Raleigh Data Center

**MyLab MIS**

- Discussion questions: 1-5, 1-6, 1-7
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- eText with Conceptual Animations

## PCL CONSTRUCTION: THE NEW DIGITAL FIRM

Many people think the most widely used tool in a construction project is a hammer, but it is more likely a filing cabinet or fax machine. The construction industry has traditionally been paper-intensive and manual. A complex project such as a large building requires hundreds of architectural drawings and design documents, which can change daily. Costly delays because of difficulty locating and accessing documents and other project information could make or break a project. Now that's changing, and PCL Construction is at the forefront. Information technology has transformed the way this business works, and it is a prime example of the new digital firm.

PCL is a group of independent general contracting construction companies, with over 4,400 employees in the United States, Canada, and Australia. The organization is active in the commercial, institutional, multifamily residential, renewable energy, heavy industrial, historical restoration, and civil-construction sectors. PCL has corporate headquarters in Edmonton, Alberta, Canada and a United States head office in Denver, Colorado.

At a PCL job site, you'll now see employees using mobile devices, including smartphones, tablets, and laptops, to access important information from PCL systems or input data. Digital touch-screen kiosks throughout the job site and electronic plan rooms provide access to digitized, updated blueprints so team members don't have to waste time tracking down paper versions.

In the past, on-site trailers used to house large paper blueprints for a project. Each time a project team member wanted to view plans, that person had to visit a trailer. With up to 800 active construction projects running simultaneously, PCL had trouble keeping project documentation up to date. Information on paper forms to track small changes to project specifications or work requirements might not reach project decision makers until 30–40 days from the time it was recorded. By then, it was too late—decisions were made "from the gut" rather than based on facts.

PCL Construction plans are now in digital form, or the paper versions are scanned for digital storage. Digitized plans can be revised much more rapidly. By performing much of the design and planning work on the computer, PCL is able to identify and resolve conflicts and constructability issues early in the construction process to help keep projects ahead of schedule and within budget.

PCL implemented Project Document Controls (PDC) to facilitate collaboration among project team members. A secure project-based website provides real-time storage and management of information in a single shared accessible

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location. Construction contractors, subcontractors, consultants, suppliers, and clients can work from the same documents wherever they are. PCL uses its own proprietary project management system for budgeting, costing, forecasting, subcontractor tracking, production, and reporting. The project management system is linked to other PCL systems, including the People and Projects database, client management and accounting systems, and the BEST Estimating system. BEST Estimating is PCL's in-house estimating program for creating lump sum and unit price estimates and providing accurate resource and cost information.

PCL started moving its computing work to Microsoft Azure Cloud, which hosts the hardware and software for running some of PCL's applications in remote computing centers managed by Microsoft. Staff working on PCL projects can access information from cloud-based systems at any time and location using mobile devices as well as conventional desktop machines and an Internet connection. PCL saves 80 percent of the cost of backing up its corporate data by using the Azure platform. Azure Cloud also hosts a real-time analytics dashboard to monitor project performance in terms of quality, safety, schedule, and cost. The data are displayed visually as bar graphs or pie charts to construction field staff, project managers, and executives, and colors ranging from red to orange to green display performance ratings.

Sources: "Technology and Innovation," pcl.com, accessed February 9, 2019; "PCL: Capitalizing on the Cloud," itworldcanada.com, accessed February 9, 2019; Brian Jackson, "PCL Constructors Reach New Heights with Real-time Analytics Solution in the Cloud," *IT World Canada*, November 9, 2017.

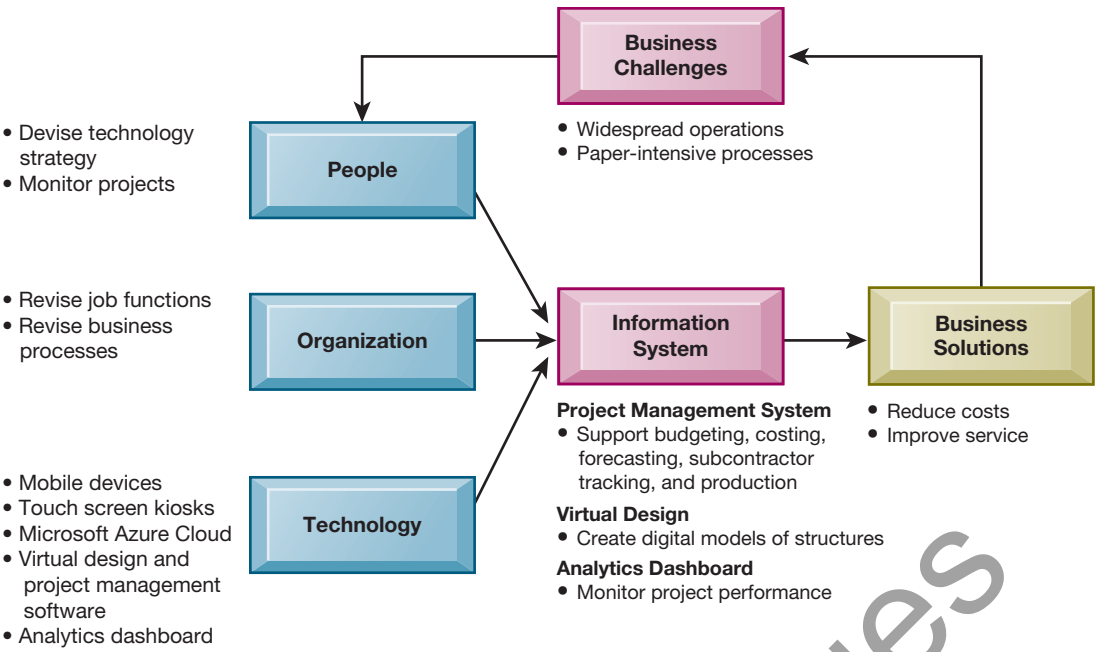


PCL Construction's experience shows how essential information systems are today. PCL operates construction projects in numerous distributed locations in an industry that traditionally has been paper-intensive. Processing and accessing the large number of documents and other information required by construction projects was excessively costly and time-consuming, driving up costs. PCL used leading-edge information technology to digitize documents and streamline business processes for documenting, tracking, and analyzing projects. The information flows that drive PCL's business have become largely digital, making use of mobile tools and a cloud computing infrastructure. PCL Construction has become a leading example of a digital firm.

The chapter-opening diagram calls attention to important points raised by this case and this chapter. To reduce time and costs and improve customer service in a heavily paper-based industry, PCL management chose to use information technology to increase the precision and efficiency of key business activities for designing, costing, budgeting, and monitoring a construction project. These technologies include mobile devices (phones, tablets, laptops), touch screen kiosks, cloud computing services, the Internet, and software for creating models, managing documents, monitoring project progress, budgeting, estimating costs, and displaying key project performance indicators on a digital dashboard. The use of leading-edge digital technologies to drive business operations and management decisions is a key topic today in the MIS world and will be discussed throughout this text.

It is also important to note that deploying information technology has changed the way PCL Construction runs its business. To effectively use all of its new digital tools, PCL had to redesign jobs and procedures for gathering, inputting, and accessing information, for designing, budgeting, and calculating costs, and for monitoring project progress. These changes had to be carefully planned to make sure they enhanced efficiency, service, and profitability.

Here are some questions to think about: How did information technology change operations at PCL Construction? What was the role of mobile technology and cloud computing?




## 1-1 Why are information systems so essential for running and managing a business today?

It's not business as usual in America, or the rest of the global economy, anymore. In 2018, American businesses invested nearly $1 trillion in information systems hardware, software, and telecommunications equipment—about 33 percent of all capital investment in the United States. In addition, they spent another $143 billion on business and management consulting and information technology services, much of which involves redesigning firms' business operations to take advantage of these new technologies. Together, investments in technology and management consulting grew at around 3.5 percent in 2018, far faster than the economy as a whole (Bureau of Economic Analysis, 2018). Worldwide, non-US expenditures for information technology exceeded $3.8 trillion in 2019 (Gartner, Inc., 2019).

### HOW INFORMATION SYSTEMS ARE TRANSFORMING BUSINESS

You can see the results of this spending around you every day. Cell phones, smartphones, tablet computers, email, and online conferencing over the Internet have all become essential tools of business. In 2018, more than 150 million businesses had registered .com or .net Internet sites. Approximately 190 million people bought something online, 220 million researched a product, 230 million used a search engine, and 180 million of these searchers used their mobile devices. What this means is that if you and your business aren't connected to the Internet and mobile apps, chances are you are not being as effective as you could be (eMarketer, 2019; Pew Internet and American Life, 2019).

In 2018 FedEx moved more than 1 billion packages worldwide, mostly overnight, and United Parcel Service (UPS) moved more than 5 billion packages as businesses sought to sense and respond to rapidly changing customer demand, reduce inventories to the lowest possible levels, and achieve higher levels of operational efficiency. The growth of e-commerce has had a significant impact on UPS's shipping volume; UPS delivers about 45 percent of all e-commerce shipments, representing about 25 percent of its revenue. Supply chains have become faster paced,

with companies of all sizes depending on the delivery of just-in-time inventory to help them compete. Companies today manage their inventories in near real time to reduce their overhead costs and get to market faster. If you are not part of this new supply chain management economy, chances are your business is not as efficient as it could be.

Print newspaper readership continues to decline, but more than 200 million people read at least some news online, and 180 million read actual newspapers online, with digital newspaper subscriptions growing at 10 percent annually. Two hundred-twenty million used a social networking site such as Facebook, Tumblr, or Pinterest. More than 160 million banked online, and about 85 million read blogs, creating an explosion of new writers, readers, and new forms of customer feedback that did not exist before. At 39 of the top 50 news sites, 60 percent of the visitors came from mobile devices. Adding to this mix of new social media, about 325 million people worldwide used Twitter (about 126 million in the United States), including 80 percent of *Fortune* 500 firms communicating with their customers. This means your customers are empowered and able to talk to each other about your business products and services. Do you have a solid online customer relationship program in place? Do you know what your customers are saying about your firm? Is your marketing department listening?

E-commerce and Internet advertising spending reached $105 billion in 2018, growing at about 15 percent at a time when traditional advertising and commerce have been flat. Facebook's ad revenue hit $55 billion in 2018, and Google's online ad revenues surpassed $116 billion. Is your advertising department reaching this new web and mobile customer?

Federal security and accounting laws require many businesses to keep email messages for five years. Coupled with existing occupational and health laws requiring firms to store employee chemical exposure data for up to 60 years, these laws are spurring the growth of digital information now estimated to be 4.7 zettabytes (4.7 trillion gigabytes), equivalent to more than 60,000 Libraries of Congress. This trove of information is doubling every year thanks in part to more than 200 billion Internet-linked sensors and data generators. Does your compliance department meet the minimal requirements for storing financial, health, and occupational information? If it doesn't, your entire business may be at risk.

Briefly, it's a new world of doing business, one that will greatly affect your future business career. Along with the changes in business come changes in jobs and careers. No matter whether you are a finance, accounting, management, marketing, operations management, or information systems major, how you work, where you work, and how well you are compensated will all be affected by business information systems. The purpose of this book is to help you understand and benefit from these new business realities and opportunities.



## KEY CHALLENGES IN MANAGEMENT INFORMATION SYSTEMS

What makes management information systems the most exciting topic in business today is the continual change in technology, management use of the technology, and the impact on business success. New start-up firms arrive in traditional industries using the latest technologies and business models. These changes present challenges to all business managers who need to decide how to adapt their firm to new developments. What are the benefits and costs of these new developments in hardware, software, and business practice?

Table 1.1 summarizes the major challenges in business uses of information systems. These challenges confront all managers, not just information systems professionals. These challenges will appear throughout the book in many chapters, so it might be a good idea to take some time now to discuss them with your professor and classmates.

**TABLE 1.1**

Keys Challenges in MIS

| Change | Management Challenge |
|---|---|
| ***Technology*** | |
| Cloud computing platform emerges as a major business area of innovation. | A flexible collection of computers on the Internet begins to perform tasks traditionally performed at corporate data centers. Major business applications can be delivered online as an Internet service (software as a service [SaaS]). What are the costs and benefits of cloud computing and how much of the firm's IT infrastructure should be moved to cloud providers? |
| Big Data and the Internet of Things (IoT) | Businesses look for insights in huge volumes of data from web traffic, email messages, social media content, and Internet-connected machines (sensors).<br>More powerful data analytics and interactive dashboards can provide real-time performance information to managers to enhance decision making. Does our firm have the ability to analyze and use Big Data and analytics? How can we use IoT to provide better products and services? |
| Artificial Intelligence (AI) | Computer programs can find patterns in large databases that can help managers understand their business, and provide better products. Where could we use AI and where can we find the expertise? What benefits can we expect? How much will it cost? |
| The mobile platform | Business and personal computing is increasingly moving to smartphones,high-definition tablet computers, car infotainment systems, and wearable devices. These mobile devices can use thousands of applications to support collaboration, coordination of work, communication with colleagues and customers, and online purchases. Over 90 percent of Internet users access the web with mobile devices. Are we making the best use of mobile capabilities for our employees and customers? Where could we improve? What are the costs and benefits? |
| ***Management and People*** | |
| Return on investment (ROI) | Although firms spend millions on information systems and services, they typically have little understanding of how much benefit they receive. How can we measure and understand the benefit we are receiving from IS/IT expenditures? Are there alternative sources of these services that would cost less? |
| Online collaboration and social networking | Millions of business professionals use Google Apps, Google Drive, Microsoft Office 365, Yammer, Zoom, and IBM Connections to support blogs, project management, online meetings, personal profiles, and online communities. Is our firm making a coordinated effort to use new technologies to improve coordination, collaboration, and knowledge sharing? Which of the many alternatives should we be using? |
| ***Organizations*** | |
| Security and privacy | Security lapses and protecting customer privacy are major public issues that affect all businesses. How do we know our data are secure? How much do we spend on security now? What privacy policies do we have in place, and how should we expand our privacy protections as new laws emerge? |
| Social business | Businesses use social networking platforms, including Facebook, Twitter, Instagram, and internal corporate social tools, to deepen interactions with employees, customers, and suppliers. What use are we making of social business tools? Where should we go from here? Are we getting real value from these platforms? |
| Telework gains momentum in the workplace. | The Internet, cloud computing, smartphones, and tablet computers make it possible for growing numbers of people to work away from the traditional office. Forty-three percent of employed Americans reported spending some time working remotely and doing so for longer times. Are we taking advantage of telework, and what are the risks of telework for productivity? |



## GLOBALIZATION CHALLENGES AND OPPORTUNITIES: A FLATTENED WORLD

Prior to AD 1500, there was no truly global economic system of trade that connected all the continents on earth although there were active regional trade markets. After the sixteenth century, a global trading system began to emerge based on advances in

navigation and ship technology. The world trade that ensued after these developments has brought the peoples and cultures of the world much closer together. The Industrial Revolution was really a worldwide phenomenon energized by expansion of trade among nations, making nations both competitors and collaborators in business. The Internet has greatly heightened the competitive tensions among nations as global trade expands and strengthened the benefits that flow from trade, and also created significant dislocations in labor markets.

In 2005, journalist Thomas Friedman wrote an influential book declaring the world was now flat, by which he meant that the Internet and global communications had greatly expanded the opportunities for people to communicate with one another and reduced the economic and cultural advantages of developed countries. The United States and European countries were in a fight for their economic lives, according to Friedman, competing for jobs, markets, resources, and even ideas with highly educated, motivated populations in low-wage areas in the less developed world (Friedman, 2007). This globalization presents you and your business with both challenges and opportunities.

A growing percentage of the economy of the United States and other advanced industrial countries in Europe and Asia depends on imports and exports. In 2018, an estimated 30 percent of the US economy resulted from foreign trade of goods and services, both imports and exports. In Europe and Asia, the number exceeds 50 percent. Half of *Fortune* 500 US firms obtain nearly 50 percent of their revenue from foreign operations. For instance, more than 50 percent of Intel's revenues in 2018 came from overseas sales of its microprocessors. Eighty percent of the toys sold in the United States are manufactured in China; about 90 percent of the PCs manufactured in China use American-made Intel or Advanced Micro Design (AMD) chips.

It's not just goods that move across borders. So too do jobs, some of them high-level jobs that pay well and require a college degree. In the past 15 years, the United States has lost an estimated 2.5 million manufacturing jobs to offshore, low-wage producers, so manufacturing is now a small part of US employment (less than 12 percent) even though it accounts for $2.1 trillion of GDP. In a normal year, about 300,000 service jobs move offshore to lower-wage countries, many of them in less-skilled information system occupations but also in tradable service jobs in architecture, financial services, customer call centers, consulting, engineering, and even radiology.

On the plus side, the US economy created 2.6 million new jobs in 2018. Employment in information systems and the other service occupations listed previously has rapidly expanded in sheer numbers, wages, productivity, and quality of work. Outsourcing has actually accelerated the development of new systems in the United States and worldwide by reducing the cost of building and maintaining them. In 2019 job openings in information systems and technologies far exceeded the supply of applicants.

The challenge for you as a business student is to develop high-level skills through education and on-the-job experience that cannot be outsourced. The challenge for your business is to avoid markets for goods and services that can be produced offshore much less expensively. The opportunities are equally immense. You can learn how to profit from the lower costs available in world markets and the chance to serve a marketplace with billions of customers. You have the opportunity to develop higher-level and more profitable products and services. Throughout this book, you will find examples of companies and individuals who either failed or succeeded in using information systems to adapt to this new global environment.

What does globalization have to do with management information systems? The answer is simple: everything. The emergence of the Internet into a full-blown international communications system has drastically reduced the costs of operating and transacting on a global scale. Communication between a factory floor in Shanghai and a distribution center in Sioux Falls, South Dakota, is now instant and virtually free. Customers now can shop in a worldwide marketplace, obtaining price and quality information reliably 24 hours a day. Firms producing goods and services on a global

scale achieve extraordinary cost reductions by finding low-cost suppliers and managing production facilities in other countries. Internet service firms, such as Google and eBay, can replicate their business models and services in multiple countries without having to redesign their expensive, fixed-cost information systems infrastructure.

## BUSINESS DRIVERS OF INFORMATION SYSTEMS

What makes information systems so essential today? Why are businesses investing so much in information systems and technologies? They do so to achieve six important business objectives: operational excellence; new products, services, and business models; customer and supplier intimacy; improved decision making; competitive advantage; and survival.

### Operational Excellence

Businesses continuously seek to improve the efficiency of their operations to achieve higher profitability. Information systems and technologies are some of the most important tools available to managers for achieving higher levels of efficiency and productivity in business operations, especially when coupled with changes in business practices and management behavior.

Walmart, the largest retailer on earth, exemplifies the power of information systems coupled with sophisticated business practices and supportive management to achieve world-class operational efficiency. In 2019, Walmart achieved more than $514 billion in sales—nearly one-tenth of retail sales in the United States—in large part because of its Retail Link system, which digitally links its suppliers to every one of Walmart's 11,666 stores worldwide. As soon as a customer purchases an item, the supplier monitoring the item knows to ship a replacement to the shelf. Walmart is the most efficient retail store in its industry, achieving sales of more than $600 per square foot compared to its closest competitor, Target, at $300 a square foot.

Amazon, the largest online retailer on earth, generating more than $232 billion in sales in 2018, invested $2.1 billion in information systems so that when one of its estimated 300 million users searches for a product, Amazon can respond in milliseconds with the correct product displayed (and recommendations for other products).

### New Products, Services, and Business Models

Information systems and technologies are a major enabling tool for firms to create new products and services, as well as entirely new business models. A **business model** describes how a company produces, delivers, and sells a product or service to create wealth. Today's music industry is vastly different from the industry a decade ago. Apple Inc. transformed an old business model of music distribution based on vinyl records, tapes, and CDs into an online, legal download distribution model based on its own operating system and iTunes store. Apple has prospered from a continuing stream of innovations, including the original iPod, iTunes music service, iPhone, and iPad.

### Customer and Supplier Intimacy

When a business really knows its customers and serves them well, the way they want to be served, the customers generally respond by returning and purchasing more. This raises revenues and profits. Likewise with suppliers: the more a business engages its suppliers, the better the suppliers can provide vital inputs. This lowers costs. How really to know your customers, or suppliers, is a central problem for businesses with millions of offline and online customers.

The Mandarin Oriental in Manhattan and other high-end hotels exemplify the use of information systems and technologies to achieve customer intimacy. These hotels use information systems to keep track of guests' preferences, such as their preferred room temperature, check-in time, frequently dialed telephone numbers, and television programs, and store these data in a giant data repository. Individual rooms

in the hotels are networked to a central network server so that they can be remotely monitored or controlled. When a customer arrives at one of these hotels, the system automatically changes the room conditions, such as dimming the lights, setting the room temperature, or selecting appropriate music, based on the customer's digital profile. The hotels also analyze their customer data to identify their best customers and develop individualized marketing campaigns based on customers' preferences.

JCPenney exemplifies the benefits of information systems-enabled supplier intimacy. Every time a dress shirt is bought at a JCPenney store in the United States, the record of the sale appears immediately on computers in Hong Kong at TAL Apparel Ltd., a giant contract manufacturer that produces one in eight dress shirts sold in the United States. TAL runs the numbers through a computer model it developed and decides how many replacement shirts to make and in what styles, colors, and sizes. TAL then sends the shirts to each JCPenney store, completely bypassing the retailer's warehouses. In other words, JCPenney's surplus shirt inventory is near zero, as is the cost of storing it.

### Improved Decision Making

Many business managers operate in an information fog bank, never really having the right information at the right time to make an informed decision. Instead, managers rely on forecasts, best guesses, and luck. The result is over- or underproduction of goods and services, misallocation of resources, and poor response times. These poor outcomes raise costs and lose customers. Information systems and technologies have now made it possible for managers to use real-time data from the marketplace when making decisions.

For instance, Verizon Communications, one of the largest telecommunications operating companies in the United States, uses a web-based digital dashboard to provide managers with precise real-time information on customer complaints, network performance for each locality served, and line outages or storm-damaged lines. Using this information, managers can immediately allocate repair resources to affected areas, inform consumers of repair efforts, and restore service fast.



### Competitive Advantage

When firms achieve one or more of these business objectives—operational excellence; new products, services, and business models; customer/supplier intimacy; and improved decision making—chances are they have already achieved a competitive advantage. Doing things better than your competitors, charging less for superior products, and responding to customers and suppliers in real time all add up to higher sales and higher profits that your competitors cannot match. Apple Inc., Walmart, and UPS are industry leaders because they know how to use information systems for this purpose.

### Survival

Business firms also invest in information systems and technologies because they are necessities of doing business. Sometimes these necessities are driven by industry-level changes. For instance, after Citibank introduced the first automated teller machines (ATMs) in the New York region to attract customers through higher service levels, its competitors rushed to provide ATMs to their customers to keep up with Citibank. Today, virtually all banks in the United States have regional ATMs and link to national and international ATM networks, such as CIRRUS. Providing ATM services to retail banking customers is simply a requirement of being in and surviving in the retail banking business.

Many federal and state statutes and regulations create a legal duty for companies and their employees to retain records, including digital records. For instance, the Toxic Substances Control Act (1976), which regulates the exposure of US workers to more than 75,000 toxic chemicals, requires firms to retain records on employee exposure

for 30 years. The Sarbanes–Oxley Act (2002), which was intended to improve the accountability of public firms and their auditors, requires public companies to retain audit working papers and records, including all email messages, for five years. Firms turn to information systems and technologies to provide the capability to respond to these information retention and reporting requirements. The Dodd–Frank Act (2010) requires financial service firms to expand their public reporting greatly on derivatives and other financial instruments.

## 1-2 What exactly is an information system? How does it work? What are its people, organizational, and technology components?

So far we've used *information systems and technologies* informally without defining the terms. **Information technology (IT)** consists of all the hardware and software that a firm needs to use to achieve its business objectives. This includes not only computers, storage technology, and mobile handheld devices but also software, such as the Windows or Linux operating systems, the Microsoft Office desktop productivity suite, and the many thousands of computer programs that can be found in a typical large firm. Information systems are more complex and can be understood best by looking at them from both a technology and a business perspective.

### WHAT IS AN INFORMATION SYSTEM?

An **information system (IS)** can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making, coordinating, and control in an organization. In addition, information systems may also help managers and workers analyze problems, visualize complex subjects, and create new products.

Information systems contain information about significant people, places, and things within the organization or in the environment surrounding it. By **information**, we mean data that have been shaped into a form that is meaningful and useful to human beings. **Data**, in contrast, are streams of raw facts representing events occurring in organizations or the physical environment before they have been organized and arranged into a form that people can understand and use.



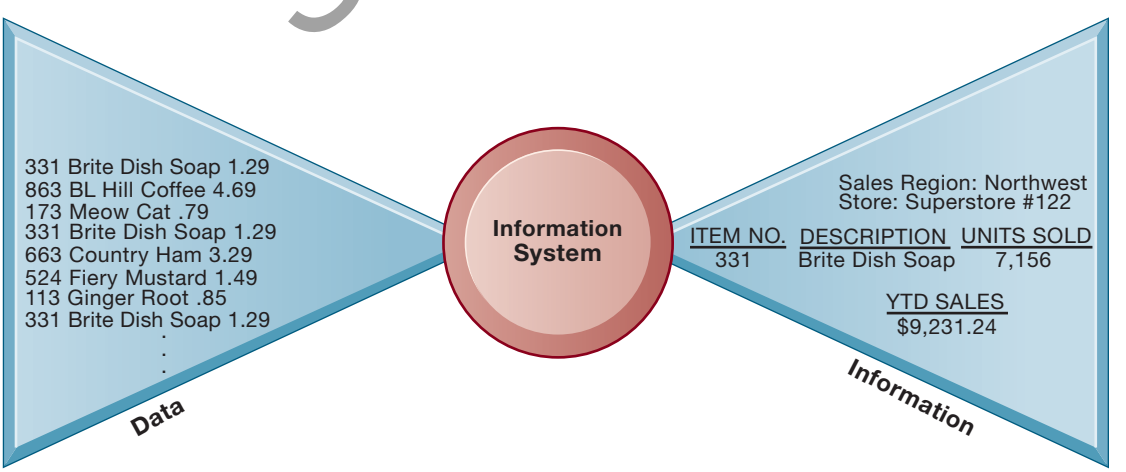



**Figure 1.1**
Data and Information
*Raw data from a supermarket checkout counter can be processed and organized to produce meaningful information, such as the total unit sales of dish detergent or the total sales revenue from dish detergent for a specific store or sales territory.*

A brief example contrasting information and data may prove useful. Supermarket checkout counters scan millions of pieces of data, such as bar codes, that describe the product. Such pieces of data can be totaled and analyzed to provide meaningful information, such as the total number of bottles of dish detergent sold at a particular store, which brands of dish detergent were selling the most rapidly at that store or sales territory, or the total amount spent on that brand of dish detergent at that store or sales region (see Figure 1.1).

Three activities in an information system produce the information that organizations need to make decisions, control operations, analyze problems, and create new products or services. These activities are input, processing, and output (see Figure 1.2). **Input** captures or collects raw data from within the organization or from its external environment. **Processing** converts this raw input into a meaningful form. **Output** transfers the processed information to the people who will use it or to the activities for which it will be used. Information systems also require **feedback**, which is output that is returned to appropriate members of the organization to help them evaluate or correct the input stage.

In PCL's project management system, input includes the names and addresses of contractors and subcontractors, project names and identification numbers, project activities, labor costs, materials costs, and start and completion dates for project activities. Computers store these data and process them to calculate how much each project activity and the entire project will cost and estimated completion time. The system provides meaningful information such as the size, cost, and duration of all projects under PCL management, projects over and under budget, and projects and project activities that are late or on time.

Although computer-based information systems use computer technology to process raw data into meaningful information, there is a sharp distinction between a computer and a computer program and an information system. Computers and related software programs are the technical foundation, the tools and materials, of modern information systems. Computers provide the equipment for storing and processing information. Computer programs, or software, are sets of operating instructions that direct and control computer processing. Knowing how computers and computer programs work is important in designing solutions to organizational problems, but computers are only part of an information system.



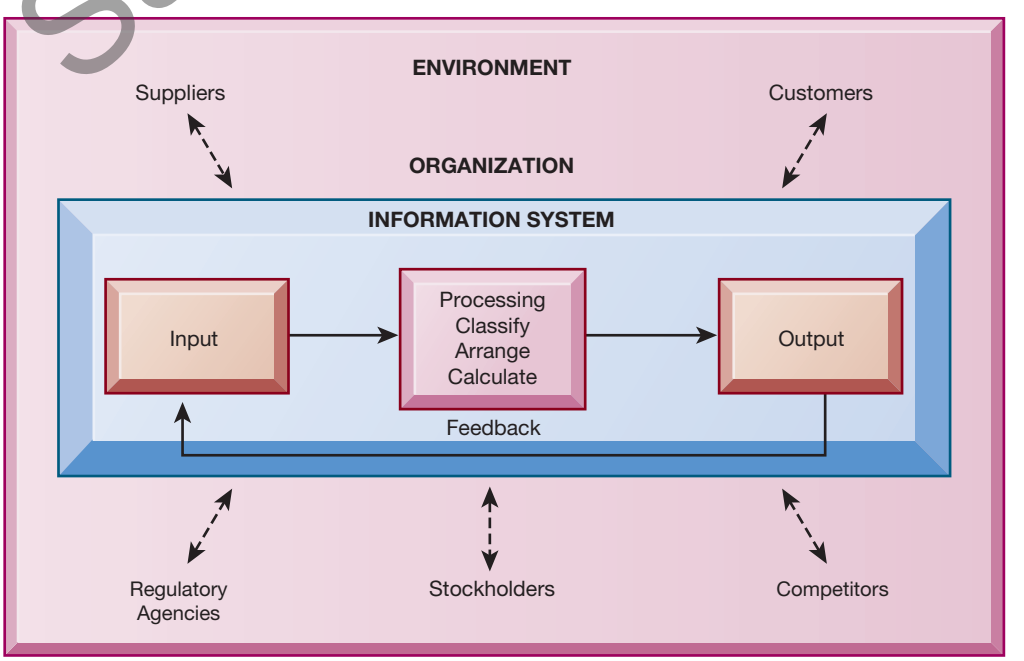



**Figure 1.2**
Functions of an Information System
*An information system contains information about an organization and its surrounding environment. Three basic activities—input, processing, and output—produce the information organizations need. Feedback is output returned to appropriate people or activities in the organization to evaluate and refine the input. Environmental actors, such as customers, suppliers, competitors, stockholders, and regulatory agencies, interact with the organization and its information systems.*

A house is an appropriate analogy. Houses are built with hammers, nails, and wood, but these alone do not make a house. The architecture, design, setting, landscaping, and all of the decisions that lead to the creation of these features are part of the house and are crucial for solving the problem of putting a roof over one's head. Computers and programs are the hammer, nails, and lumber of computer-based information systems, but alone they cannot produce the information a particular organization needs. To understand information systems, you must understand the problems they are designed to solve, their architectural and design elements, and the organizational processes that lead to these solutions.

## IT ISN'T SIMPLY TECHNOLOGY: THE ROLE OF PEOPLE AND ORGANIZATIONS

To understand information systems fully, you will need to be aware of the broader organization, people, and information technology dimensions of systems (see Figure 1.3) and their power to provide solutions to challenges and problems in the business environment. We refer to this broader understanding of information systems, which encompasses an understanding of the people and organizational dimensions of systems as well as the technical dimensions of systems, as **information systems literacy**. Information systems literacy includes a behavioral as well as a technical approach to studying information systems. **Computer literacy**, in contrast, focuses primarily on knowledge of information technology.

The field of **management information systems (MIS)** tries to achieve this broader information systems literacy. MIS deals with behavioral issues as well as technical issues surrounding the development, use, and impact of information systems that managers and employees in the firm use.

## DIMENSIONS OF INFORMATION SYSTEMS

Let's examine each of the dimensions of information systems—organizations, people, and information technology.

### Organizations

Information systems are an integral part of organizations and, although we tend to think about information technology changing organizations and business firms, it is, in fact, a two-way street. The history and culture of business firms also affects how the technology is used and how it should be used. To understand how a specific business firm uses information systems, you need to know something about the structure, history, and culture of the company.



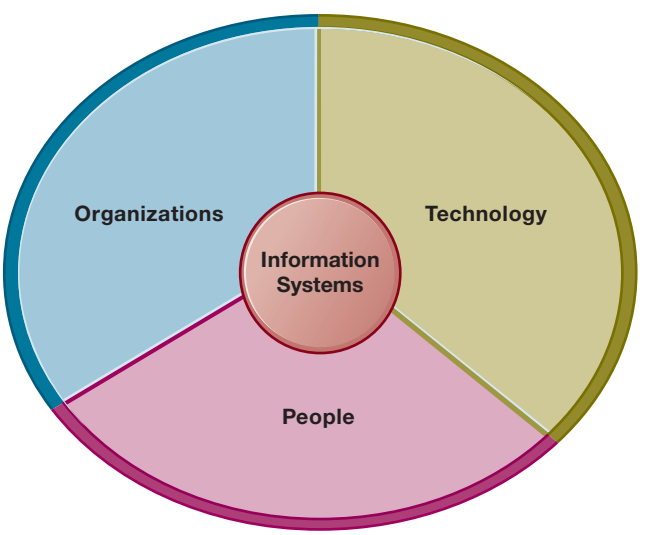



**Figure 1.3**
Information Systems Are More Than Computers
*Using information systems effectively requires an understanding of the organization, people, and information technology shaping the systems. An information system provides a solution to important business problems or challenges facing the firm.*

Organizations have a structure that is composed of different levels and specialties. Their structures reveal a clear-cut division of labor. A business firm is organized as a hierarchy, or a pyramid structure, of rising authority and responsibility. The upper levels of the hierarchy consist of managerial, professional, and technical employees, whereas the lower levels consist of operational personnel. Experts are employed and trained for different business functions, such as sales and marketing, manufacturing and production, finance and accounting, and human resources. The firm builds information systems to serve these different specialties and levels of the firm. Chapter 2 provides more detail on these business functions and organizational levels and the ways in which information systems support them.

An organization accomplishes and coordinates work through this structured hierarchy and through its **business processes**, which are logically related tasks and behaviors for accomplishing work. Developing a new product, fulfilling an order, and hiring a new employee are examples of business processes.

Most organizations' business processes include formal rules that have been developed over a long time for accomplishing tasks. These rules guide employees in a variety of procedures, from writing an invoice to responding to customer complaints. Some of these business processes have been written down, but others are informal work practices, such as a requirement to return telephone calls from coworkers or customers, that are not formally documented. Information systems automate many business processes. For instance, how a customer receives credit or how a customer is billed is often determined by an information system that incorporates a set of formal business processes.

Each organization has a unique **culture**, or fundamental set of assumptions, values, and ways of doing things, that has been accepted by most of its members. Parts of an organization's culture can always be found embedded in its information systems. For instance, the United Parcel Service's concern with placing service to the customer first is an aspect of its organizational culture that can be found in the company's package tracking systems.

Different levels and specialties in an organization create different interests and points of view. These views often conflict. Conflict is the basis for organizational politics. Information systems come out of this cauldron of differing perspectives, conflicts, compromises, and agreements that are a natural part of all organizations.



## People

A business is only as good as the people who work there and run it. Likewise with information systems, they are useless without skilled people to build and maintain them or people who can understand how to use the information in a system to achieve business objectives.

For instance, a call center that provides help to customers by using an advanced customer relationship management system (described in later chapters) is useless if employees are not adequately trained to deal with customers, find solutions to their problems, and leave the customer feeling that the company cares for them. Likewise, employee attitudes about their jobs, employers, or technology can have a powerful effect on their abilities to use information systems productively.

Business firms require many kinds of skills and people, including managers as well as rank-and-file employees. The job of managers is to make sense out of the many situations organizations face, make decisions, and formulate action plans to solve organizational problems. Managers perceive business challenges in the environment, they set the organizational strategy for responding to those challenges, and they allocate the human and financial resources to coordinate the work and achieve success. Throughout, they must exercise responsible leadership.

However, managers must do more than manage what already exists. They must also create new products and services and even re-create the organization from time to time. A substantial part of management responsibility is creative work driven

by new knowledge and information. Information technology can play a powerful role in helping managers develop novel solutions to a broad range of problems.

As you will learn throughout this text, technology is relatively inexpensive today, but people are very expensive. Because people are the only ones capable of business problem solving and converting information technology into useful business solutions, we spend considerable effort in this text looking at the people dimension of information systems.

## Technology

Information technology is one of many tools managers use to cope with change and complexity. **Computer hardware** is the physical equipment used for input, processing, and output activities in an information system. It consists of the following: computers of various sizes and shapes; various input, output, and storage devices; and networking devices that link computers.

**Computer software** consists of the detailed, preprogrammed instructions that control and coordinate the computer hardware components in an information system. Chapter 5 describes the contemporary software and hardware platforms firms use today in greater detail.

**Data management technology** consists of the software governing the organization of data on physical storage media. More detail on data organization and access methods can be found in Chapter 6.

**Networking and telecommunications technology**, consisting of both physical devices and software, links the various pieces of hardware and transfers data from one physical location to another. Computers and communications equipment can be connected in networks for sharing voice, data, images, sound, and video. A **network** links two or more computers to share data or resources such as a printer.

The world's largest and most widely used network is the **Internet**, a global network of networks that uses universal standards (described in Chapter 7) to connect millions of networks in more than 230 countries around the world.

The Internet has created a new, universal technology platform on which to build new products, services, strategies, and business models. This same technology platform has internal uses, providing the connectivity to link different systems and networks within the firm. Internal corporate networks based on Internet technology are called **intranets**. Private intranets extended to authorized users outside the organization are called **extranets**, and firms use such networks to coordinate their activities with other firms for making purchases, collaborating on design, and performing other interorganizational work. For most business firms today, using Internet technology is a business necessity and a competitive advantage.

The **World Wide Web** is a service the Internet provides that uses universally accepted standards for storing, retrieving, formatting, and displaying information in a page format on the Internet. Web pages contain text, graphics, animations, sound, and video and are linked to other web pages. By clicking highlighted words or buttons on a web page, you can link to related pages to find additional information and links to other locations on the web. The web can serve as the foundation for new kinds of information systems such as UPS's web-based package tracking system.

All these technologies, along with the people required to run and manage them, represent resources that can be shared throughout the organization and constitute the firm's **information technology (IT) infrastructure**. The IT infrastructure provides the foundation, or *platform*, on which the firm can build its specific information systems. Each organization must carefully design and manage its information technology infrastructure so that it has the set of technology services it needs for the work it wants to accomplish with information systems. Chapters 5, 6, 7, and 8 of this text examine each major technology component of information technology infrastructure and show how they all work together to create the technology platform for the organization.

# UPS Competes Globally with Information Technology

United Parcel Service (UPS) started out in 1907 in a closet-sized basement office. Jim Casey and Claude Ryan—two teenagers from Seattle with two bicycles and one phone—promised the "best service and lowest rates." UPS has used this formula successfully for more than a century to become the world's largest ground and air package-delivery company. It's a global enterprise with more than 454,000 employees and over 119,000 delivery vehicles.

Today UPS delivers 5.1 billion packages and documents in more than 220 countries and territories. The firm has been able to maintain leadership in small-package delivery services despite stiff competition from FedEx and the US Postal Service by investing heavily in advanced information technology. UPS spends more than $1 billion each year to maintain a high level of customer service while keeping costs low and streamlining its overall operations.

It all starts with the scannable bar-coded label attached to a package, which contains detailed information about the sender, the destination, and when the package should arrive. Customers can download and print their own labels using special software provided by UPS or by accessing the UPS website. Before the package is even picked up, information from the "smart" label is transmitted to one of UPS's computer centers in Mahwah, New Jersey, or Alpharetta, Georgia, and sent to the distribution center nearest its final destination.

Dispatchers at this center download the label data and use special routing software called ORION to create the most efficient delivery route for each driver that considers traffic, weather conditions, and the location of each stop. Each UPS driver makes an average of 100 stops per day. In a network with 55,000 routes in the United States alone, shaving even one mile off each driver's daily route translates into big savings in time, fuel consumption, miles driven, and carbon emissions—as much as $400 million per year.

These savings are critical as UPS tries to boost earnings growth as more of its business shifts to less-profitable e-commerce deliveries. UPS drivers who used to drop off several heavy packages a day at one retailer now often make multiple stops scattered across residential neighborhoods, delivering one package per household. The shift requires more fuel and more time, increasing the cost to deliver each package.

The first thing a UPS driver picks up each day is a handheld computer called a Delivery Information Acquisition Device (DIAD), which can access a wireless cell phone network. As soon as the driver logs on, his or her day's route is downloaded onto the handheld. The DIAD also automatically captures customers' signatures along with pickup and delivery information. Package tracking information is then transmitted to UPS's computer network for storage and processing. From there, the information can be accessed worldwide to provide proof of delivery to customers or to respond to customer queries. It usually takes less than 60 seconds from the time a driver presses "complete" on the DIAD for the new information to be available on the web.

Through its automated package tracking system, UPS can monitor and even reroute packages throughout the delivery process. At various points along the route from sender to receiver, bar code devices scan shipping information on the package label and feed data about the progress of the package into the central computer. Customer service representatives are able to check the status of any package from desktop computers linked to the central computers and respond immediately to inquiries from customers. UPS customers can also access this information from the company's website using their own computers or mobile phones. UPS now has mobile apps and a mobile website for iPhone, BlackBerry, and Android smartphone users.

Anyone with a package to ship can access the UPS website to track packages, check delivery routes, calculate shipping rates, determine time in transit, print labels, and schedule a pickup. The data collected at the UPS website are transmitted to the UPS central computer and then back to the customer after processing. UPS also provides tools that enable customers, such as Cisco Systems, to embed UPS functions, such as tracking and cost calculations, into their own websites so that they can track shipments without visiting the UPS site.

UPS is now leveraging its decades of expertise managing its own global delivery network to manage logistics and supply chain activities for other companies. It created a UPS Supply Chain Solutions division that provides a complete bundle of standardized services to subscribing companies at a fraction of what it would cost to build their own systems and infrastructure. These services include supply chain design and management,

freight forwarding, customs brokerage, mail services, multimodal transportation, and financial services in addition to logistics services.

UPS technology and business services are helpful to businesses of all sizes, including small start-ups. Fondarific is a Savannah-based company that manufactures and sells fondant icings for decorating wedding cakes and childrens'cakes. UPS made it possible for Fondarific to grow rapidly when international sales took off. UPS set up a class in exporting to teach Fondarific how to manage international sales and logistics and how to use its WorldShip global shipping software for UPS package and freight services. UPS also showed the company how to integrate shipping systems with Quickbooks accounting software and inventory software.

UPS provides both financial and shipping advice and services to 4Moms, a Pittsburgh-headquartered company with 80 employees that makes innovative baby products using consumer technology. 4Moms uses UPS Trade Direct, which enables companies to reduce freight and inventory costs by bypassing distribution centers and shipping their goods directly to retailers. The UPS Cargo Finance service helps 4Moms manage the cost of inventory as it is shipped around the world.

Sources: Bloomberg, "UPS Sees Payoff From $20Bn Tech Bet, SupplyChainBrain," April 24, 2019; www.ups.com, accessed February 7, 2019; Shefali Kapadia, "Company of the Year: UPS," *Supply Chain Dive*, December 3, 2018; and Haylle Sok, "UPS Technology to Save $75 Million per Year in 2020," *Global Trade*, December 25, 2018.

## CASE STUDY QUESTIONS

1. What are the inputs, processing, and outputs of UPS's package tracking system?
2. What technologies are used by UPS? How are these technologies related to UPS's business strategy?
3. What strategic business objectives do UPS's information systems address?
4. What would happen if UPS's information systems were not available?



The Interactive Session on Technology describes some of the typical technologies used in computer-based information systems today. UPS invests heavily in information systems technology to make its business more efficient and customer oriented. It uses an array of information technologies, including bar code scanning systems, wireless networks, large mainframe computers, handheld computers, the Internet, and many pieces of software for tracking packages, calculating fees, maintaining customer accounts, and managing logistics. As you read this case, try to identify the problem this company was facing, what alternative solutions were available to management, and how well the chosen solution worked.

Let's identify the organization, people, and technology elements in the UPS package tracking system we have just described. The organization element anchors the package tracking system in UPS's sales and production functions (the main product of UPS is a service—package delivery). It specifies the required procedures for identifying packages with both sender and recipient information, taking inventory, tracking the packages en route, and providing package status reports for UPS customers and customer service representatives.

The system must also provide information to satisfy the needs of managers and workers. UPS drivers need to be trained in both package pickup and delivery procedures and in how to use the package tracking system so that they can work efficiently and effectively. UPS customers may need some training to use UPS in-house package tracking software or the UPS website.

UPS's management is responsible for monitoring service levels and costs and for promoting the company's strategy of combining low cost and superior service. Management decided to use automation to increase the ease of sending a package via UPS and of checking its delivery status, thereby reducing delivery costs and increasing sales revenues.

The technology supporting this system consists of handheld computers, bar code scanners, wired and wireless communications networks, desktop computers, UPS's central computer, storage technology for the package delivery data, UPS in-house package tracking software, and software to access the web. The result is an information system solution to the business challenge of providing a high level of service with low prices in the face of mounting competition.

## 1-3 How will a four-step method for business problem solving help you solve information system–related problems?

Our approach to understanding information systems is to consider information systems and technologies as solutions to a variety of business challenges and problems. We refer to this as a problem-solving approach. Businesses face many challenges and problems, and information systems are one major way of solving these problems. All the cases in this book illustrate how a company used information systems to solve a specific problem.

The problem-solving approach has direct relevance to your future career. Your future employers will hire you because you can solve business problems and achieve business objectives. Your knowledge of how information systems contribute to problem solving will be very helpful to both you and your employers.

### THE PROBLEM-SOLVING APPROACH

At first glance, problem solving in daily life seems to be perfectly straightforward; a machine breaks down, parts and oil spill all over the floor, and, obviously, somebody has to do something about it. So, of course, you find a tool around the shop and start repairing the machine. After a cleanup and proper inspection of other parts, you start the machine, and production resumes.

No doubt, some problems in business are this straightforward, but few problems are this simple in the real world of business. In real-world business firms, a number of major factors are simultaneously involved in problems. These major factors can usefully be grouped into three categories: *organization, technology,* and *people*. In other words, a whole set of problems is usually involved.



### A MODEL OF THE PROBLEM-SOLVING PROCESS

There is a simple model of problem solving that you can use to help you understand and solve business problems by using information systems. You can think of business problem-solving as a four-step process (see Figure 1.4). Most problem solvers work through this model on their way to finding a solution. Let's take a brief look at each step.

#### Problem Identification

The first step in the problem-solving process is to understand what kind of problem exists. Contrary to popular beliefs, problems are not like basketballs on a court simply waiting to be picked up by some objective problem solver. Before problems can be solved, there must be agreement in a business that a problem exists, about what the problem is, about its causes, and about what can be done about it, given the limited resources of the organization. Problems have to be properly defined by people in an organization before they can be solved.

For instance, what at first glance what might seem like a problem with employees not adequately responding to customers in a timely and accurate manner might in reality be a result of an older, out-of-date information system for keeping track of customers; or it might be a combination of both poor employee incentives for treating

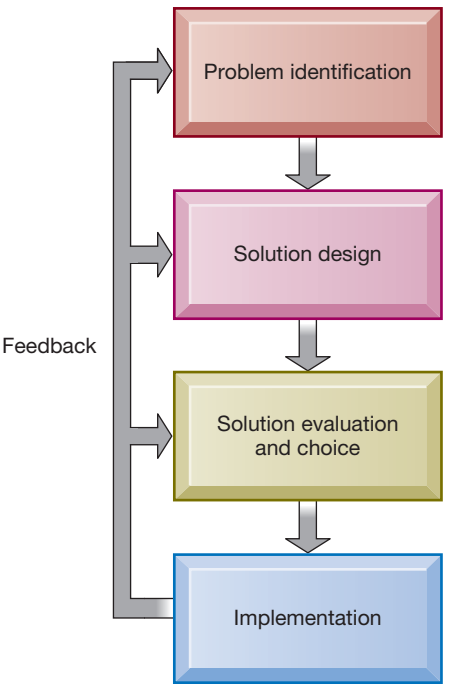



**Figure 1.4**
Problem Solving Is a Continuous Four-Step Process
*During implementation and thereafter, the outcome must be continually measured, and the information about how well the solution is working is fed back to the problem solvers. In this way, the identification of the problem can change over time, solutions can be changed, and new choices can be made, all based on experience.*

customers well and an outdated system. Once you understand this critical fact, you can start to solve problems creatively. Finding answers to these questions will require fact gathering, interviews with people involved in the problem, and analysis of documents and data.

In this text, we emphasize three different and typical dimensions of business problems: organizations, technology, and people (see Table 1.2). Typical organizational problems include poor business processes (usually inherited from the past), unsupportive culture, political infighting, and changes in the organization's surrounding environment. Typical technology problems include insufficient or aging hardware, outdated software, inadequate database capacity, insufficient network capacity, and the incompatibility of old systems with new technology. Typical people problems include employee training, difficulties of evaluating performance, legal and regulatory compliance, ergonomics, poor or indecisive management, and employee support and participation. When you begin to analyze a business problem, you will find these dimensions are helpful guides to understanding the kind of problem with which you are working.



## Solution Design

The second step is to design solutions to the problem(s) you have identified. As it turns out, there are usually a great many solutions to any given problem, and the choice of solution often reflects the differing perspectives of people in an organization. You should try to consider as many solutions as possible so that you can understand the range of possible solutions. Some solutions emphasize technology; others focus on change in the organization and people aspects of the problem. As you will find throughout the text, most successful solutions result from an integrated approach in which changes in organization and people accompany new technologies.

## Solution Evaluation and Choice

Choosing the best solution for your business firm is the next step in the process. Some of the factors to consider when trying to find the best single solution are the cost of the solution, the feasibility of the solution for your business given existing resources and skills, and the length of time required to build and implement the solution. Also very important at this point are the attitudes and support of your employees and

**TABLE 1.2**
Dimensions of Business Problems

| Dimension | Description |
|---|---|
| Organizational dimensions | Outdated business processes |
| | Unsupportive culture and attitudes |
| | Political conflict |
| | Turbulent business environment, change |
| | Complexity of task |
| | Inadequate resources |
| Technology dimensions | Insufficient or aging hardware |
| | Outdated software |
| | Inadequate database capacity |
| | Insufficient network capacity |
| | Incompatibility of old systems with new technology |
| | Rapid technological change and failure to adopt new technology |
| People dimensions | Lack of employee training |
| | Difficulties of evaluating performance |
| | Legal and regulatory compliance |
| | Work environment |
| | Lack of employee support and participation |
| | Indecisive management |
| | Poor management |
| | Wrong incentives |



managers. A solution that does not have the support of all the major interests in the business can quickly turn into a disaster.

## Implementation

The best solution is one that can be implemented. Implementation of an information system solution involves building the solution and introducing it into the organization. This includes purchasing or building the software and hardware—the technology part of the equation. The software must be tested in a realistic business setting; then employees need to be trained, and documentation about how to use the new system needs to be written.

You will definitely need to think about change management. **Change management** refers to the many techniques used to bring about successful change in a business. Nearly all information systems require changes in the firm's business processes and, therefore, changes in what hundreds or even thousands of employees do every day. You will have to design new, more efficient business processes and then figure out how to encourage employees to adapt to these new ways of doing business. This may require meeting sessions to introduce the change to groups of employees, new training modules to bring employees quickly up to speed on the new information systems and processes, and, finally, some kind of rewards or incentives to encourage people to support the changes enthusiastically.

Implementation also includes the measurement of outcomes. After a solution has been implemented, it must be evaluated to determine how well it is working and whether any additional changes are required to meet the original objectives. This information is fed back to the problem solvers. In this way, the identification of the problem can change over time, solutions can be changed, and new choices made, all based on experience.

## Problem Solving: A Process, Not an Event

It is easy to fall into the trap of thinking about problem solving as an event that is over at some point, like a relay race or a baseball game. Often in the real world, this

does not happen. Sometimes the chosen solution does not work, and new solutions are required.

For instance, the US National Aeronautics and Space Administration (NASA) spent more than $1 billion to fix a problem with shedding foam on the space shuttle. Experience proved the initial solution did not work. More often, the chosen solution partially works but needs a lot of continuous changes to fit the situation well. Sometimes, the nature of the problem changes in a way that makes the initial solution ineffective. For instance, hackers create new variations on computer viruses that require continually evolving antivirus programs to hold them in check. For all these reasons, problem solving is a continuous process rather than a single event.

## THE ROLE OF CRITICAL THINKING IN PROBLEM SOLVING

It is amazingly easy to accept someone else's definition of a problem or to adopt the opinions of some authoritative group that has objectively analyzed the problem and offers quick solutions. You should try to resist this tendency to accept existing definitions of any problem. It is essential for you to try to maintain some distance from any specific solution until you are sure you have properly identified the problem, developed understanding, and analyzed alternatives. Otherwise, you may leap off in the wrong direction, solve the wrong problem, and waste resources. You will have to engage in some critical-thinking exercises.

**Critical thinking** can be briefly defined as the sustained suspension of judgment with an awareness of multiple perspectives and alternatives. It involves at least four elements as described below:

- Maintaining doubt and suspending judgment
- Being aware of different perspectives
- Testing alternatives and letting experience guide
- Being aware of organizational and personal limitations

Simply following a rote pattern of decision making, or a model, does not guarantee a correct solution. The best protection against incorrect results is to engage in critical thinking throughout the problem-solving process.

First, maintain doubt and suspend judgment. Perhaps the most frequent error in problem solving is to arrive prematurely at a judgment about the nature of the problem. By doubting all solutions at first and refusing to rush to a judgment, you create the necessary mental conditions to take a fresh, creative look at problems, and you keep open the chance to make a creative contribution.

Second, recognize that all interesting business problems have many dimensions and that the same problem can be viewed from different perspectives. In this text, we have emphasized the usefulness of three perspectives on business problems: technology, organizations, and people. Within each of these broad perspectives are many subperspectives, or views. The *technology perspective*, for instance, includes a consideration of all the components in the firm's IT infrastructure and the way they work together. The *organization perspective* includes a consideration of a firm's business processes, structure, culture, and politics. The ***people perspective*** includes consideration of the firm's management as well as employees as individuals and their interrelationships in workgroups.

You will have to decide for yourself which major perspectives are useful for viewing a given problem. The ultimate criterion here is usefulness: Does adopting a certain perspective tell you something more about the problem that is useful for solving the problem? If not, reject that perspective as not meaningful in this situation and look for other perspectives.

The third element of critical thinking involves testing alternatives, or modeling solutions to problems, letting experience be the guide. Not all contingencies can be known in advance, and much can be learned through experience. Therefore, experiment, gather data, and reassess the problem periodically.

### THE CONNECTIONS AMONG BUSINESS OBJECTIVES, PROBLEMS, AND SOLUTIONS

Now let's make the connection between business information systems and the problem-solving approach. At the beginning of this chapter, we identified six business objectives of information systems: operational excellence; new products, services, and business models; customer/supplier intimacy; improved decision making; strategic advantage; and survival. When firms cannot achieve these objectives, they become challenges or problems that receive attention. Managers and employees who are aware of these challenges often turn to information systems as one of the solutions or the entire solution.

Review the diagram at the beginning of this chapter. The diagram shows how PCL's systems solved the business problem of inefficiencies created by a far-flung, highly paper-intensive business. These systems provided a solution that takes advantage of opportunities provided by new wireless digital technology and the Internet. PCL digitally enabled its key business processes for planning, designing, and monitoring its construction projects. These systems have been essential in improving PCL's overall business performance. The diagram also illustrates how people, technology, and organizational elements work together to create the systems.

Each chapter of this text begins with a diagram similar to this one to help you analyze the chapter-opening case. You can use this diagram as a starting point for analyzing any information system or information system problem you encounter.

## 1-4 What information systems skills and knowledge are essential for business careers?

Looking out to 2026, the US economy will create 11.5 million new jobs, and 34 million existing jobs will open up as their occupants retire. More than 95 percent of the new jobs will be created in the service sector, and the fastest growing jobs will be in healthcare services. About 35 percent of the new jobs will require at least a bachelor's degree, another 30 percent some postsecondary education (US Bureau of Labor Statistics, 2019; US Census, 2019).

What this means is that US business firms are looking for candidates who have a broad range of problem-solving skills—the ability to read, write, and present ideas—as well as the technical skills required for specific tasks. Regardless of your business school major, or your future occupation, information systems and technologies will play a major and expanding role in your day-to-day work and your career. Your career opportunities, and your compensation, will in part depend on your ability to help business firms use information systems to achieve their objectives.

### HOW INFORMATION SYSTEMS WILL AFFECT BUSINESS CAREERS

In the following sections, we describe how specific occupations will be affected by information systems and what skills you should be building in order to benefit from this emerging labor market based on the research of the Bureau of Labor Statistics (Bureau of Labor Statistics, 2019; US Census, 2019).

#### Accounting

There are about 1.4 million accountants in the US labor force today, and the field is expected to expand by 11 percent by the year 2026, adding 140,000 new jobs and twice as many to replace retirees. This above-average growth in accounting is driven in part by new accounting laws for public companies, greater scrutiny of public and private firms by government tax auditors, and a growing demand for management and operational advice.

Accountants rely heavily on information systems to summarize transactions, create financial records, organize data, and perform financial analysis. Because of new public laws, accountants require an intimate knowledge of databases, reporting systems, and networks to trace financial transactions. Because so many transactions are occurring over the Internet, accountants need to understand online transaction and reporting systems and how systems are used to achieve management accounting functions in an online and mobile business environment.

## Finance

If you include financial analysts, stock analysts, brokers, loan officers, budget analysts, financial advisors, and related financial service occupations, there are currently about 2 million managers and employees in finance. These financial occupations are expected to grow on average by about 12 percent by the year 2026 and add more than 130,000 new jobs. Financial advisors will grow by 15 percent in this period.

Financial managers play important roles in planning, organizing, and implementing information system strategies for their firms. Financial managers work directly with a firm's board of directors and senior management to ensure that investments in information systems help achieve corporate goals and high returns. The relationship between information systems and the practice of modern financial management and services is so strong that many advise finance majors to comajor in information systems (and vice versa).

## Marketing

No field has undergone more technology-driven change in the past five years than marketing and advertising. The explosion in e-commerce activity described earlier means that eyeballs are moving rapidly to the Internet. Internet advertising is the fastest-growing form of advertising, reaching $105 billion in 2018. Product branding and customer communication are moving online at a fast pace.

There are about 1.5 million public relations, marketing analysts, and marketing and sales managers in the US labor force. This field is growing faster than average, at about 10 percent, and is expected to add more than 300,000 jobs by 2026. There is a much larger group of 1.2 million nonmanagerial employees in marketing-related occupations (art, design, entertainment, sports, and media) and more than 15.9 million employees in sales. These occupations together are expected to create an additional 2 million jobs by 2026. Marketing and advertising managers and specialists deal with large databases of customer behavior both online and offline in the process of creating brands and selling products and services. They develop reports on product performance, retrieve feedback from customers, and manage product development. These managers need an understanding of how enterprise-wide systems for product management, sales force management, and customer relationship management are used to develop products that consumers want, to manage the customer relationship, and to manage an increasingly mobile sales force.

## Operations Management in Services and Manufacturing

The growing size and complexity of modern industrial production and the emergence of huge global service companies have created a growing demand for employees who can coordinate and optimize the resources required to produce goods and services. Operations management as a discipline is directly relevant to three occupational categories: industrial production managers, administrative service managers, and operations analysts.

Production managers, administrative service managers, and operations analysts will be employing information systems and technologies every day to accomplish their jobs, with extensive use of database and analytical software.

*The job of management requires extensive use of information systems to support decision making and monitor the performance of the firm.*





## Management

Management is the largest single group in the US business labor force with more than 13 million members, not including an additional 612,000 management analysts and consultants. Overall, the management corps in the United States is expected to expand at an average pace of 7 percent, adding about 1 million new jobs by 2026. The Bureau of Labor Statistics tracks more than 20 types of managers, all the way from chief executive officer to human resource managers, production managers, project managers, lodging managers, medical managers, and community service managers.

Arguably, it would be impossible to manage business firms today, even very small firms, without the extensive use of information systems. Nearly all US managers use information systems and technologies every day to accomplish their jobs, from desktop productivity tools to mobile applications coordinating the entire enterprise. Managers today manage through a variety of information technologies without which it would be impossible to control and lead the firm.

## Information Systems

The information systems field is one of the fastest-changing and dynamic of all the business professions because information technologies are among the most important tools for achieving business firms' key objectives. The explosive growth of business information systems has generated a growing demand for information systems employees and managers who work with other business professionals to design and develop new hardware and software systems to serve the needs of business.

There are about 3.7 million information system managers and employees in the United States, with an estimated growth rate of 13 percent through 2026, expanding the number of new jobs by more than 500,000. As businesses and government agencies increasingly rely on the Internet for communication and computing resources, system and network security management positions are growing very rapidly. The fastest-growing occupations in this category are software developers (up 24 percent) and web developers (up 15 percent).

## Outsourcing and Offshoring

The Internet has created new opportunities for outsourcing many information systems jobs, along with many other service sector and manufacturing jobs. There are two kinds of outsourcing: outsourcing to domestic US firms and offshore outsourcing to low-wage countries such as India, China, and eastern European countries. Even this distinction blurs as domestic service providers develop global outsourcing centers offshore.

# Will Automation Steal Our Jobs?

The city of Lakeland in central Florida is home to more than 600,000 people, with many employment opportunities at local distribution centers for Amazon, Walmart, Medline, and Publix as well as local factories producing natural and artificial flavors. Yet the good times for Lakeland could rapidly end. A Brookings Institution report based on data from the US Census Bureau and McKinsey & Co. ranked Lakeland third among metro areas that are most at risk of losing jobs due to the automation and artificial intelligence that make its warehouses and factories so productive.

Automation is not the only cause of job losses. The National Bureau of Economic Research estimated that imports of manufactured goods from low-wage countries accounted for nearly half of the 5 million job losses in manufacturing over the last 15 years. The other half of job losses in manufacturing came from increases in productivity due to investments in technology, primarily involving information technology. This continues a long-term historical pattern of technology leading to higher productivity, and job losses. But the increases in productivity have also led to job expansion in other sectors that offset manufacturing losses.

A November 2015 McKinsey Global Institute report by Michael Chui, James Manyika, and Mehdi Miremadi examined 2,000 distinct types of work activities in 800 occupations. The authors found that 45 percent of these work activities could be automated by 2055 using technologies that currently exist. About 51 percent of the work activities Americans perform involve predictable and routine physical work, data collection, and data processing. All of these tasks are ripe for some degree of automation. No one knows exactly how many US jobs will be lost or how soon, but the researchers estimate that from 9 to 47 percent of jobs could eventually be affected and perhaps 5 percent of jobs eliminated entirely. These changes shouldn't lead to mass unemployment because automation could increase global productivity by 0.8 percent to 1.4 percent annually over the next 50 years and create many new jobs.

Unfortunately, the effects of automation are not equally distributed. Automation is splitting the US labor force into two worlds—a small elite group of highly educated professionals earning high salaries at corporations like Intel or AT&T and a sea of less educated workers relegated to low-paying service-sector jobs in hotels, restaurants, and nursing homes. Much of this service work is difficult to automate, and employers have less incentive to replace low-wage workers with machines. Recent research has found that robots and other forms of automation are reducing the demand for workers, weighing down wages, and pushing workers into low-paying parts of the economy.

There is a long-standing belief among economists that by reducing prices and improving quality, technology would raise demand, which would require more jobs, and more productive workers would have higher incomes. Now some economists are not so sure. MIT labor economist David Autor and Anna Salomons of Utrecht University found that over the last 40 years, the number of jobs has declined in many industries that introduced technology to enhance productivity. The only reason unemployment did not rise across the entire economy was because industries with less productivity growth and more low-paying jobs picked up the slack.

Manufacturing jobs have been the hardest hit by robots and automation. According to a study by economists Daron Acemoglu of MIT and Pascual Restrepo of Boston University, for every robot per thousand workers, up to six workers lost their jobs and wages fell as much as 0.75 percent. Acemoglu and Restrepo found little employment increase in other occupations to offset job losses in manufacturing. Acemoglu and Restrepo noted that a specific local economy, such as Detroit, could be especially hard-hit, although nationally the effects of robots are smaller because jobs were created in other places. The new jobs created by technology are not necessarily in the places losing jobs, such as the Rust Belt. Those forced out of a job by robots generally do not have the skills or mobility to assume the new jobs created by automation.

A large body of economists and scholars remain more optimistic about automation. Erik Briynjolfsson, Director of MIT's Initiative on the Digital Economy and professor at MIT Sloan School of Management, agrees that wide-scale automation will produce some disruption over the next 5 to 10 years as automation works its way through the economy.

Brynjolfsson and his research team analyzed a US Department of Labor dataset with descriptions for 964 occupations in the United States. Each job consisted of 20 to 32 tasks. The team evaluated each job's skillset to determine which tasks could be performed better using artificial intelligence (AI) technology and which were performed

better by humans. The study found that in occupation after occupation there were many tasks that AI could perform better than humans, but still plenty of tasks where humans excelled over AI. Brynjolfsson predicted that most jobs in an organization will be partly affected by AI, but there will still be many tasks that humans need to do. And new tasks are likely to increase the demand for labor as they have in the past century, moderating job losses due to automation.

Sources: Eduardo Porter, "Tech Is Splitting the U.S. Work Force in Two," *New York Times*, February 4, 2019; Christopher Mims, "This Thriving City and Many Others Could Soon Be Disrupted by Robots," *Wall Street Journal*, February 9, 2019; Sarah K. White, "AI's Impact on the Future of Work," CIO, June 9, 2018; James Manyika and Michael Spence, "The False Choice Between Automation and Jobs," *Harvard Business Review*, February 5, 2018; Andrew Hobbs, "Automation Will Replace 9 Percent of U.S. Jobs in 2018," *Internet of Business*, February 16, 2018; David Autor and Anna Salomons, "Is Automation Labor-Displacing? Productivity Growth, Employment, and the Labor Share," BPEA Conference Drafts, March 8–9, 2018; Daron Acemoglu and Pascual Restrepo, "Artificial, Intelligence, Automation, and Work," Working Paper 24196. National Bureau of Economic Research, January 2018; Steve Lohr, "Robots Will Take Jobs, But Not as Fast as Some Fear," *New York Times*, January 12, 2017; Daron Acemoglu, David Dorn, Gordon H. Hanson, and Brendan Price, "Import Competition and the Great US Employment Sag of the 2000s," *Journal of Labor Economics* 34, no. 1 Part 2, January 2016; and Michael Chui, James Manyika, and Mehdi Miremadi, "Where Machines Could Replace Humans—and Where They Can't (Yet)," *McKinsey Quarterly*, July 2016.

## CASE STUDY QUESTIONS

**1.** How does automating jobs pose an ethical dilemma? Who are the stakeholders? Identify the options that can be taken and the potential consequences of each.

**2.** If you were the owner of a factory deciding on whether to acquire robots to perform certain tasks, what people, organization, and technology factors would you consider?



The most common and successful offshore outsourcing projects involve production programming and system maintenance programming work, along with call center work related to customer relationship management systems. However, inflation in Indian and Chinese wages for technology work, coupled with the additional management costs incurred in outsourcing projects, is leading to a counter movement of some IT jobs back to the United States. Moreover, although routine technical information systems (IS) jobs such as software maintenance can be outsourced easily, all those management and organizational tasks required in systems development—including business process design, user interface design, and supply chain management—often remain in the United States.

Innovative new products, services, and systems are rarely outsourced either domestically or globally. The advantage of low-wage countries is their low wages and ready availability of technical talent, not their keen sense of new products, services, and technologies for other countries' markets. Software outsourcing of routine IS work to low-wage countries lowers the cost of building and maintaining systems in the United States and other high-wage countries. As systems become less expensive, more are built. The net result is that offshore outsourcing likely increases demand domestically for employment in a wide variety of IS positions.

Given all these factors in the IT labor market, on what kinds of skills should information system majors focus? Following is a list of general skills we believe will optimize employment opportunities:

- An in-depth knowledge of how business firms can use new and emerging hardware and software to make them more efficient and effective, enhance customer and supplier intimacy, improve decision making, achieve competitive advantage, and ensure firm survival. This includes an understanding of artificial intelligence, cloud computing, business analytics, databases, system implementation, and mobile application development.
- An ability to take a leadership role in the design and implementation of new information systems, work with other business professionals to ensure systems meet business objectives, and work with cloud computing services and software firms providing new system solutions.