

CHAPTER

1

Business Information Systems in Your Career

LEARNING OBJECTIVES

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

- I-1** Why are information systems so essential for running and managing a business today?
- I-2** What exactly is an information system? How does it work? What are its people, organizational, and technology components?
- I-3** How will a four-step method for business problem solving help you solve information system–related problems?
- I-4** What information systems skills and knowledge are essential for business careers?
- I-5** How will MIS help my career?

CHAPTER CASES

- PCL Construction: The New Digital Firm
- UPS Competes Globally with Information Technology
- Will AI Kill 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- New Technology at UPS Clashes with Outdated Ways of Working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

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- Hands-on MIS Projects: 1-8, 1-9, 1-10, 1-11

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.

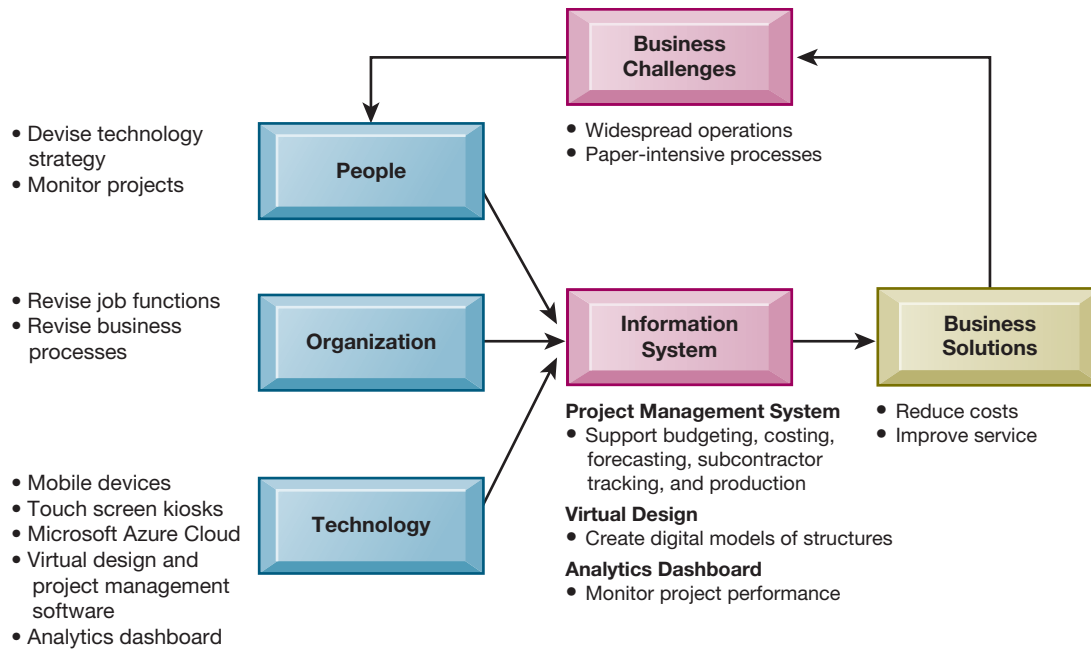
Sources: "Technology and Innovation," pcl.com, accessed February 9, 2019; "PCL: Capitalizing on the Cloud," itworldcanada.com, accessed February 9, 2019; Brian Jackson, "PCL Constructors Reach New Heights with Real-time Analytics Solution in the Cloud," *IT World Canada*, November 9, 2017.

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?



I-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, smart-phones, tablet computers, email, and online conferencing over the Internet have all become essential tools of business. Worldwide, 4.3 billion people are online, more than half of the world's population (Internet World Stats, 2019) 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. Amazon delivered more packages than both FedEx and UPS combined. 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). 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 Amsterdam, 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 worldwide—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 global 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 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 large global banks 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 nations have statutes and regulations that 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. Financial regulatory authorities in Europe, Japan, India, and China have similar information management requirements.

I-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.

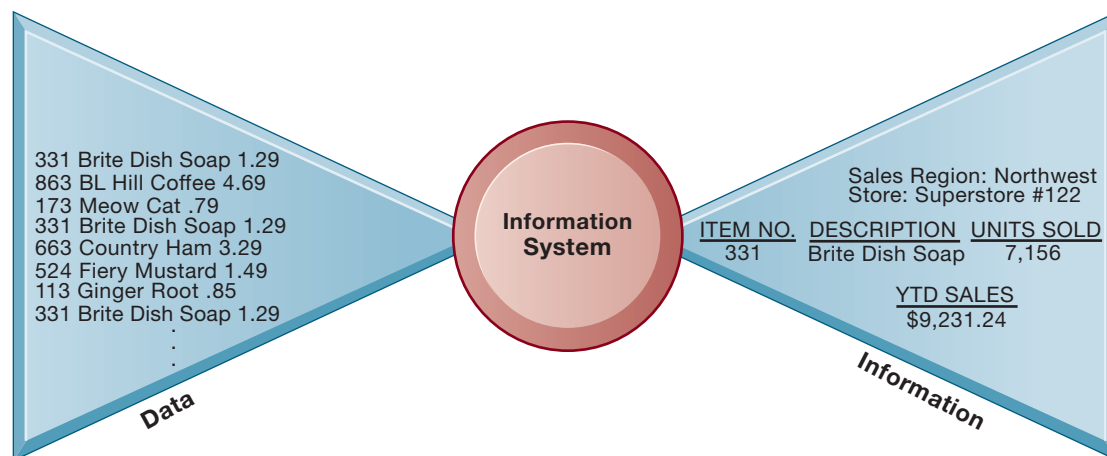


Figure I.1
Data and Information

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).

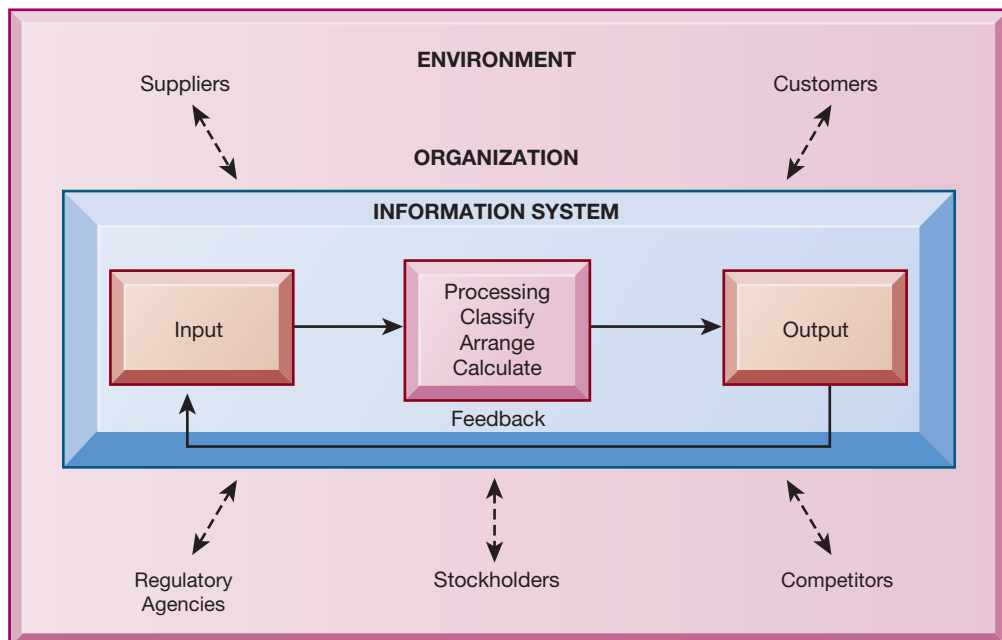
Three activities in an information system produce the information that organizations need to make decisions, control operations, analyze problems, and create new products or services. These activities are input, processing, and output (see Figure 1.2). **Input** captures or collects raw data from within 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.

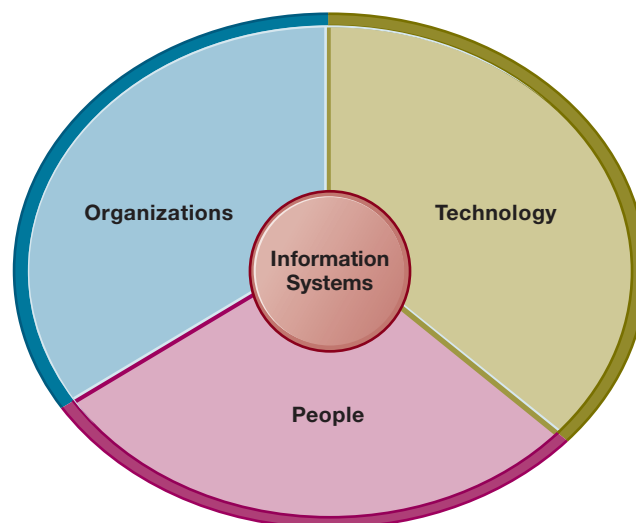


Figure 1.3
Information Systems
Are More Than
Computers

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.

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 Hayle 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.

I-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

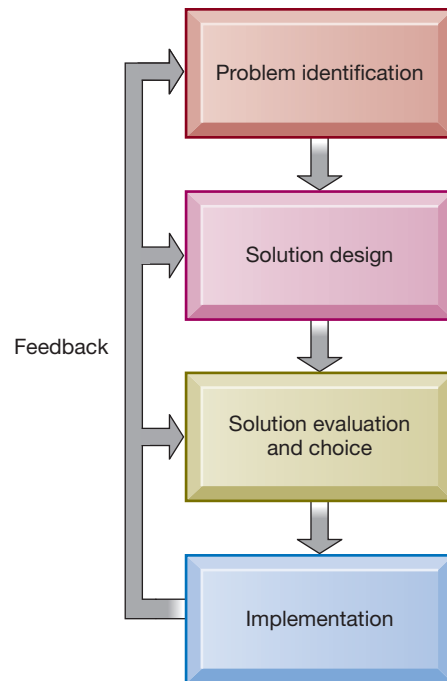


Figure 1.4
Problem Solving Is a
Continuous Four-Step
Process

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.

I-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 health-care 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). Similar changes are occurring in developed countries around the world.

What this means is that business firms and government agencies 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 career. Your career opportunities, and your compensation, will in part depend on your ability to help business firms and other organizations use information systems.

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.



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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.

Artificial Intelligence (AI) is causing another paradigm shift, just as the World Wide Web did before it. AI has been widely employed by many industries, from banking, to education, to marketing, to health-care, to perform a wide range of repetitive tasks, including customer service, technical support, facial recognition, online search, online ad targeting, and limited medical diagnoses. Despite its limitations, AI in the form of machine learning can be used to increase the efficiency of business operations and management decision making. Supplemented with other technologies, such as robots, big data, and cloud computing, AI is expected to be the next big thing that helps enterprises create value and reduce costs.

While AI is beneficial to businesses, some worry that the technology threatens job stability. In a survey of 2,092 people in Switzerland by the Swiss Broadcasting Corporation, two-thirds of the respondents believed that the emergence of AI would render many jobs obsolete. Among the respondents, only 9 percent of the farmers and a quarter of the senior management were confident that their jobs would not be affected by AI. As noted by the European Commission in a comprehensive study on the changing nature of work and skills in the digital age, it is difficult to estimate the number of jobs that may be impacted by AI in the future, with estimates varying widely. In one study conducted in 32 countries, the Organization for Economic Co-operation and Development (OECD) estimated that only about 14 percent of jobs are at high risk (that is, they have more than 70 percent probability) of being automated. That said, the number of job losses forecast by the OECD—around 66 million—is still significant.

However, it may be too early to be pessimistic about the job market in the era of AI. Technological breakthroughs do not necessarily mean job loss. McKinsey & Company estimated that 60 percent of current jobs have technically automatable activities of over 30 percent. Moreover, many AI applications are designed to facilitate individuals in doing their jobs rather than replacing them completely. Human-machine collaboration is expected to generate optimal results.

McKinsey & Company's study of historical data also found that new waves of technology have both eliminated and created jobs. There are always shortages of the sort of labor that can master the skills related to new technologies. Advancements in tech-

nology have resulted in temporary job losses, but in the long term, they have created new openings to be filled by individuals who have equipped themselves with the right skillsets to thrive alongside technological progress. Dun & Bradstreet conducted a survey among 100 attendees of the AI World Conference and Expo held in late 2018 and found that only 8 percent of respondents said that their organizations were axing jobs because of AI deployment. As much as 40 percent of respondents' organizations are adding more jobs because of AI implementation within their business. The respondents also said that a lack of internal human expertise was one of the obstacles to further implementation of AI in 2019. Thus, AI will definitely take away many jobs but will likely create many others, perhaps at an unprecedented rate. McKinsey & Company posits that AI will generate 50 million jobs by 2030, creating vacancies we cannot yet foresee.

The European Commission, OECD, and McKinsey & Company studies all note that the number of jobs affected by AI will vary by country and by industry. For example, the European Commission study notes that the percentage of jobs at risk is much higher in eastern and southern Europe than in the Nordic countries and the UK. Those who work in farms or factories are at high risk, but some positions in the service sector may also be replaced by AI. These jobs require a relatively low level of education; generally, the higher the level of education required for an occupation, the more secure it is against the threat of AI substitutes. McKinsey & Company has estimated that if there is rapid adoption of automation, up to 375 million workers globally (approximately 14 percent of the global workforce) may have to change occupations and adopt new skills. The studies have both found that appropriate training will help workers switch to other career paths. However, not all workers are lucky enough to get the necessary training, and even if they do, they may not earn the same wage after changing jobs.

The OECD study also found a U-shape relationship between automation and age. Surprisingly, the peak is at the young age group rather than the older generation, with the valley at the age group of 30–35. This means that the chance of losing a job to an AI is higher among the younger workforce—with less work experience—than the age group that's close to retirement age. Fortunately, young people are usually better

at keeping up with technological progress than their senior counterparts. After six decades of IT driven automation, which early on was predicted by “experts” to lead to massive unemployment, the most interesting question is, why did employment and jobs expand so rapidly despite intensive application of IT?

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CASE STUDY QUESTIONS

1. What are the various views on the impact of AI on jobs? What do you think will happen in your country?
2. Some people think that AI does not kill jobs but transforms business models. Do you agree? Why or why not?
3. How would AI potentially add more jobs than it eliminates?

Case contributed by Joyce Chan, City University of Hong Kong

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.

Information Technology and the Future of Jobs

Few topics have recently captured the attention of journalists, academics, and the general public than the impact of artificial intelligence, and automation in general, on employment in the United States and worldwide. This general concern is not new, but recurs with every advance in information technology since the 1950s. The Interactive Session on People illustrates some of the differing views on how new information technologies like artificial intelligence may impact employment in coming years.

INFORMATION SYSTEMS AND BUSINESS CAREERS: WRAP-UP

Looking back at the information system skills and knowledge required for specific majors, there are some common themes that affect all business majors. Following is a list of these common requirements.

- All business students, regardless of major, should understand how information systems and technologies can help firms achieve business objectives such as attaining operational efficiency, developing new products and services, and maintaining customer intimacy.
- All business students need to develop skills in analysis of information and helping firms understand and make sense of their data. Business analytics and business intelligence are important skill sets to analyze the mountains of big data the on-line business environment and Internet of Things (IoT) produce.
- All business majors need to be able to work with specialists and system designers who build and implement information systems. This is necessary to ensure that the systems that are built actually service business purposes and provide the information and understanding managers and employees require.
- Each of the business majors will be affected by changes in the ethical, social, and legal environment of business. Business school students need to understand how information systems can be used to meet business requirements for reporting to government regulators and the public and how information systems affect the ethical issues in their fields.

Regardless of your major, liberal arts skills (often called “soft” skills) are highly prized, including the ability to communicate verbally and in writing, and to collaborate with others on a team. If you are a liberal arts major and combine these skills with business experience, your prospects for a high-paying career are bright. English and history majors may not initially earn as much as their classmates focusing on business or science, but their earning potential develops over the course of their careers to nearly equal STEM majors as they become skilled problem-solvers.

HOW THIS BOOK PREPARES YOU FOR THE FUTURE

This book is explicitly designed to prepare you for your future business career. It provides you with the necessary knowledge and foundational concepts for understanding the role of information systems in business organizations. You will be able to use this knowledge to identify opportunities for increasing the effectiveness of your business. You will learn how to use information systems to improve operations, create new products and services, improve decision making, increase customer intimacy, and promote competitive advantage.

Equally important, this book develops your ability to use information systems to solve problems that you will encounter on the job. You will learn how to analyze and define a business problem and how to design an appropriate information system solution. You will deepen your critical-thinking and problem-solving skills. The following features of the text and the accompanying learning package reinforce this problem-solving and career orientation.

A Framework for Describing and Analyzing Information Systems

The text provides you with a framework for analyzing and solving problems by examining the people, organizational, and technology components of information systems. This framework is used repeatedly throughout the text to help you understand information systems in business and analyze information systems problems.

A Four-Step Model for Problem Solving

The text provides you with a four-step method for solving business problems, which we introduced in this chapter. You will learn how to identify a business problem, design alternative solutions, choose the correct solution, and implement the solution. You will be asked to use this problem-solving method to solve the case studies in each chapter. Chapter 12 will show you how to use this approach to design and build new information systems and determine their business value.

Hands-On MIS Projects for Stimulating Critical Thinking and Problem Solving

Each chapter concludes with a series of hands-on MIS projects to sharpen your critical-thinking and problem-solving skills. These projects include two Management Decision Problems, hands-on application software problems, and projects for building Internet skills. For each of these projects, we identify both the business skills and the software skills required for the solution.

Career Resources

To make sure you know how the text is directly useful in your future business career, we've added a full set of career resources to help you with career development and job hunting.

Career Opportunities Feature To show you how this book can help you find a job and build your career, we have added a new “Career Opportunities” feature, identified by this icon, to each chapter. The last major section of each chapter, titled “How will MIS help my career?,” presents a description of an entry-level job for a recent college graduate based on a real-world job description. The job requirements are related to the topics covered in that chapter. The job description shows the required educational background and skills, lists business-related questions that might arise during the job interview, and provides author tips for answering the questions and preparing for the interview. Students and instructors can find more detail about how to use this feature in the Preface and in MyLab MIS.



Digital Portfolio MyLab MIS includes a template for preparing a structured digital portfolio to demonstrate the business knowledge, application software skills, Internet skills, and analytical skills you have acquired in this course. You can include this portfolio in your résumé or job applications. Your professors can also use the portfolio to assess the skills you have learned.

Additional Career Resources A Career Resources section in MyLab MIS shows you how to integrate what you have learned in this course in your résumé, cover letter, and job interview to improve your chances for success in the job market.



I-5 How will MIS help my career?

Here is how Chapter 1 can help you find an entry-level job as a financial client support and sales assistant.

THE COMPANY

Power Financial Analytics Data Services, a data and software company serving the financial industry with offices in Frankfurt, Istanbul, Dhubai, Sydney, and Cape Town, is looking to fill an entry-level position for a financial client support and sales

assistant. The company has 1,600 employees, many of whom are consultants showing clients how to work with its powerful financial analytics software and data products.

POSITION DESCRIPTION

The financial client support and sales assistant will be part of a team in the company's consulting services. Consulting teams combine a thorough understanding of finance and technology with specific expertise in Power Financial Analytics Data Services software and assist clients in a variety of ways. The company provides on-the-job training in its software and consulting methods. Job responsibilities include:

- Supporting Financial Analytics Data Services applications.
- Helping the team create custom models and screens.
- Training clients in their offices and at seminars.
- Providing expert consultation to clients by telephone and on site.

JOB REQUIREMENTS

- Recent college graduate or investment professional with one to two years of experience. Applicants with backgrounds in finance, MIS, economics, accounting, business administration, and mathematics are preferred.
- Knowledge of or interest in learning about financial markets
- Sound working knowledge of spreadsheets
- Very strong communication and interpersonal skills
- Strong desire to learn in rapidly changing environment

INTERVIEW QUESTIONS

1. What is your background in finance? What courses did you take? Have you ever worked in the financial industry? What did you do there?
2. What is your proficiency level with spreadsheet software? What work have you done with Excel spreadsheets? Can you show examples of your work?
3. Are you able to discuss current trends in the financial industry and how they impact Power Financial's business model and client base?
4. Did you ever work with clients? Can you give examples of how you provided client service or support?
5. Can you give us an example of a finance-related problem or other business problem that you helped solve? Did you do any writing and analysis? Can you provide examples?

AUTHOR TIPS

1. Use the web to learn about financial markets and the financial industry.
2. Use the web to research the company, its financial products, and the tools and services it offers customers. Learn what you can about its consulting services. Additionally, examine the company's social media channels, such as LinkedIn and Facebook, for trends and themes.
3. Inquire exactly how you would be using spreadsheets for this job. Provide examples of how you used spreadsheets to solve problems in the classroom or for a job assignment. Show the spreadsheet work you did in finance.
4. Bring examples of your writing (including some from your Digital Portfolio described in MyLab MIS) demonstrating your analytical skills and project experience. Be prepared to discuss how you helped customers solve a business problem or the business problem solving you did for your courses.

Review Summary

1-1 Why are information systems so essential for running and managing a business today? Information systems are a foundation for conducting business today. In many industries, survival and even existence is difficult without extensive use of information technology. Businesses use information systems to achieve six major objectives: operational excellence; new products, services, and business models; customer/supplier intimacy; improved decision making; competitive advantage; and day-to-day survival.

1-2 What exactly is an information system? How does it work? What are its people, organizational, and technology components? From a technical perspective, an information system collects, stores, and disseminates information from an organization's environment and internal operations to support organizational functions and decision making, communication, coordination, control, analysis, and visualization. Information systems transform raw data into useful information through three basic activities: input, processing, and output. From a business perspective, an information system provides a solution to a problem or challenge facing a firm and represents a combination of people, organization, and technology elements.

The people dimension of information systems involves issues such as training, job attitudes, and management behavior. The technology dimension consists of computer hardware, software, data management technology, and networking/telecommunications technology, including the Internet. The organization dimension of information systems involves issues such as the organization's hierarchy, functional specialties, business processes, culture, and political interest groups.

1-3 How will a four-step method for business problem solving help you solve information system–related problems? Problem identification involves understanding what kind of problem is being presented and identifying people, organizational, and technology factors. Solution design involves designing several alternative solutions to the problem that has been identified. Evaluation and choice entail selecting the best solution, taking into account its cost and the available resources and skills in the business. Implementation of an information system solution entails purchasing or building hardware and software, testing the software, providing employees with training and documentation, managing change as the system is introduced into the organization, and measuring the outcome. Problem solving requires critical thinking in which one suspends judgment to consider multiple perspectives and alternatives.

1-4 What information system skills and knowledge are essential for business careers? Business careers in accounting, finance, marketing, operations management, management and human resources, and information systems all will need an understanding of how information systems help firms achieve major business objectives; skills in data analysis and business intelligence; sensitivity to the ethical, social, and legal issues systems raise; and the ability to work with technology specialists and other business professionals in designing and building systems. The ability to communicate verbally and in writing and to collaborate with others on a team have also become increasingly important skills in all areas of today's workplace.

Key Terms

Business model, 35
Business processes, 40
Change management, 46
Computer hardware, 41
Computer literacy, 39
Computer software, 41
Critical thinking, 47

Culture, 40
Data, 37
Data management technology, 41
Extranets, 41
Feedback, 38
Information, 37

Information system (IS), 37
Information systems literacy, 39
Information technology (IT), 37
Information technology (IT) infrastructure, 41
Input, 38

Internet, 41	Network, 41	Output, 38
Intranets, 41	Networking and	Processing, 38
Management information	telecommunications	World Wide Web, 41
systems (MIS), 39	technology, 41	

Review Questions

- I-1** Why are information systems so essential for running and managing a business today?
- List and describe the six reasons information systems are so important for business today.
 - Describe the challenges and opportunities of globalization.
- I-2** What exactly is an information system? How does it work? What are its people, organization, and technology components?
- Describe the three activities in an information system that produce the information that organizations need.
 - Explain the differences between information and data. Why is the former essential to the latter?
 - Explain why organizations have a structure composed of different levels and specialties.
 - Describe how the parts of an organization's culture can be found embedded in its information systems.
- I-3** How will a four-step method for business problem solving help you solve information system–related problems?
- Explain why it is essential to treat problem solving as a process and not an event.
 - Identify and describe the people-based techniques that could be used to implement solutions to problems.
 - How would you distinguish between technological, organizational, and people perspectives in the context of problems?
 - Explain how you might distinguish between technological, organizational, and people perspectives in relation to information systems.
- I-4** What information system skills and knowledge are essential for business careers?
- Describe the role of information systems in careers in accounting, finance, marketing, management, and operations management and explain how careers in information systems have been affected by new technologies and outsourcing.
 - List and describe the information system skills and knowledge that are essential for all business careers.

MyLab MIS™

To complete the problems with **MyLab MIS**, go to the EOC Discussion Questions in MyLab MIS.

Discussion Questions

- I-5** Information systems are too important to be left to computer scientists. Do you agree? Why or why not?
- I-6** If you were setting up the website for a business firm, what people, organizational, and technology issues might you encounter?
- I-7** How have global and national statutes and regulations impacted the use of information systems?

Hands-On MIS Projects

The projects in this section give you hands-on experience in analyzing financial reporting and inventory management problems, using data management software to improve management decision making about increasing sales, and using Internet software for researching job requirements. Visit MyLab MIS to access this chapter's Hands-On MIS Projects.

MANAGEMENT DECISION PROBLEMS

- I-8** Magical Toys is a South African toy store chain. The toys are sold in their five stores and from their own Web shop. Each Tuesday, management needs sales reports from last week's activities. Work at the stores is hectic, so usually at least one store fails to deliver the report, making it impossible to sum up the previous week's sales. The reports, sent by email as spreadsheets, sometimes have inconclusive or erroneous data, and following up means that employees are unable to give their full focus to the customers. Some errors in the spreadsheets may also cause the purchasing manager to place unnecessary purchase orders. What are the main issues that Magical Toys faces in the absence of an information system? How could an information system be of help, and what issues can an information system not solve?
- I-9** Bargain Land is a small chain of discount stores operating throughout the United Kingdom. It sells a broad range of high-demand household products and works on very low margins but with a high turnover of stock. The popularity of the stores is based on the low-cost business model and a wide customer base. There is no tracking technology used to manage inventory either in terms of receiving stock on delivery or of stock management and conversion to sales. There has also been a significant increase in losses associated with missing and damaged stock. Management is unsure whether this is related to internal employee theft or mishandling, or theft from the shops by external parties. Bargain Land wants to keep costs as low as possible and has therefore not yet implemented an automated method for keeping track of inventory at each store. How is the lack of an automated system causing the company problems? Given that investing in an information system solution is becoming increasingly necessary, what decisions should now be made?

IMPROVING DECISION MAKING: USING DATABASES TO ANALYZE SALES TRENDS

Software skills: Database querying and reporting

Business skills: Sales trend analysis

- I-10** In this project, you will start out with raw transactional sales data and use Microsoft Access database software to develop queries and reports that help managers make better decisions about product pricing, sales promotions, and inventory replenishment. In MyLab MIS, you can find a Store and Regional Sales Database developed in Microsoft Access. The database contains raw data on weekly store sales of computer equipment in various sales regions. The database includes fields for store identification number, sales region, item number, item description, unit price, units sold, and the weekly sales period when the sales were made. Use Access to develop some reports and queries to make this information more useful for running the business. Sales and production managers want answers to the following questions:
- Which products should be restocked?
 - Which stores and sales regions would benefit from a promotional campaign and additional marketing?

- When (what time of year) should products be offered at full price, and when should discounts be used?

Print your reports and results of queries.

IMPROVING DECISION MAKING: USING THE INTERNET TO LOCATE JOBS REQUIRING INFORMATION SYSTEMS KNOWLEDGE

Software skills: Internet-based software

Business skills: Job searching

- I-11** Visit a job-posting website such as Monster.com. Spend some time at the site examining jobs for accounting, finance, sales, marketing, and human resources. Find two or three descriptions of jobs that require some information systems knowledge. What information systems knowledge do these jobs require? What do you need to do to prepare for these jobs? Write a one- to two-page report summarizing your findings.

COLLABORATION AND TEAMWORK PROJECT

Selecting Team Collaboration Tools

- I-12** Form a team with three or four classmates and review the capabilities of Google Drive and Google Sites for your team collaboration work. Compare the capabilities of these two tools for storing team documents, project announcements, source materials, work assignments, illustrations, presentations, and web pages of interest. Learn how each works with Google Docs. Explain why Google Drive or Google Sites is more appropriate for your team. If possible, use Google Docs to brainstorm and develop a presentation of your findings for the class. Organize and store your presentation by using the Google tool you have selected.

BUSINESS PROBLEM-SOLVING CASE

NEW TECHNOLOGY AT UPS CLASHES WITH OUTDATED WAYS OF WORKING

This chapter's Interactive Session on Technology described how UPS investments in information technology are helping it remain competitive in the package delivery market. Unfortunately, UPS has not been as competitive as it could be because critical aspects of its operations have been saddled with outdated technology and manual procedures.

Although much of UPS's IT infrastructure is leading-edge, not all of it is. UPS moves millions of packages each day using 80,000 drivers. Until recently, about half were processed through automated facilities, the rest being handled using 30-year-old equipment and manual processes.

For example, in UPS's Mesquite, Texas, package-sorting facility, a 30-year-old analog control panel the size of a chest freezer with rows of red and green lights informs workers when something on the facility's web of conveyor belts goes awry. The sorting process begins with boxes being unloaded from trucks onto conveyor belts. A worker is required to align each box so that a scanner can read the delivery label on the front, top, or one side. The packages move inside to a line of about 50 workers. There are nine conveyor belts, three along the ground, three waist-high, and three directly overhead. A human sorter picks a package, quickly deciphers the label, and then places the package onto the correct belt. A worker around the corner sorts packages down chutes, where loaders fill truck trailers. In an automated facility scanners would read a package's destination and use equipment called shoe pucks to push packages down the proper chute.

At an older less-automated facility such as Mesquite, a medium-sized package receives four "touches," with each "touch" representing an act of handling. Each "touch" increases the chance of a sorting error or damage to the package. Mesquite processes about 40,000 pieces per hour, so even rare human mistakes add up. Missorted packages can add an extra day to a UPS delivery, degrading customer service and adding to operating costs.

All FedEx ground hubs, such as the facility in Edison, New Jersey, are automated. There, FedEx workers "touch" most packages only twice, for unloading and loading only. Amazon operations likewise are heavily automated, especially its warehouses, which feature driverless forklifts and robots that bring shelves to workers.

About 30 miles from Mesquite, UPS's Fort Worth facility illustrates UPS's efforts to catch up. There boxes are scanned, sorted by destination, and sent to outbound vehicles via machines. With six-sided scanners, employees do not need to worry about which side is up. UPS employees in an air-conditioned control room view a wall of flat-screen monitors displaying live video feeds. The computer detects jams and other malfunctions, and workers can reroute where the conveyors send packages. There is no human element in rerouting a package in the Fort Worth building. A few workers walk alongside the belts to replace any package that falls off, which rarely happens any more. Directing the sorting network is software that helps manage package flows, including those between automated facilities and older ones. The technology can divert additional packages destined for areas overwhelmed by volume. This automated 750-worker facility can process the same number of packages daily as can Mesquite with 1,170 workers. Automation has increased the accuracy of the sorting, and also generates data to help the company optimize delivery routes using fewer miles, less fuel, and less equipment and also provide better forecasts of shipping volume.

In contrast, 96 percent of competitor FedEx's ground packages move through automated sites. FedEx discarded outdated equipment and manual processes years ago, and new rival Amazon.com never had to deal with outdated systems at all.

UPS initially applied a "band-aid" approach to dealing with surging e-commerce shipments. It would add extra shifts, extend working hours, or retrofit parts of older buildings with new equipment. But UPS management knows it has to rectify this situation to remain competitive in the twenty-first century, and be able to handle the new distribution requirements posed by e-commerce.

The company plans to invest \$20 billion between 2019 and 2022 to adequately meet twenty-first-century shopping and shipping trends. Much of this investment will be directed toward new automated shipping and warehousing facilities, including seven "super hubs," which can sort packages 30 percent more efficiently than standard facilities.

In the past, most of the shipments handled by UPS went to retailers and business corporations. Today, more and more of these shipments are destined for

individual households who have purchased an item or two online using the Internet. UPS now delivers more than 50 percent of the packages it handles to homes. Numerous deliveries to far-flung suburban homes are more costly to UPS than delivering and picking up multiple packages at large businesses or offices.

Although some of UPS's management worried about so much company business going toward lower-margin deliveries, the company knew it had to embrace e-commerce. According to UPS spokesperson Steve Gant, there is "tremendous opportunity" in delivering e-commerce orders even amidst formidable competitors who at the moment appear to be more technologically and organizationally advanced. UPS plans to process all packages, with the exception of some large ones that travel short distances, through automated hubs by 2022.

Trying to use outdated shipping technology and procedures in the new e-commerce environment had caused UPS to lose business. Bottlenecks from being overwhelmed at times by online orders created delays that drove some health care, industrial, and other corporate customers to switch to FedEx. Amazon is creating its own delivery network of trucks, vans, and planes to handle most of its online orders, especially in cities and suburbs. Since Amazon accounts for as much as 10 percent of UPS's revenue and an even higher share of shipping volume, UPS will definitely be affected.

UPS is unionized, FedEx ground-operation workers are not. Has that made a difference? The International Brotherhood of Teamsters represents 260,000 UPS drivers, sorters, and other workers, and it wants UPS to hire more full-time workers to help handle the surging UPS package shipments. The union has opposed technology such as drones and self-driving vehicles and is concerned about changes that can perform the same work with fewer employees. As Sean O'Brien, a Boston Teamsters leader pointed out, technology streamlines and eliminates jobs. Once jobs are replaced, "it's pretty tough to get them back."

FedEx has no unionized workers in its ground network, so it doesn't have to deal quite as much with opposition from organized labor. Additionally, FedEx's ground delivery network is newer than that of UPS, employing more modern technology and operating procedures. It doesn't have to grapple with retrofitting automation into facilities with older ways of working.

According to UPS, unionization has not heavily impeded company efforts to spend more on automation. The cost of new machines to automate an older facility have become low enough for UPS to both retrofit older facilities and build new ones.

In some instances, new automated package sorting facilities have helped UPS create new jobs. For example, a new automated UPS package delivery center in northwest Houston has created 575 full- and part-time jobs. The 238,000-square-foot center added 300 trucks to the company's delivery fleet in the Houston area.

FedEx, which has spent \$10 billion on its network of 37 ground hubs since 2005, is now trying to slim down. Some places, such as the \$259 million FedEx Indianapolis ground hub, are being closed. FedEx has ground hubs such as the one in Edison, New Jersey, that are designed for flexibility. This facility uses only one-third of a building's space and has room to expand with additional equipment on short notice. This arrangement enables FedEx to adjust its network to accommodate more volatile flows of online orders.

UPS is also implementing other technologies to complement automated package sorting. In 2017 it started placing wireless Bluetooth receivers inside delivery trucks to reduce the likelihood of misloaded packages. Wireless signals are passed between Bluetooth beacons and the scanning devices worn on workers' hands and hips to read UPS package labels. The beacons beep loudly if a worker places a package into a delivery truck that is not headed to the package's destination. A different beep confirms when packages enter the correct truck. Before deploying this technology, UPS did not perform a final scan to confirm that all parcels were on the right truck. Drivers had to drive out of their way to deliver these packages or find a supervisor to transfer them to the correct truck.

Besides reducing delays, the Bluetooth-driven system can furnish customers with more details about upcoming deliveries. When packages are scanned in the morning, the data update UPS's service for sending customers emails showing the status of their shipments. Customers signed up for this service receive a message about the package's arrival date and estimated delivery time.

Another Bluetooth enhancement informs seasonal workers about where to direct outbound packages that UPS vehicles pick up during the day and bring to the company's sorting facilities. UPS hires nearly 100,000 seasonal workers from November through January. In the past, these workers would have to memorize hundreds of zip codes to know where to place parcels. UPS started outfitting some of these seasonal workers with scanning devices and inexpensive Bluetooth headphones that issue one-word commands for "Red," "Green," or "Blue," designating specific conveyor belts for transporting packages to locations for further processing.

New technology makes it possible for UPS processing facility managers to know exactly how many undeliverable packages they must process each night and when they will arrive, which helps them plan work shifts for rerouting the packages. The information is displayed in real time on managers' Samsung smartphones in the form of graphs showing the number of incoming packages, how quickly they are being processed, and which worker groups are busiest, so staff can be allocated where demand is highest. In the past, UPS managers had to rely on historical data and radio conversations with drivers to estimate how many undeliverable packages they would have to handle each night.

All of these technology investments are starting to pay off. UPS was able to handle the upsurge in deliveries during the 2018 holiday season much more easily than in the past. By the end of 2019, about 80 percent of UPS-eligible ground shipment volume will be processed in automated facilities, resulting in annual savings and cost avoidance of as much as \$1 billion.

Sources: Bloomberg, "UPS Sees Payoff from \$20BN Tech Bet," *SupplyChainBrain*, April 24, 2019; Paul Ziobro, "UPS's \$20 Billion Problem: Operations Stuck in the Twentieth Century," *Wall Street Journal*, June 15, 2018; Katherine Feser, "UPS Package Delivery Facility in NW Houston Creates 575 Jobs," *Chron*, January 17, 2019; Elizabeth Woyke, "How UPS Delivers Faster Using \$8 Headphones and Code That Decides When Dirty Trucks Get Cleaned," *MIT Technology Review*, February 16, 2018; and Shefali Kepadia, "Company of the Year: UPS," *Supply Chain Dive*, December 3, 2018.

CASE STUDY QUESTIONS:

- I-13** Identify the problem faced by UPS. Was it a people problem, an organizational problem, or a management problem? Explain your answer.
- I-14** Describe the solution to this problem pursued by UPS? Is this a successful solution? Why or why not?
- I-15** Diagram the packing sorting process at UPS before and after automation.
- I-16** How did automated package sorting change operations and decision making at UPS?

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