CHAPTER

1 Information Systems in Global Business Today

LEARNING OBJECTIVES

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

1-1 How are information systems transforming business, and why are they so essential for running and managing a business today?

1-2 What is an information system? How does it work? What are its management, organization, and technology components? Why are complementary assets essential for ensuring that information systems provide genuine value for organizations?

1-3 What academic disciplines are used to study information systems, and how does each contribute to an understanding of information systems?

1-4 How will MIS help my career?

CHAPTER CASES

PCL Construction: The New Digital Firm
Can You Run the Company with Your iPhone?
UPS Competes Globally with Information Technology
Did Information Systems Cause Deutsche Bank to Stumble?

VIDEO CASES

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

Instructional Video:
Tour IBM's Raleigh Data Center

MyLab MIS

Discussion Questions: 1-4, 1-5, 1-6; **Hands-on MIS Projects:** 1-7, 1-8, 1-9, 1-10; **Writing Assignments:** 1-16, 1-17; **eText with Conceptual Animations**

PCL Construction: The New Digital Firm

Many people think the most widely used tool in a construction project is a hammer, but it is more likely a filing cabinet or fax machine. The construction industry has traditionally been very 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 the 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.

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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. Electronic 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.

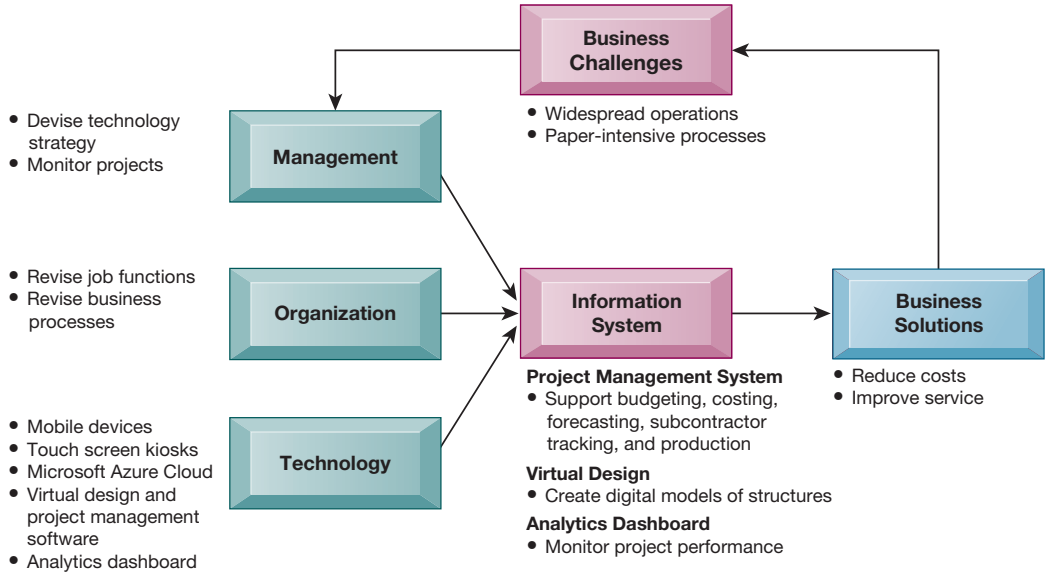
PCL implemented Project Document Controls (PDC) to facilitate collaboration among project team members. A secure project-based website provides real-time storage and management of information in a single shared accessible location. Construction contractors, subcontractors, consultants, suppliers, and 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, 2018; "PCL: Capitalizing on the Cloud," itworldcanada.com, accessed February 9, 2018; 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 has been traditionally very paper-intensive. Processing and accessing the large number of documents and other information required by construction projects was excessively costly and time-consuming, driving up costs. PCL used leading-edge information technology to digitize documents and streamline business processes for documenting, tracking, and analyzing projects. The information flows that drive PCL's business have become largely digital, making use of mobile tools and a cloud computing infrastructure. PCL Construction has become a leading example of a digital firm.

The chapter-opening diagram calls attention to important points raised by this case and this chapter. To reduce time and costs and improve customer service in a heavily paper-based industry, PCL management chose to use information technology to increase the precision and efficiency of key business activities for designing, costing, budgeting, and monitoring a construction project. These technologies include mobile devices (phones, tablets, laptops), touch screen kiosks, cloud computing services, the Internet, and software for creating models, managing documents, monitoring project progress, budgeting, estimating costs, and



displaying key project performance indicators on a digital dashboard. The use of leading-edge digital technologies to drive business operations and management decisions is a key topic today in the MIS world and will be discussed throughout this text.

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

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

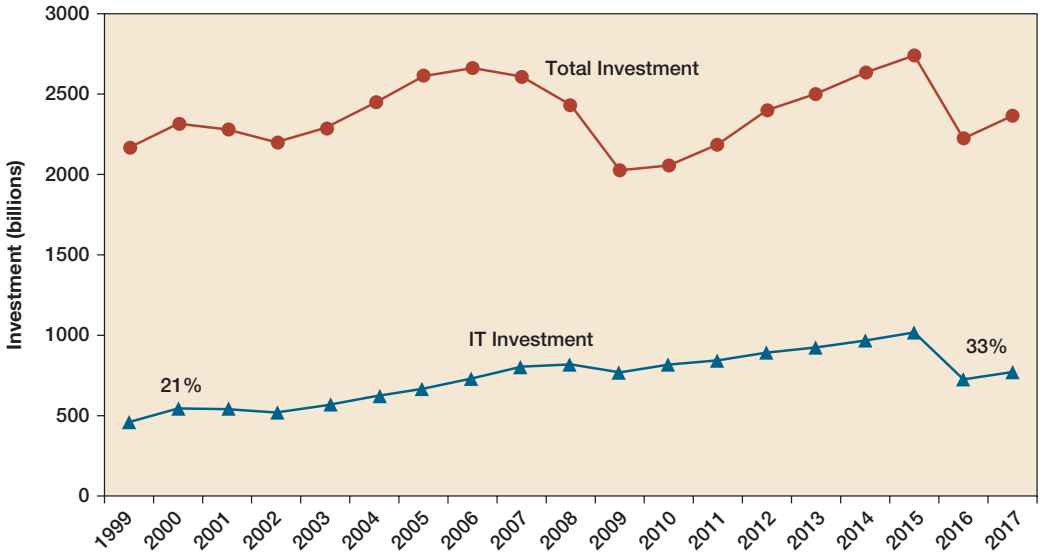
1-1 How are information systems transforming business, and why are they so essential for running and managing a business today?

It's not business as usual in the United States or the rest of the global economy anymore. In 2017, American businesses spent nearly $1 trillion on information systems hardware, software, and telecommunications equipment. In addition, they spent another $143 billion on business and management consulting and services—much of which involves redesigning firms' business operations to take advantage of these new technologies. In fact, most of the business value of IT investment derives from these organizational, management, and cultural changes inside firms (Saunders and Brynjolfsson, 2016). Figure 1.1 shows that between 1999 and 2017, private business investment in information technology consisting of hardware, software, and communications equipment grew from 21 to 33 percent of all invested capital.

FIGURE 1.1 INFORMATION TECHNOLOGY CAPITAL INVESTMENT

Information technology capital investment, defined as hardware, software, and communications equipment, grew from 21 to 33 percent of all invested capital between 1999 and 2017.

Source: Based on data in U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts*, Table 5.3.6. Real Private Fixed Investment by Type, Chained Dollars (2018).



As managers, most of you will work for firms that are intensively using information systems and making large investments in information technology. You will certainly want to know how to invest this money wisely. If you make wise choices, your firm can outperform competitors. If you make poor choices, you will be wasting valuable capital. This book is dedicated to helping you make wise decisions about information technology and information systems.

How Information Systems Are Transforming Business

You can see the results of this large-scale spending around you every day by observing how people conduct business. Changes in technology and new innovative business models have transformed social life and business practices. More than 269 million Americans have mobile phones (81 percent of the population), and 230 million of these people access the Internet using smartphones and tablets. Fifty-five percent of the entire population now uses tablet computers, whose sales have soared. Two hundred million Americans use online social networks; 175 million use Facebook, while 54 million use Twitter. Smartphones, social networking, texting, e-mailing, and webinars have all become essential tools of business because that's where your customers, suppliers, and colleagues can be found (eMarketer, 2018).

By June 2017, more than 140 million businesses worldwide had dot-com Internet sites registered. Today, 220 million Americans shop online, and 190 million will purchase online. In 2017, FedEx moved about 16 million packages daily in 220 countries and territories around the world, mostly overnight, and the United Parcel Service (UPS) moved more than 28 million packages daily. Businesses are using information technology to sense and respond to rapidly changing customer demand, reduce inventories to the lowest possible levels, and achieve higher

levels of operational efficiency. Supply chains have become more fast-paced, with companies of all sizes depending on just-in-time inventory to reduce their overhead costs and get to market faster.

As newspaper print readership continues to decline, in 2017 more than 180 million people read a newspaper online, and millions more read other news sites. Online digital newspaper readership is growing at 10 percent annually, about twice as fast as the Internet itself. About 128 million people watch a video online every day, 85 million read a blog, and 30 million post to blogs, creating an explosion of new writers and new forms of customer feedback that did not exist five years ago (eMarketer, 2018). Social networking site Facebook attracted 214 million monthly visitors in 2018 in the United States and more than 2 billion worldwide. Businesses are using social networking tools to connect their employees, customers, and managers worldwide. Most *Fortune* 500 companies now have Facebook pages, Twitter accounts, and Tumblr sites.

E-commerce and Internet advertising continue to expand. Google's U.S. online ad revenues surpassed $32 billion in 2017, and Internet advertising continues to grow at more than 20 percent a year in the United States, reaching more than $107 billion in revenues in 2018 (eMarketer, 2018).

New federal security and accounting laws requiring many businesses to keep e-mail messages for five years, coupled with existing occupational and health laws requiring firms to store employee chemical exposure data for up to 60 years, are spurring the annual growth of digital information at the estimated rate of 5 exabytes annually, equivalent to 37,000 new Libraries of Congress.

What's New in Management Information Systems?

Plenty. In fact, there's a whole new world of doing business using new technologies for managing and organizing. What makes the MIS field the most exciting area of study in schools of business is the continuous change in technology, management, and business processes. Five changes are of paramount importance.

IT Innovations. A continuing stream of information technology innovations is transforming the traditional business world. Examples include the emergence of cloud computing, the growth of a mobile digital business platform based on smartphones and tablet computers, big data and the Internet of Things (IoT), business analytics, machine learning systems, and the use of social networks by managers to achieve business objectives. Most of these changes have occurred in the past few years. These innovations are enabling entrepreneurs and innovative traditional firms to create new products and services, develop new business models, and transform the day-to-day conduct of business. In the process, some old businesses, even industries, are being destroyed while new businesses are springing up.

New Business Models. For instance, the emergence of online video services for streaming or downloading, such as Netflix, Apple iTunes, and Amazon, has forever changed how premium video is distributed and even created. Netflix in 2018 attracted more than 125 million subscribers worldwide to what it calls the "Internet TV revolution." Netflix has moved into premium TV show production with nearly 1,000 original shows such as *American Vandal*, *Suburra*, *The Crown*, *Friends From College*, *No Country For Old Men, House of Cards*, and *Orange Is the New Black*, challenging cable

and broadcast producers of TV shows, and potentially disrupting cable network dominance of TV show production. Apple's iTunes now accounts for 67 percent of movie and TV show downloads and has struck deals with major Hollywood studios for recent movies and TV shows. A growing trickle of viewers are unplugging from cable and using only the Internet for entertainment.

E-commerce Expansion. E-commerce generated about $700 billion in revenues in 2017 and is estimated to grow to nearly $950 billion by 2020. E-commerce is changing how firms design, produce, and deliver their products and services. E-commerce has reinvented itself again, disrupting the traditional marketing and advertising industry and putting major media and content firms in jeopardy. Facebook and other social networking sites such as YouTube, Twitter, and Tumblr, along with Netflix, Apple Music, and many other media firms, exemplify the new face of e-commerce in the twenty-first century. They sell services. When we think of e-commerce, we tend to think of selling physical products. While this iconic vision of e-commerce is still very powerful and the fastest-growing form of retail in the United States, growing up alongside is a whole new value stream based on selling services, not goods. It's a services model of e-commerce. Growth in social commerce is spurred by powerful growth of the mobile platform: 85 percent of Facebook's users access the service from mobile phones and tablets. Information systems and technologies are the foundation of this new services-based e-commerce. Mobile e-commerce hit $229 billion in 2017 and is growing at 30 percent a year.

Management Changes. The management of business firms has changed: With new mobile smartphones, high-speed wireless Wi-Fi networks, and tablets, remote salespeople on the road are only seconds away from their managers' questions and oversight. Management is going mobile. Managers on the move are in direct, continuous contact with their employees. The growth of enterprise-wide information systems with extraordinarily rich data means that managers no longer operate in a fog of confusion but instead have online, nearly instant access to the really important information they need for accurate and timely decisions. In addition to their public uses on the web, social networking tools, wikis, and blogs are becoming important corporate tools for communication, collaboration, and information sharing.

Changes in Firms and Organizations. Compared to industrial organizations of the previous century, new fast-growing twenty-first-century business firms put less emphasis on hierarchy and structure and more emphasis on employees taking on multiple roles and tasks and collaborating with others on a team. They put greater emphasis on competency and skills rather than position in the hierarchy. They emphasize higher-speed and more-accurate decision making based on data and analysis. They are more aware of changes in technology, consumer attitudes, and culture. They use social media to enter into conversations with consumers and demonstrate a greater willingness to listen to consumers, in part because they have no choice. They show better understanding of the importance of information technology in creating and managing business firms and other organizations. To the extent organizations and business firms demonstrate these characteristics, they are twenty-first-century digital firms.

You can see some of these trends at work in the Interactive Session on Management. Millions of managers rely heavily on the mobile digital platform to coordinate suppliers and shipments, satisfy customers, and manage their employees. A business day without these mobile devices or Internet access would be unthinkable.

INTERACTIVE SESSION MANAGEMENT

Can You Run the Company with Your iPhone?

Can you run the company just by using your iPhone? Perhaps not entirely, but there are many business functions today that can be performed using an iPhone, iPad, or Android mobile device. Smartphones and tablets have become all-in-one tools that help managers and employees work more efficiently, packing a powerful, networked computer into a pocket-size device. With a tap or flick of a finger, these mobile devices can access the Internet or serve as a telephone, camera, music or video player, an e-mail and messaging machine, and, increasingly, a gateway into corporate systems. New software applications for document sharing, collaboration, sales, order processing, inventory management, scheduling, and production monitoring make these devices even more versatile business tools.

Network Rail runs, maintains, and develops the rail tracks, signaling, bridges, tunnels, level crossings, and many key stations for most of the rail network in England, Scotland, and Wales. Keeping trains running on time is one of its top priorities. To maintain 20,000 miles of track safely and efficiently, skilled workers must be equipped with appropriate tools and work across thousands of sites throughout the rail network, 24 hours a day. Network Rail uses a group of custom apps for its 22,000 iPhone and iPad devices to streamline maintenance operations, quickly capture incident data, and immediately share critical information.

Several apps help Network Rail improve railway performance and safety. The Close Call app helps employees report hazards as they are found so problems can be addressed quickly. The MyWork app gives maintenance teams all the information they need to start and complete repair tasks. The Sentinel app allows field managers to electronically scan ID cards to verify that workers are qualified to perform specific tasks.

The iPhone and iPad apps provide maintenance technicians with current technical data, GPS locations, and streamlined reports, replacing cumbersome reference books and rain-soaked paperwork that slowed the repair process. Many service calls start with hazardous conditions reported by Network Rail employees themselves. Rather than waiting hours to fill out a report at the depot, workers can take pictures of dangerous situations right away, using the Close Call app to describe situations and upload photos to the call center. Once provided with the hazard's GPS coordinates, the call center will usually schedule repairs within 24 hours.

MyWork gives maintenance workers a simple overview of all of the jobs each team needs to complete during a specific shift. This mobile app clusters jobs by location, skills required, and opening and closing times. Using precise map coordinates, workers can find sites easily and finish jobs more quickly. By electronically delivering daily job schedules to over 14,000 maintenance staff members, MyWork has enabled them to complete over a half a million work orders to date while minimizing interruptions.

British Airways is the largest airline in the United Kingdom, with operations in more than 200 airports worldwide. The airline has found many ways to use the iPad to improve customer service and operational efficiency. The airline has created more than 40 custom apps for over 17,000 iPads for its workforce that have transformed the way it does business.

Unforeseen disruptions can create long lines of passengers seeking flight information and rebooking. The FlightReact app used by British Airways mobilizes agents to scan a boarding pass, review the customer's booking, look up alternate flight options, and rebook and reticket passengers—all within four minutes. iBanner allows agents to identify passengers transferring onto a specific flight, while iTranslate enables staff to communicate easily with travelers speaking any language.

Inside the airport, iPads and iPhones communicate with low-energy wireless Bluetooth signals from iBeacon, notifying customers of Wi-Fi access, gate locations, and flight updates. Beyond the terminal, mobile apps are helping British Airways to improve the aircraft turnaround process. British Airways has more than 70 planes at London Heathrow Terminal, five turning around at once, and each requiring a team of around 30 people. To shorten and streamline this process can generate huge business benefits.

Loading luggage and cargo onto an aircraft is one of the most complex parts of the turnaround process, requiring detailed communications between the turnaround manager (TRM), who coordinates and manages the services around the aircraft during

departure and arrival, the offsite Centralized Load Control (CLC) team, and the pilot. With iPads running the iLoad Direct app, turnaround managers are able to monitor the aircraft loading process and share data with pilots and back-office staff in real time. TRMs can receive and input real-time data about the aircraft load's contents, weight, and distribution. These data are essential to help the pilot calculate the right amount of fuel and position the plane for take-off. By streamlining communications between the ground crew, the CLC team, and the pilot, iLoad Direct and iPad speed up the pace at which aircraft become airborne. These mobile tools have helped British Airways achieve an industry-leading benchmark for aircraft turnaround.

In addition to facilitating managerial work, mobile devices are helping rank-and-file employees manage their work lives more effectively. Shyft is one of several smartphone apps that allow workers to share information, make schedule changes, and report labor violations. Thousands of employees at chains like Starbucks and Old Navy are using these apps to view their schedules and swap shifts when they've got a scheduling conflict or need extra work.

Sources: "British Airways: Transforming the Travel Experience from Start to Finish," *Apple at Work*, www.apple.com, accessed February 7, 2018; www.networkrail.co.uk,accessed September 2, 2018; "Network Rail," *iPhone in Business*, www.apple.com, accessed January 4, 2017; and Lauren Weber, "Apps Empower Employees, Ease Scheduling," *Wall Street Journal*, January 3, 2017.

CASE STUDY QUESTIONS

1. What kinds of applications are described here? What business functions do they support? How do they improve operational efficiency and decision making?
2. Identify the problems that the business in this case study solved by using mobile digital devices.
3. What kinds of businesses are most likely to benefit from equipping their employees with mobile digital devices such as iPhones and iPads?
4. One company deploying iPhones has stated, "The iPhone is not a game changer, it's an industry changer. It changes the way that you can interact with your customers" and "with your suppliers." Discuss the implications of this statement.

iPhone and iPad Applications for Business

1. Salesforce
2. Cisco WebEx Meetings
3. SAP Business One
4. iWork
5. Evernote
6. Adobe Acrobat Reader
7. Oracle Business Intelligence Mobile
8. Dropbox

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Whether it's attending an online meeting, checking orders, working with files and documents, or obtaining business intelligence, Apple's iPhone and iPad offer unlimited possibilities for business users. A stunning multitouch display, full Internet browsing, and capabilities for messaging, video and audio transmission, and document management make each an all-purpose platform for mobile computing.

Globalization Challenges and Opportunities: A Flattened World

In 1492, Columbus reaffirmed what astronomers were long saying: the world was round and the seas could be safely sailed. As it turned out, the world was populated by peoples and languages living in isolation from one another, with great disparities in economic and scientific development. The world trade that ensued after Columbus's voyages has brought these peoples and cultures closer. The "industrial revolution" was really a worldwide phenomenon energized by expansion of trade among nations and the emergence of the first global economy.

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 reduced the economic and cultural advantages of developed countries. Friedman argued that the United States and European countries were in a fight for their economic lives, 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 both challenges and opportunities for business firms.

A significant percentage of the economy of the United States and other advanced industrial countries in Europe and Asia depends on imports and exports. In 2017, about 30 percent of the $20 trillion U.S. economy resulted from foreign trade, both imports and exports. In Europe and Asia, the number exceeded 50 percent. Many Fortune 500 U.S. firms derive more than half their revenues from foreign operations. Tech companies are particularly dependent on offshore revenue: 80 percent of Intel's revenues in 2017 came from overseas sales of its microprocessors, while Apple got 60 percent of its revenue outside of the United States. Eighty percent of the toys sold in the United States are manufactured in China, while about 90 percent of the PCs manufactured in China use American-made Intel or Advanced Micro Design (AMD) chips. The microprocessor chips are shipped from the United States to China for assembly into devices.

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 decade, the United States lost 7 million manufacturing jobs to offshore, low-wage producers. But manufacturing is now a very small part of U.S. employment (less than 12 percent of the labor force and declining). In a normal year, about 300,000 service jobs move offshore to lower-wage countries. Many of the jobs are in less-skilled information system occupations, but some are "tradable service" jobs in architecture, financial services, customer call centers, consulting, engineering, and even radiology. Yet at the same time the United States has lost so many jobs, it has added 33 million new service jobs.

The U.S. economy creates more than 3.5 million new jobs in a normal, non-recessionary year. Although only 1.1 million private sector jobs were created in 2011 due to slow economic recovery, by 2017, the U.S. economy was adding more than 2 million new jobs annually for the third straight year. Employment in information systems and the other service occupations is expanding rapidly, and wages are stable. Outsourcing may have accelerated the development of new systems worldwide, as these systems could be maintained and developed in low-wage countries. In part this explains why the job market for MIS and computer science graduates is growing rapidly in the United States.

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. 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? That's 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 Rapid City, South Dakota, is now instant and virtually free. Customers can now 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, are able to replicate their business models and services in multiple countries without having to redesign their expensive fixed-cost information systems infrastructure. Briefly, information systems enable globalization.

The Emerging Digital Firm

All of the changes we have just described, coupled with equally significant organizational redesign, have created the conditions for a fully digital firm. A digital firm can be defined along several dimensions. A **digital firm** is one in which nearly all of the organization's *significant business relationships* with customers, suppliers, and employees are digitally enabled and mediated. *Core business processes* are accomplished through digital networks spanning the entire organization or linking multiple organizations.

Business processes refer to the set of logically related tasks and behaviors that organizations develop over time to produce specific business results and the unique manner in which these activities are organized and coordinated. Developing a new product, generating and fulfilling an order, creating a marketing plan, and hiring an employee are examples of business processes, and the ways organizations accomplish their business processes can be a source of competitive strength. (A detailed discussion of business processes can be found in Chapter 2.)

Key corporate assets—intellectual property, core competencies, and financial and human assets—are managed through digital means. In a digital firm, any piece of information required to support key business decisions is available at any time and anywhere in the firm.

Digital firms sense and respond to their environments far more rapidly than traditional firms, giving them more flexibility to survive in turbulent times. Digital firms offer extraordinary opportunities for more-flexible global organization and management. In digital firms, both time shifting and space shifting are the norm. *Time shifting* refers to business being conducted continuously, 24/7, rather than in narrow "work day" time bands of 9 a.m. to 5 p.m. *Space shifting* means that work takes place in a global workshop as well as within national boundaries. Work is accomplished physically wherever in the world it is best accomplished.

Many firms, such as Cisco Systems, 3M, and GE (see the Chapter 12 ending case), are close to becoming digital firms, using the Internet to drive every aspect of their business. Most other companies are not fully digital, but they are moving toward close digital integration with suppliers, customers, and employees.

Strategic Business Objectives of Information Systems

What makes information systems so essential today? Why are businesses investing so much in information systems and technologies? In the United States, more than 25 million business and financial managers, and 36 million professional workers in the labor force rely on information systems to conduct business. Information systems are essential for conducting day-to-day business in the United States and most other advanced countries as well as achieving strategic business objectives.

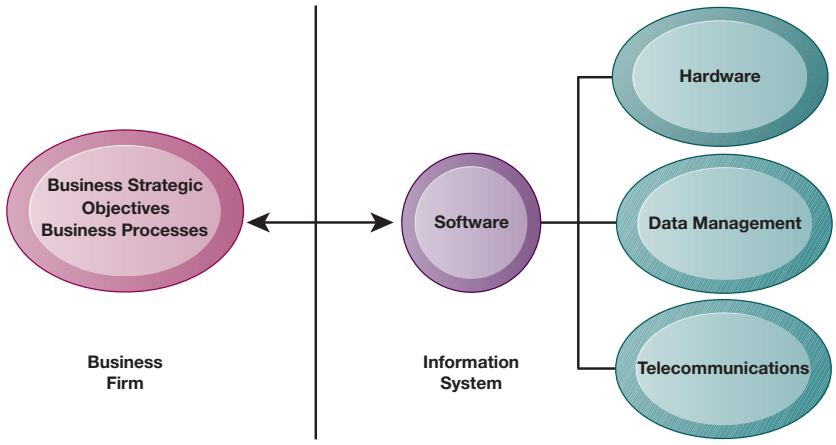
Entire sectors of the economy are nearly inconceivable without substantial investments in information systems. E-commerce firms such as Amazon, eBay, Google, and E*Trade simply would not exist. Today's service industries—finance, insurance, and real estate as well as personal services such as travel, medicine, and education—could not operate without information systems. Similarly, retail firms such as Walmart and Target and manufacturing firms such as General Motors and GE require information systems to survive and prosper. Just as offices, telephones, filing cabinets, and efficient tall buildings with elevators were once the foundations of business in the twentieth century, information technology is a foundation for business in the twenty-first century.

There is a growing interdependence between a firm's ability to use information technology and its ability to implement corporate strategies and achieve corporate goals (see Figure 1.2). What a business would like to do in five years often depends on what its systems will be able to do. Increasing market share, becoming the high-quality or low-cost producer, developing new products, and increasing employee productivity depend more and more on the kinds and quality of information systems in the organization. The more you understand about this relationship, the more valuable you will be as a manager.

Specifically, business firms invest heavily in information systems to achieve six strategic business objectives: operational excellence; new products, services,

FIGURE 1.2 THE INTERDEPENDENCE BETWEEN ORGANIZATIONS AND INFORMATION SYSTEMS

In contemporary systems, there is a growing interdependence between a firm's information systems and its business capabilities. Changes in strategy, rules, and business processes increasingly require changes in hardware, software, databases, and telecommunications. Often, what the organization would like to do depends on what its systems will permit it to do.



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 in order 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 state-of-the-art business practices and supportive management to achieve world-class operational efficiency. In fiscal year 2018, Walmart achieved over $500 billion in sales—nearly one-tenth of retail sales in the United States—in large part because of its Retail Link system, which digitally links its suppliers to every one of Walmart's stores. 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 the industry, achieving sales of more than $600 per square foot, compared with its closest competitor, Target, at $425 per square foot and other large general merchandise retail firms producing less than $200 per square foot.

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 distribution model based on its own iPod technology platform. Apple has prospered from a continuing stream of innovations, including the iTunes music service, the iPad, and the iPhone.

Customer and Supplier Intimacy

When a business really knows its customers and serves them well, 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 to really know your customers or suppliers is a central problem for businesses with millions of offline and online customers.

The Mandarin Oriental in Manhattan and other high-end hotels exemplify the use of information systems and technologies to achieve customer intimacy. These hotels use computers 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 large data repository. Individual rooms in the hotels are networked to a central network server computer so that they can be remotely monitored and 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 to 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 the TAL Apparel Ltd. supplier, a 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 then decides how many replacement shirts to make and in what styles, colors, and sizes. TAL then sends the shirts to each JCPenney store, bypassing completely the retailer's warehouses. In other words, JCPenney's 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. In the past decade, information systems and technologies have made it possible for managers to use real-time data from the marketplace when making decisions.

For instance, Verizon Corporation, one of the largest telecommunications 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, described later in this chapter, 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 in 1977 to attract customers through higher service levels, its competitors rushed to provide ATMs to their customers to keep up with Citibank. Today, virtually all banks in the United States have regional ATMs and link to national and international ATM networks, such as CIRRUS. Providing ATM services to retail banking customers is simply a requirement of being in and surviving in the retail banking business.

There are many federal and state 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 U.S. 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 certified public accounting firms that audit public companies to retain audit working papers and records, including all e-mails, for five

years. The Dodd-Frank Wall Street Reform and Consumer Protection Act (2010), which was intended to strengthen regulation of the banking industry, requires firms to retain all records for 10 years. Many other pieces of federal and state legislation in health care, financial services, education, and privacy protection impose significant information retention and reporting requirements on U.S. businesses. Firms turn to information systems and technologies to provide the capability to respond to these challenges.

1-2 What is an information system? How does it work? What are its management, organization, and technology components? Why are complementary assets essential for ensuring that information systems provide genuine value for organizations?

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 in order to achieve its business objectives. This includes not only computer machines, storage devices, and handheld mobile 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 best understood by looking at them from both a technology and a business perspective.

What Is an Information System?

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

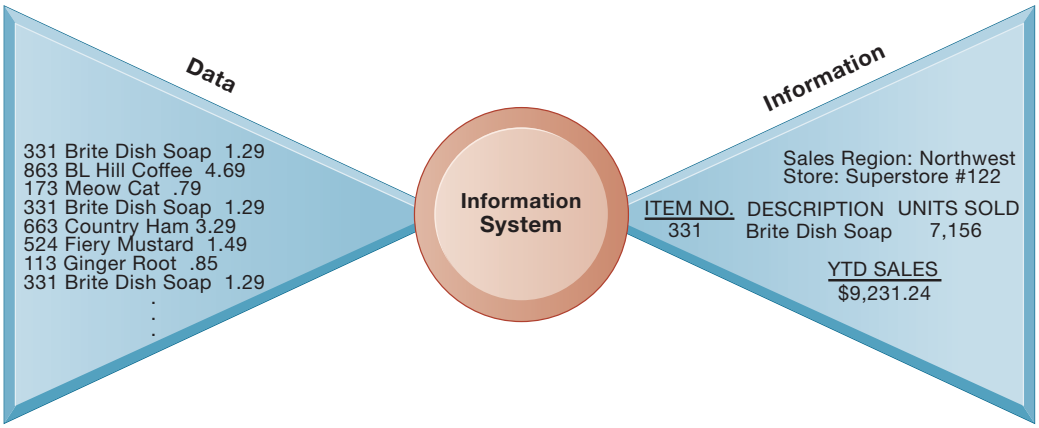
Information systems contain information about significant people, places, and things within the organization or in the environment surrounding it. By **information** we mean data that have been shaped into a form that is meaningful and useful to human beings. **Data**, in contrast, are streams of raw 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.

A brief example contrasting information and data may prove useful. Supermarket checkout counters scan millions of pieces of data from bar codes, which describe each 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 1.3).

Three activities in an information system produce the information that organizations need to make decisions, control operations, analyze problems, and

FIGURE 1.3 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.



create new products or services. These activities are input, processing, and output (see Figure 1.4). **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.

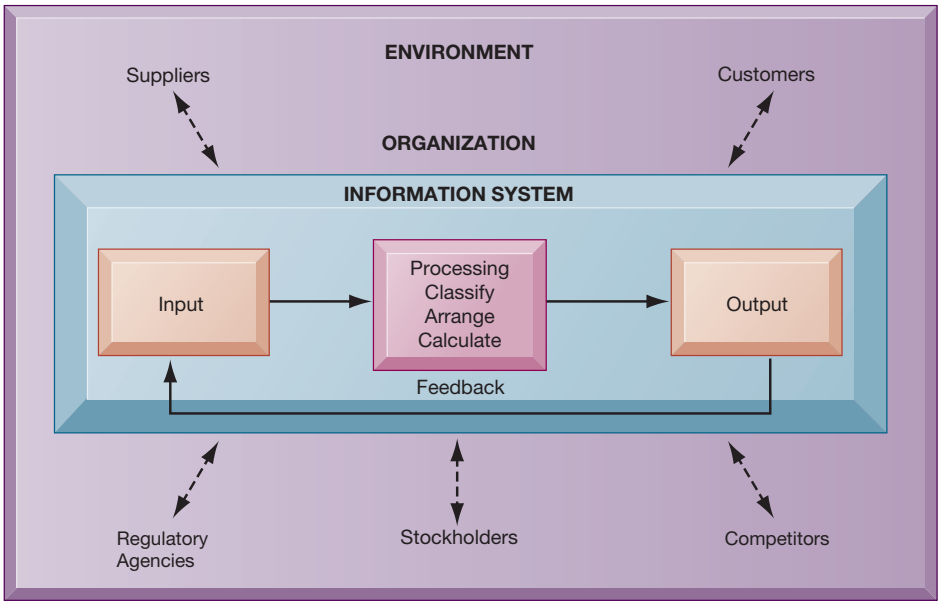
In PCL's project management system, input includes the names and addresses of contractors and subcontractors, project names and identification numbers, project activities, labor costs, materials costs, and start and completion dates for project activities. Computers store these data and process them 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 on the one hand and an information system on the other. 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.

A house is an appropriate analogy. Houses are built with hammers, nails, and wood, but these 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 hammers, nails, and lumber of computer-based information systems, but alone they cannot produce the information a particular organization needs. To understand information systems, you

FIGURE 1.4 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.



must understand the problems they are designed to solve, their architectural and design elements, and the organizational processes that lead to the solutions.

Dimensions of Information Systems

To fully understand information systems, you must understand the broader organization, management, and information technology dimensions of systems (see Figure 1.5) 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 management and organizational dimensions of systems as well as the technical dimensions of systems, as **information systems literacy**. **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 used by managers and employees in the firm.

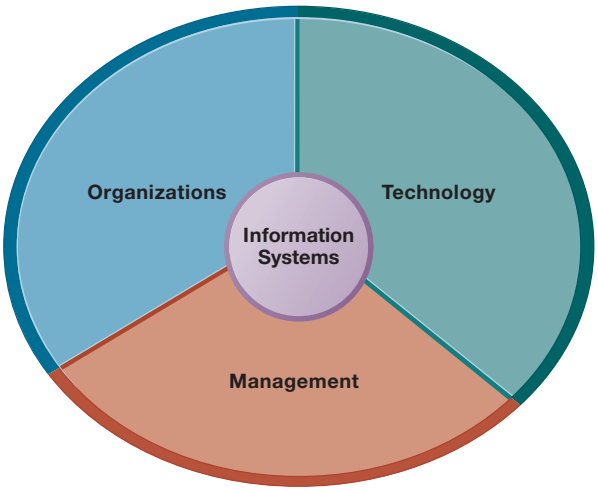
Let's examine each of the dimensions of information systems—organizations, management, and information technology.

Organizations

Information systems are an integral part of organizations. Indeed, for some companies, such as credit reporting firms, there would be no business without an information system. The key elements of an organization are its people, structure,

FIGURE 1.5 INFORMATION SYSTEMS ARE MORE THAN COMPUTERS

Using information systems effectively requires an understanding of the organization, management, and information technology shaping the systems. An information system creates value for the firm as an organizational and management solution to challenges posed by the environment.



business processes, politics, and culture. We introduce these components of organizations here and describe them in greater detail in Chapters 2 and 3.

Organizations have a structure that is composed of different levels and specialties. Their structures reveal a clear-cut division of labor. Authority and responsibility in a business firm are organized as a hierarchy, or a pyramid structure. The upper levels of the hierarchy consist of managerial, professional, and technical employees, whereas the lower levels consist of operational personnel.

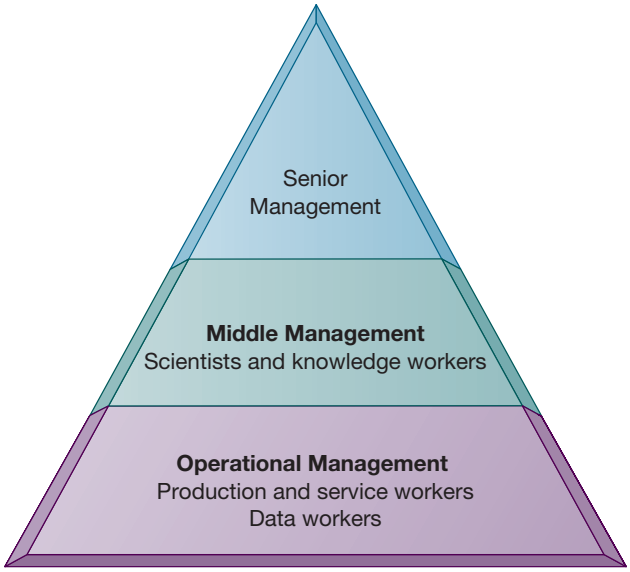
Senior management makes long-range strategic decisions about products and services as well as ensures financial performance of the firm. **Middle management** carries out the programs and plans of senior management, and **operational management** is responsible for monitoring the daily activities of the business. **Knowledge workers**, such as engineers, scientists, or architects, design products or services and create new knowledge for the firm, whereas **data workers**, such as secretaries or clerks, assist with scheduling and communications at all levels of the firm. **Production or service workers** actually produce the product and deliver the service (see Figure 1.6).

Experts are employed and trained for different business functions. The major **business functions**, or specialized tasks performed by business organizations, consist of sales and marketing, manufacturing and production, finance and accounting, and human resources (see Table 1.1). Chapter 2 provides more detail on these business functions and the ways in which they are supported by information systems.

An organization coordinates work through its hierarchy and through its *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

FIGURE 1.6 LEVELS IN A FIRM

Business organizations are hierarchies consisting of three principal levels: senior management, middle management, and operational management. Information systems serve each of these levels. Scientists and knowledge workers often work with middle management.



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. You can see organizational culture at work by looking around your university or college. Some bedrock assumptions of university life are that professors know more than students, that the reason students attend college is to learn, and that classes follow a regular schedule.

Parts of an organization's culture can always be found embedded in its information systems. For instance, UPS's first priority is customer service, which is an aspect of its organizational culture that can be found in the company's package tracking systems, which we describe in this section.

Different levels and specialties in an organization create different interests and points of view. These views often conflict over how the company should be run and how resources and rewards should be distributed. Conflict is the basis for organizational politics. Information systems come out of this cauldron of differing perspectives, conflicts, compromises, and agreements that are a

TABLE 1.1 MAJOR BUSINESS FUNCTIONS

FUNCTION	PURPOSE
Sales and marketing	Selling the organization's products and services
Manufacturing and production	Producing and delivering products and services
Finance and accounting	Managing the organization's financial assets and maintaining the organization's financial records
Human resources	Attracting, developing, and maintaining the organization's labor force; maintaining employee records

natural part of all organizations. In Chapter 3, we examine these features of organizations and their role in the development of information systems in greater detail.

Management

Management's job is to make sense out of the many situations faced by organizations, 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. The business information systems described in this book reflect the hopes, dreams, and realities of real-world managers.

But 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 design and deliver new products and services and redirecting and redesigning their organizations. Chapter 12 treats management decision making in detail.

Information Technology

Information technology is one of many tools managers use to cope with change. **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 (including mobile handheld devices); various input, output, and storage devices; and telecommunications devices that link computers together.

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 used by firms 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**. The Internet is 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 other interorganizational work. For most business

firms today, using Internet technology is both a business necessity and a competitive advantage.

The **World Wide Web** is a service provided by the Internet 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 on 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 described in the Interactive Session.

All of 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 IT infrastructure so that it has the set of technology services it needs for the work it wants to accomplish with information systems. Chapters 5 through 8 of this book examine each major technology component of information technology infrastructure and show how they all work together to create the technology platform for the organization.

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 different pieces of software for tracking packages, calculating fees, maintaining customer accounts, and managing logistics.

Let's identify the organization, management, 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 computer systems to increase the ease of sending a package using 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, desktop computers, wired and wireless communications networks, UPS's data center, storage technology for the package delivery data, UPS in-house package tracking software, and software to access the World Wide Web. The result is an information system solution to the business challenge

INTERACTIVE SESSION TECHNOLOGY

UPS Competes Globally with Information Technology

United Parcel Service (UPS) started out in 1907 in a closet-sized basement office. Jim Casey and Claude Ryan—two teenagers from Seattle with two bicycles and one phone—promised the "best service and lowest rates." UPS has used this formula successfully for more than a century to become the world's largest ground and air package-delivery company. It's a global enterprise with more than 454,000 employees, over 112,000 vehicles, and the world's ninth-largest airline.

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 U.S. 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: $50 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 make many stops scattered across residential neighborhoods, delivering one lightweight 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 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. CandleScience, based in Durham, North Carolina, is an industry leader in the candle and soap supply industry, providing raw materials such as waxes, wicks, and fragrances to candle makers around the world. UPS worked with CandleScience to accurately model shipping rates for the company and its customers and to add a freight shipping option capability to its website. UPS also helped CandleScience identify the optimal location for a new warehouse for its West Coast customers. The new West Coast warehouse in Sparks, Nevada lets the company reach some of its largest customers faster, more efficiently and less expensively.

UPS provides both financial and shipping advice and services to Flags of Valor, a small business based in Ashton, Virginia, which sells hundreds of hand-crafted wooden flags each day to online customers. Using UPS Quantum View Manage® technology, the staff can view and monitor outbound packages and immediately respond to customer questions about order status. UPS Capital®, the financial service division of UPS, showed the company how to protect its cash flow and assets by moving to a comprehensive insurance plan.

Sources: Paul Ziobro, "UPS's $20 Billion Problem: Operations Stuck in the 20th Century," *Wall Street Journal*, June 15, 2018; www.ups.com, accessed February 7, 2018; "Igniting Growth with CandleScience," *UPS Compass*, May 2017; and "Stars and Stripes Flying High," *UPS Compass*, December 2017.

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?

of providing a high level of service with low prices in the face of mounting competition.

It Isn't Just Technology: A Business Perspective on Information Systems

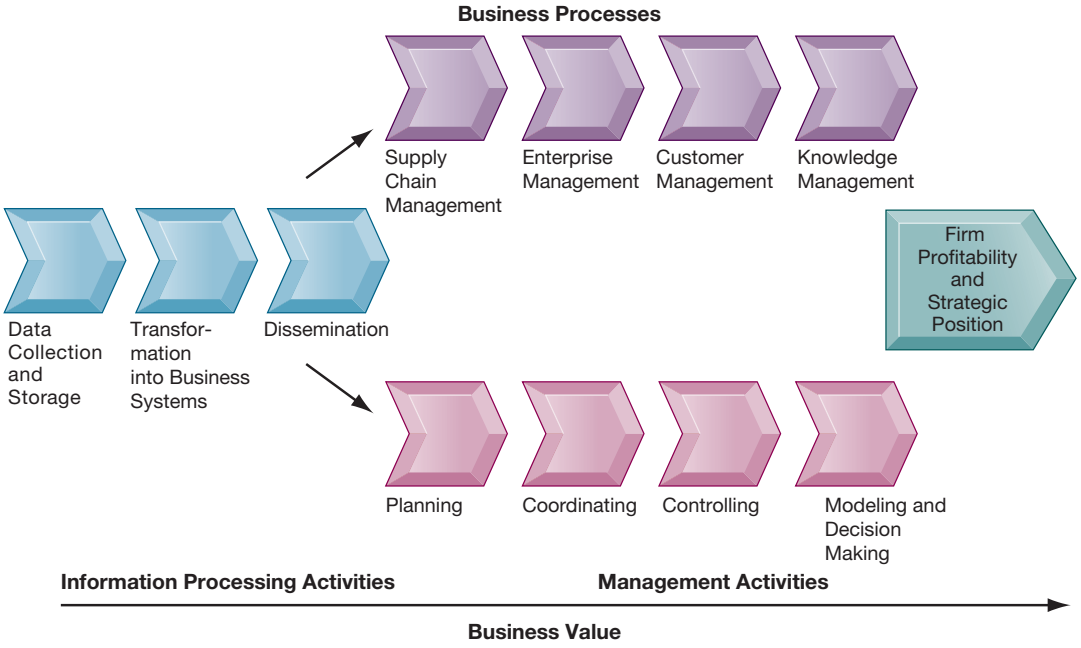
Managers and business firms invest in information technology and systems because they provide real economic value to the business. The decision to build or maintain an information system assumes that the returns on this investment will be superior to other investments in buildings, machines, or other assets. These superior returns will be expressed as increases in productivity, as increases in revenues (which will increase the firm's stock market value), or perhaps as superior long-term strategic positioning of the firm in certain markets (which will produce superior revenues in the future).

We can see that from a business perspective, an information system is an important instrument for creating value for the firm. Information systems enable the firm to increase its revenue or decrease its costs by providing information that helps managers make better decisions or that improves the execution of business processes. For example, the information system for analyzing supermarket checkout data illustrated in Figure 1.3 can increase firm profitability by helping managers make better decisions as to which products to stock and promote in retail supermarkets.

Every business has an information value chain, illustrated in Figure 1.7, in which raw information is systematically acquired and then transformed

FIGURE 1.7 THE BUSINESS INFORMATION VALUE CHAIN

From a business perspective, information systems are part of a series of value-adding activities for acquiring, transforming, and distributing information that managers can use to improve decision making, enhance organizational performance, and, ultimately, increase firm profitability.



through various stages that add value to that information. The value of an information system to a business, as well as the decision to invest in any new information system, is, in large part, determined by the extent to which the system will lead to better management decisions, more efficient business processes, and higher firm profitability. Although there are other reasons why systems are built, their primary purpose is to contribute to corporate value.

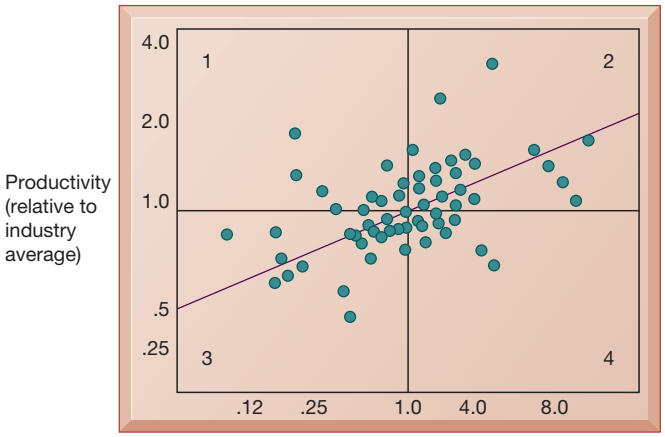
The business perspective calls attention to the organizational and managerial nature of information systems. An information system represents an organizational and management solution, based on information technology, to a challenge or problem posed by the environment. Every chapter in this book begins with a short case study that illustrates this concept. A diagram at the beginning of each chapter illustrates the relationship between a business challenge and resulting management and organizational decisions to use IT as a solution to challenges generated by the business environment. You can use this diagram as a starting point for analyzing any information system or information system problem you encounter.

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 management, technology, and organizational elements work together to create the systems.

FIGURE 1.8 **VARIATION IN RETURNS ON INFORMATION TECHNOLOGY INVESTMENT**

Although, on average, investments in information technology produce returns far above those returned by other investments, there is considerable variation across firms.

Source: Brynjolfsson, Erik and Lorin M. Hitt. "Beyond Computation: Information Technology, Organizational Transformation, and Business Performance." Journal of Economic Perspectives 14, No. 4 (2000).



Complementary Assets: Organizational Capital and the Right Business Model

Awareness of the organizational and managerial dimensions of information systems can help us understand why some firms achieve better results from their information systems than others. Studies of returns from information technology investments show that there is considerable variation in the returns firms receive (see Figure 1.8). Some firms invest a great deal and receive a great deal (quadrant 2); others invest an equal amount and receive few returns (quadrant 4). Still other firms invest little and receive much (quadrant 1), whereas others invest little and receive little (quadrant 3). This suggests that investing in information technology does not by itself guarantee good returns. What accounts for this variation among firms?

The answer lies in the concept of complementary assets. Information technology investments alone cannot make organizations and managers more effective unless they are accompanied by supportive values, structures, and behavior patterns in the organization and other complementary assets. Business firms need to change how they do business before they can really reap the advantages of new information technologies.

Complementary assets are those assets required to derive value from a primary investment (Teece, 1998). For instance, to realize value from automobiles requires substantial complementary investments in highways, roads, gasoline stations, repair facilities, and a legal regulatory structure to set standards and control drivers.

Research indicates that firms that support their technology investments with investments in complementary assets, such as new business models, new business processes, management behavior, organizational culture, or training, receive superior returns, whereas those firms failing to make these complementary investments receive less or no returns on their information technology investments (Brynjolfsson, 2005; Brynjolfsson and Hitt, 2000; Laudon, 1974). These investments in organization and management are also known as **organizational and management capital**.

TABLE 1.2 COMPLEMENTARY SOCIAL, MANAGERIAL, AND ORGANIZATIONAL ASSETS REQUIRED TO OPTIMIZE RETURNS FROM INFORMATION TECHNOLOGY INVESTMENTS

Organizational assets	Supportive organizational culture that values efficiency and effectiveness
	Appropriate business model
	Efficient business processes
	Decentralized authority
	Distributed decision-making rights
	Strong IS development team
Managerial assets	Strong senior management support for technology investment and change
	Incentives for management innovation
	Teamwork and collaborative work environments
	Training programs to enhance management decision skills
	Management culture that values flexibility and knowledge-based decision making.
Social assets	The Internet and telecommunications infrastructure
	IT-enriched educational programs raising labor force computer literacy
	Standards (both government and private sector)
	Laws and regulations creating fair, stable market environments
	Technology and service firms in adjacent markets to assist implementation

Table 1.2 lists the major complementary investments that firms need to make to realize value from their information technology investments. Some of this investment involves tangible assets, such as buildings, machinery, and tools. However, the value of investments in information technology depends to a large extent on complementary investments in management and organization.

Key organizational complementary investments are a supportive business culture that values efficiency and effectiveness, an appropriate business model, efficient business processes, decentralization of authority, highly distributed decision rights, and a strong information system (IS) development team.

Important managerial complementary assets are strong senior management support for change, incentive systems that monitor and reward individual innovation, an emphasis on teamwork and collaboration, training programs, and a management culture that values flexibility and knowledge.

Important social investments (not made by the firm but by the society at large, other firms, governments, and other key market actors) are the Internet and the supporting Internet culture, educational systems, network and computing standards, regulations and laws, and the presence of technology and service firms.

Throughout the book, we emphasize a framework of analysis that considers technology, management, and organizational assets and their interactions. Perhaps the single most important theme in the book, reflected in case studies and exercises, is that managers need to consider the broader organization and management dimensions of information systems to understand current problems as well as to derive substantial above-average returns from their information technology investments. As you will see throughout the text, firms that

can address these related dimensions of the IT investment are, on average, richly rewarded.

1-3 What academic disciplines are used to study information systems, and how does each contribute to an understanding of information systems?

The study of information systems is a multidisciplinary field. No single theory or perspective dominates. Figure 1.9 illustrates the major disciplines that contribute problems, issues, and solutions in the study of information systems. In general, the field can be divided into technical and behavioral approaches. Information systems are sociotechnical systems. Though they are composed of machines, devices, and "hard" physical technology, they require substantial social, organizational, and intellectual investments to make them work properly.

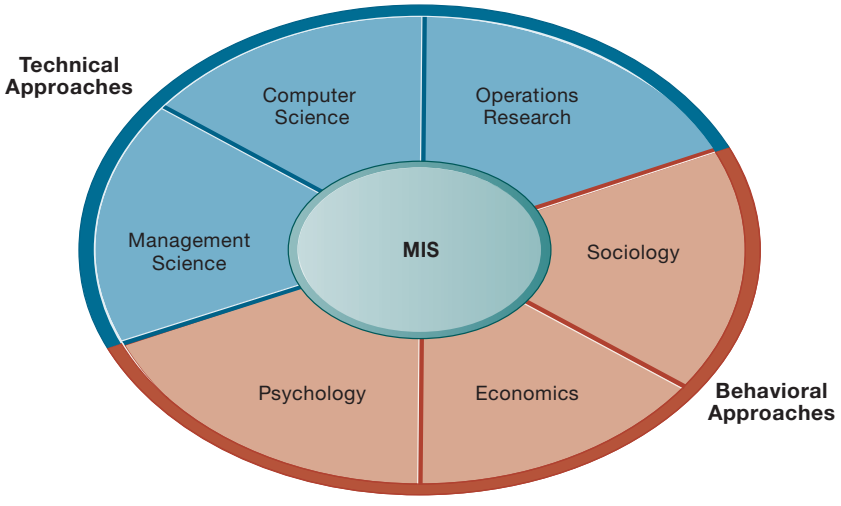
Technical Approach

The technical approach to information systems emphasizes mathematically based models to study information systems as well as the physical technology and formal capabilities of these systems. The disciplines that contribute to the technical approach are computer science, management science, and operations research.

Computer science is concerned with establishing theories of computability, methods of computation, and methods of efficient data storage and access. Management science emphasizes the development of models for decision-making and management practices. Operations research focuses on mathematical techniques for optimizing selected parameters of organizations, such as transportation, inventory control, and transaction costs.

FIGURE 1.9 CONTEMPORARY APPROACHES TO INFORMATION SYSTEMS

The study of information systems deals with issues and insights contributed from technical and behavioral disciplines.



Behavioral Approach

An important part of the information systems field is concerned with behavioral issues that arise in the development and long-term maintenance of information systems. Issues such as strategic business integration, design, implementation, utilization, and management cannot be explored usefully with the models used in the technical approach. Other behavioral disciplines contribute important concepts and methods.

For instance, sociologists study information systems with an eye toward how groups and organizations shape the development of systems and also how systems affect individuals, groups, and organizations. Psychologists study information systems with an interest in how human decision makers perceive and use formal information. Economists study information systems with an interest in understanding the production of digital goods, the dynamics of digital markets, and how new information systems change the control and cost structures within the firm.

The behavioral approach does not ignore technology. Indeed, information systems technology is often the stimulus for a behavioral problem or issue. But the focus of this approach is generally not on technical solutions. Instead, it concentrates on changes in attitudes, management and organizational policy, and behavior.

Approach of This Text: Sociotechnical Systems

Throughout this book, you will find a rich story with four main actors: suppliers of hardware and software (the technologists); business firms making investments and seeking to obtain value from the technology; managers and employees seeking to achieve business value (and other goals); and the contemporary legal, social, and cultural context (the firm's environment). Together these actors produce what we call *management information systems*.

The study of management information systems (MIS) arose to focus on the use of computer-based information systems in business firms and government agencies. MIS combines the work of computer science, management science, and operations research with a practical orientation toward developing system solutions to real-world problems and managing information technology resources. It is also concerned with behavioral issues surrounding the development, use, and impact of information systems, which are typically discussed in the fields of sociology, economics, and psychology.

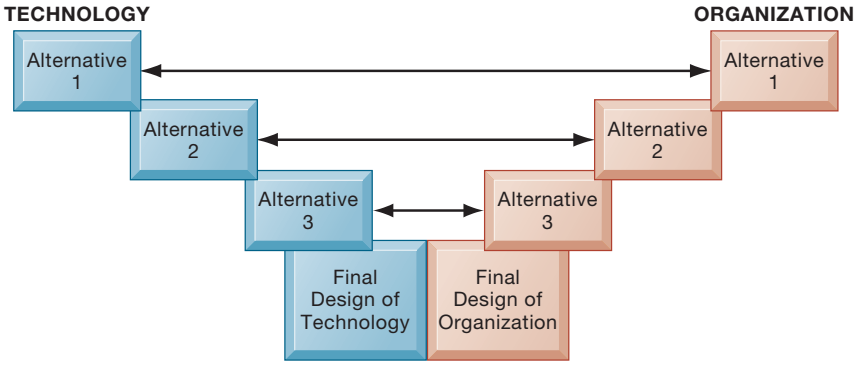
Our experience as academics and practitioners leads us to believe that no single approach effectively captures the reality of information systems. The successes and failures of information systems are rarely all technical or all behavioral. Our best advice to students is to understand the perspectives of many disciplines. Indeed, the challenge and excitement of the information systems field are that it requires an appreciation and tolerance of many different approaches.

The view we adopt in this book is best characterized as the **sociotechnical view** of systems. In this view, optimal organizational performance is achieved by jointly optimizing both the social and technical systems used in production.

Adopting a sociotechnical systems perspective helps to avoid a purely technological approach to information systems. For instance, the fact that information technology is rapidly declining in cost and growing in power does not

FIGURE 1.10 A SOCIOTECHNICAL PERSPECTIVE ON INFORMATION SYSTEMS

In a sociotechnical perspective, the performance of a system is optimized when both the technology and the organization mutually adjust to one another until a satisfactory fit is obtained.



necessarily or easily translate into productivity enhancement or bottom-line profits. The fact that a firm has recently installed an enterprise-wide financial reporting system does not necessarily mean that it will be used, or used effectively. Likewise, the fact that a firm has recently introduced new business procedures and processes does not necessarily mean employees will be more productive in the absence of investments in new information systems to enable those processes.

In this book, we stress the need to optimize the firm's performance as a whole. Both the technical and behavioral components need attention. This means that technology must be changed and designed in such a way as to fit organizational and individual needs. Sometimes, the technology may have to be "de-optimized" to accomplish this fit. For instance, mobile phone users adapt this technology to their personal needs, and as a result manufacturers quickly seek to adjust the technology to conform to user expectations. Organizations and individuals must also be changed through training, learning, and planned organizational change to allow the technology to operate and prosper. Figure 1.10 illustrates this process of mutual adjustment in a sociotechnical system.

1-4 How will MIS help my career?

Here is how Chapter 1 and this text 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 New York City, Atlanta, Los Angeles, and Chicago, 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 medial 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 How are information systems transforming business, and why are they so essential for running and managing a business today?

E-mail, online conferencing, smartphones, and tablet computers have become essential tools for conducting business. Information systems are the foundation of fast-paced supply chains. The Internet allows many businesses to buy, sell, advertise, and solicit customer feedback online. Organizations are trying to become more competitive and efficient by digitally enabling their core business processes and evolving into digital firms. The Internet has stimulated globalization by dramatically reducing the costs of producing, buying, and selling goods on a global scale. New information system trends include the emerging mobile digital platform, big data, and cloud computing.

Information systems are a foundation for conducting business today. In many industries, survival and the ability to achieve strategic business goals are difficult without extensive use of information technology. Businesses today 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 is an information system? How does it work? What are its management, organization, and technology components? Why are complementary assets essential for ensuring that information systems provide genuine value for organizations?

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 management, organization, and technology elements. The management dimension of information systems involves issues such as leadership, strategy, 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.

In order to obtain meaningful value from information systems, organizations must support their technology investments with appropriate complementary investments in organizations and management. These complementary assets include new business models and business processes, supportive organizational culture and management behavior, and appropriate technology standards, regulations, and laws. New information technology investments are unlikely to produce high returns unless businesses make the appropriate managerial and organizational changes to support the technology.

1-3 What academic disciplines are used to study information systems, and how does each contribute to an understanding of information systems?

The study of information systems deals with issues and insights contributed from technical and behavioral disciplines. The disciplines that contribute to the technical approach focusing on formal models and capabilities of systems are computer science, management science, and operations research. The disciplines contributing to the behavioral approach focusing on the design, implementation, management, and business impact of systems are psychology, sociology, and economics. A sociotechnical view of systems considers both technical and social features of systems and solutions that represent the best fit between them.

Key Terms

Business functions, 19
Business model, 14
Business processes, 12
Complementary assets, 26
Computer hardware, 21
Computer literacy, 18
Computer software, 21
Culture, 20
Data, 16
Data management technology, 21
Data workers, 19
Digital firm, 12
Extranets, 21
Feedback, 17
Information, 16
Information system, 16
Information systems literacy, 18
Information technology (IT), 16
Information technology (IT) infrastructure, 22
Input, 17
Internet, 21
Intranets, 21
Knowledge workers, 19
Management information systems (MIS), 18
Middle management, 19
Network, 21
Networking and telecommunications technology, 21
Operational management, 19
Organizational and management capital, 26
Output, 17
Processing, 17
Production or service workers, 19
Senior management, 19
Sociotechnical view, 29
World Wide Web, 22

MyLab MIS

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

Review Questions

1-1 How are information systems transforming business, and why are they so essential for running and managing a business today?

- Describe how information systems have changed the way businesses operate and their products and services.
- Identify three major new information system trends.
- Describe the characteristics of a digital firm.
- Describe the challenges and opportunities of globalization in a "flattened" world.
- List and describe six reasons why information systems are so important for business today.

1-2 What is an information system? How does it work? What are its management, organization, and technology components? Why are complementary assets essential for ensuring that information systems provide genuine value for organizations?

- Define an information system and describe the activities it performs.
- List and describe the organizational, management, and technology dimensions of information systems.
- Distinguish between data and information and between information systems literacy and computer literacy.
- Explain how the Internet and the World Wide Web are related to the other technology components of information systems.
- Define complementary assets and describe their relationship to information technology.
- Describe the complementary social, managerial, and organizational assets required to optimize returns from information technology investments.

1-3 What academic disciplines are used to study information systems, and how does each contribute to an understanding of information systems?

- List and describe each discipline that contributes to a technical approach to information systems.
- List and describe each discipline that contributes to a behavioral approach to information systems.
- Describe the sociotechnical perspective on information systems.

Discussion Questions

1-4 MyLab MIS Information systems are too important to be left to computer specialists. Do you agree? Why or why not?

1-5 MyLab MIS If you were setting up the website for a Major League Baseball team, what management, organization, and technology issues might you encounter?

1-6 MyLab MIS What are some of the organizational, managerial, and social complementary assets that help make UPS's information systems so successful?

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

1-7 Snyders of Hanover, which sells about 80 million bags of pretzels, snack chips, and organic snack items each year, had its financial department use spreadsheets and manual processes for much of its data gathering and reporting. Snyder's financial analyst would spend the entire final week of every month collecting spreadsheets from the heads of more than 50 departments worldwide. She would then consolidate and reenter all the data into another spreadsheet, which would serve as the company's monthly profit-and-loss statement. If a department needed to update its data after submitting the spreadsheet to the main office, the analyst had to return the original spreadsheet, then wait for the department to resubmit its data before finally submitting the updated data in the consolidated document. Assess the impact of this situation on business performance and management decision making.

1-8 Dollar General Corporation operates deep-discount stores offering housewares, cleaning supplies, clothing, health and beauty aids, and packaged food, with most items selling for $1. Its business model calls for keeping costs as low as possible. The company has no automated method for keeping track of inventory at each store. Managers know approximately how many cases of a particular product the store is supposed to receive when a delivery truck arrives, but the stores lack technology for scanning the cases or verifying the item count inside the cases. Merchandise losses from theft or other mishaps have been rising and now represent more than 3 percent of total sales. What decisions have to be made before investing in an information system solution?

Improving Decision Making: Using Databases to Analyze Sales Trends

Software skills: Database querying and reporting
Business skills: Sales trend analysis

1-9 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?

You can easily modify the database table to find and report your answers. 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

1-10 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

1-11 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, electronic 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 using the Google tool you have selected.

Did Information Systems Cause Deutsche Bank to Stumble?

CASE STUDY

Deutsche Bank AG, founded in 1870, is one of the world's top financial companies, with 2,425 branches worldwide. It offers a range of financial products and services, including retail and commercial banking, foreign exchange, and services for mergers and acquisitions. The bank provides products for mortgages, consumer finance, credit cards, life insurance, and corporate pension plans; financing for international trade; and customized wealth management services for wealthy private clients. Deutsche Bank is also the largest bank in Germany, and plays a central role in German economic life. In many ways, Deutsche Bank is the embodiment of the global financial system.

Deutsche Bank has the world's largest portfolio of derivatives, valued at about $46 trillion. A financial derivative is a contract between two or more parties whose value is dependent upon or derived from one or more underlying assets, such as stocks, bonds, commodities, currencies, and interest rates. Although Deutsche Bank had survived the 2008 banking crisis, which was partly triggered by flawed derivatives, it is now struggling with seismic changes in the banking industry, including recent regulatory change. The bank was forced to pay $7.2 billion to resolve U.S. regulator complaints about its sale of toxic mortgage securities that contributed to the 2008 financial crisis.

In addition, the Commodity Futures Trading Commission (CFTC) charged that Deutsche Bank submitted incomplete and untimely credit default swap data, failed to properly supervise employees responsible for swap data reporting, and lacked an adequate business continuity and disaster recovery plan. (A credit default swap is a type of credit insurance contract in which an insurer promises to compensate an insured party [such as a bank] for losses incurred when a debtor [such as a corporation] defaults on a debt and that can be purchased or sold by either party on the financial market. Credit default swaps are very complex financial instruments.)

The CFTC complained that on April 16, 2016, Deutsche Bank's swap data reporting system experienced a system outage that prevented Deutsche Bank from reporting any swap data for multiple asset classes for approximately five days. Deutsche Bank's subsequent efforts to end the system outage repeatedly exacerbated existing reporting problems and led to the discovery and creation of new reporting problems.

For example, Deutsche Bank's swap data reported before and after the system outage revealed persistent problems with the integrity of certain data fields, including numerous invalid legal entity identifiers. (A legal entity identifier [LEI] is an identification code to uniquely identify all legal entities that are parties to financial transactions.) The CFTC complaint alleged that a number of these reporting problems persist today, affecting market data that is made available to the public as well as data that is used by the CFTC to evaluate systemic risk throughout the swaps markets. The CFTC complaint also alleged that Deutsche Bank's system outage and subsequent reporting problems occurred in part because Deutsche Bank failed to have an adequate business continuity and disaster recovery plan and other appropriate supervisory systems in place.

In addition to incurring high costs associated with coping with regulators and paying fines, Deutsche Bank was a very unwieldy and expensive bank to operate. U.S. regulators have identified Deutsche Bank's antiquated technology as one reason why the bank was not always able to provide the correct information for running its business properly and responding to regulators. Poor information systems may have even contributed to the 2008 financial crisis. Banks often had trouble untangling the complex financial products they had bought and sold to determine their underlying value.

Banks, including Deutsche Bank, are intensive users of information technology, and they rely on technology to spot misconduct. If Deutsche Bank was such an important player in the German and world financial systems, why were its systems not up to the job?

It turns out that Deutsche Bank, like other leading global financial companies, had undergone decades of mergers and expansion. When these banks merged or acquired other financial companies, they often did not make the requisite (and often far-reaching) changes to integrate their information systems with

those of their acquisitions. The effort and costs required for this integration, including coordination across many management teams, were too great. So the banks left many old systems in place to handle the workload for each of their businesses. This created what experts call "spaghetti balls" of overlapping and often incompatible technology platforms and software programs. These antiquated legacy systems were designed to handle large numbers of transactions and sums of money, but they were not well suited to managing large bank operations. They often did not allow information to be shared easily among departments or provide senior management with a coherent overview of bank operations.

Deutsche Bank had more than 100 different booking systems for trades in London alone and no common set of codes for identifying clients in each of these systems. Each of these systems might use a different number or code for identifying the same client, so it would be extremely difficult or impossible to show how the same client was treated in all of these systems. Individual teams and traders each had their own incompatible platforms. The bank had employed a deliberate strategy of pitting teams against each other to spur them on, but this further encouraged the use of different systems because competing traders and teams were reluctant to share their data. Yet the bank ultimately had to reconcile the data from these disparate systems, often by hand, before trades could be processed and recorded.

This situation has made it very difficult for banks to undertake ambitious technology projects for the systems that they need today or to comply with regulatory requirements. U.S. regulators criticized Deutsche Bank for its inability to provide essential information because of its antiquated technology. Regulators are demanding that financial institutions improve the way they manage risk. The banks are under pressure to make their aging computer systems comply, but the IT infrastructures at many traditional financial institutions are failing to keep up with these regulatory pressures or with changing consumer expectations. Deutsche Bank and its peers must also adapt to new innovative technology competitors such as Apple that are muscling into banking services.

In July 2015, John Cryan became Deutsche Bank's CEO. He tried to reduce costs and improve efficiency, laying off thousands of employees. He focused on overhauling Deutsche Bank's fragmented, antiquated information systems, which are a major impediment to controlling costs and finding new sources of profit and growth. Cryan noted that the bank's cost base was swollen by poor and ineffective business processes, inadequate technology, and too many tasks being handled manually. He has called for standardizing the bank's systems and procedures, eliminating legacy software, standardizing and enhancing data, and improving reporting.

Cryan appointed technology specialist Kim Hammonds as chief operating officer to oversee reengineering the bank's information systems and operations. Hammonds had been Deutsche Bank's global chief information officer and, before that, chief information officer at Boeing. Hammonds observed that Deutsche Bank's information systems operated by trial and error, as if her former employer Boeing launched aircraft into the sky, watched them crash, and then tried to learn from the mistakes.

In February 2015, Deutsche Bank announced a 10-year, multibillion-dollar deal with Hewlett-Packard (HP) to standardize and simplify its IT infrastructure, reduce costs, and create a more modern and agile technology platform for launching new products and services. Deutsche Bank would migrate to a cloud computing infrastructure where it would run its information systems in HP's remote computer centers. HP would provide computing services, hosting, and storage. Deutsche Bank would still be in charge of application development and information security technologies, which it considers as proprietary and crucial for competitive differentiation.

Deutsche Bank is withdrawing from high-risk client relationships, improving its control framework, and automating manual reconciliations. To modernize its IT infrastructure, the bank is reducing the number of its individual operating systems that control the way a computer works from 45 to four, replacing scores of outdated computers, and replacing antiquated software applications. Thousands of applications and functions will be shifted from Deutsche Bank's mainframes to HP's cloud computing services. Automating manual processes will promote efficiency and better control. These improvements are expected to reduce "run the bank" costs by 800 million euros. Eliminating 6,000 contractors will create total savings of 1 billion euros. Deutsche Bank has also opened four technology centers to work with financial technology startups to improve its technology.

Despite all of these efforts, Deutsche Bank has struggled to regain profitability and stability. In early April 2018 the bank's supervisory board replaced Cryan with Christian Sewing, a longtime

insider who had been in charge of the bank's wealth management division and its branch network in Germany. During his tenure, Cryan was unable to restore profitability. In February 2018 the bank reported a loss of €735 million, or about $900 million, for 2017, which represented its third consecutive annual loss.

Deutsche Bank has not been the only major bank to be hampered by system problems. IT shortcomings were one reason Banco Santander's U.S. unit in 2016 failed the U.S. Federal Reserve's annual "stress tests," which gauge how big banks would fare in a new financial crisis. A 2015 Accenture consultants' report found that only 6 percent of board of director members and 3 percent of CEOs at the world's largest banks had professional technology experience. Financial technology innovations, security, IT resilience, and technology implications of regulatory changes are now all critical issues for bank boards of directors, but many lack the knowledge to assess these issues and make informed decisions about strategy, investment, and how best to allocate technology resources.

Sources: Jack Ewing, "Deutsche Bank Replaces CEO Amid Losses and Lack of Direction," *New York Times*, April 8, 2018; Charles Riley, "Deutsche Bank Hasn't Made a Profit in Three Years," *CNN Money*, February 2, 2018; Anna Irrera, "Deutsche Bank Launches Tech Startup Lab in New York City," *Reuters*, March 21, 2017; Geoffrey Smith, "Things You Should Know About the Deutsche Bank Train Wreck," *Fortune*, September 28, 2016; Hayley McDowell, "System Outage Sees Deutsche Bank Charged over Reporting Failures," *The Trade News*, August 19, 2016; Derek du Preez, "US Regulator Charges Deutsche Bank over Multiple Systems Failures," *Diginomica*, August 19, 2016; Kat Hall, "Deutsche Bank's Creaking IT Systems Nervously Eyeing Bins," *The Register*, October 27, 2015; Martin Arnold and Tom Braithwaite, "Banks' Ageing IT Systems Buckle Under Strain," *Financial Times*, June 18, 2015; Martin Arnold, "Deutsche Bank to Rip Out IT Systems Blamed for Problems," *Financial Times*, October 26, 2015; Ben Moshinsky, "Deutsche Bank Has a Technology Problem," *Business Insider*, October 20, 2015; Edward Robinson and Nicholas Comfort, "Cryan's Shakeup at Deutsche Bank Sees Tech Restart," *Bloomberg*, December 20, 2015; and Accenture, "Bank Boardrooms Lack Technology Experience, Accenture Global Research Finds," October 28, 2015.

CASE STUDY QUESTIONS

1-12 Identify the problem described in this case study. What management, organization, and technology factors contributed to this problem?

1-13 What was the role of information technology at Deutsche Bank? How was IT related to the bank's operational efficiency, decision-making capability, and business strategy?

1-14 Was Deutsche Bank using technology effectively to pursue its business strategy? Explain your answer.

1-15 What solution for Deutsche Bank was proposed? How effective do you think it will be? Explain your answer.

MyLab MIS

Go to the Assignments section of MyLab MIS to complete these writing exercises.

1-16 What are the strategic objectives that firms try to achieve by investing in information systems and technologies? For each strategic objective, give an example of how a firm could use information systems to achieve that objective.

1-17 Describe the complementary assets that firms need in order to optimize returns from their information system investments. For each type of complementary asset, give an example of a specific asset a firm should have.

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