information
systems **5e**

Paige Baltzan

Daniels College of Business

University of Denver

**Mc
Graw
Hill
Education**
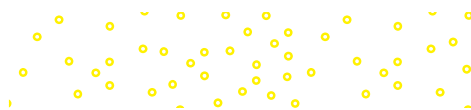
information
systems 5e

SENIOR PORTFOLIO MANAGER **BRIAN SYLVESTER**

DIRECTOR **WYATT MORRIS**

PRODUCT DEVELOPER **DAVID PLOSKONKA, KELLY DELSO**

MARKETING MANAGER **CORBAN QUIGG**

CONTENT PROJECT MANAGERS **MELISSA M. LEICK, BRUCE GIN, KAREN JOZEFOWICZ**

BUYER **LAURA FULLER**

DESIGN **MATT DIAMOND**

CONTENT LICENSING SPECIALIST **ANN MARIE JANNETTE**

COVER IMAGE **©LEE YIU TUNG/SHUTTERSTOCK**

COMPOSITOR **SPI GLOBAL**

mheducation.com/highered

brief contents

©EyeEm/Alamy Stock Photo

contents

connect® | Students—study more efficiently, retain more and achieve better outcomes. Instructors—focus on what you love—teaching.

SUCCESSFUL SEMESTERS INCLUDE CONNECT

FOR INSTRUCTORS

You're in the driver's seat.

Want to build your own course? No problem. Prefer to use our turnkey, prebuilt course? Easy. Want to make changes throughout the semester? Sure. And you'll save time with Connect's auto-grading too.
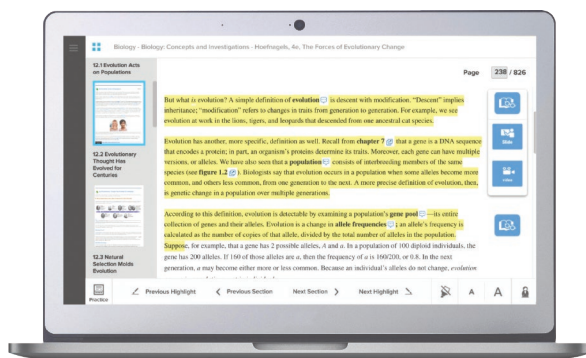
65%
Less Time Grading

They'll thank you for it.

Adaptive study resources like SmartBook® help your students be better prepared in less time. You can transform your class time from dull definitions to dynamic debates. Hear from your peers about the benefits of Connect at **www.mheducation.com/highered/connect**.

Make it simple, make it affordable.

Connect makes it easy with seamless integration using any of the major Learning Management Systems—Blackboard®, Canvas, and D2L, among others—to let you organize your course in one convenient location. Give your students access to digital materials at a discount with our inclusive access program. Ask your McGraw-Hill representative for more information.

©Hill Street Studios/Tobin Rogers/Blend Images LLC

Solutions for your challenges.

A product isn't a solution. Real solutions are affordable, reliable, and come with training and ongoing support when you need it and how you want it. Our Customer Experience Group can also help you troubleshoot tech problems—although Connect's 99% uptime means you might not need to call them. See for yourself at **status.mheducation.com**

©Shutterstock/wavebreakmedia

FOR STUDENTS

Effective, efficient studying.

Connect helps you be more productive with your study time and get better grades using tools like SmartBook, which highlights key concepts and creates a personalized study plan. Connect sets you up for success, so you walk into class with confidence and walk out with better grades.

> "I really liked this app— it made it easy to study when you don't have your textbook in front of you."
>
> – Jordan Cunningham, Eastern Washington University

Study anytime, anywhere.

Download the free ReadAnywhere app and access your online eBook when it's convenient, even if you're offline. And since the app automatically syncs with your eBook in Connect, all of your notes are available every time you open it. Find out more at **www.mheducation. com/readanywhere**

No surprises.

The Connect Calendar and Reports tools keep you on track with the work you need to get done and your assignment scores. Life gets busy; Connect tools help you keep learning through it all.

13	14
Chapter 12 Quiz	Chapter 11 Quiz
Chapter 13 Evidence of Evolution	Chapter 11 DNA Technology
	Chapter 7 Quiz
	Chapter 7 DNA Structure and Gene...
	and 7 more...
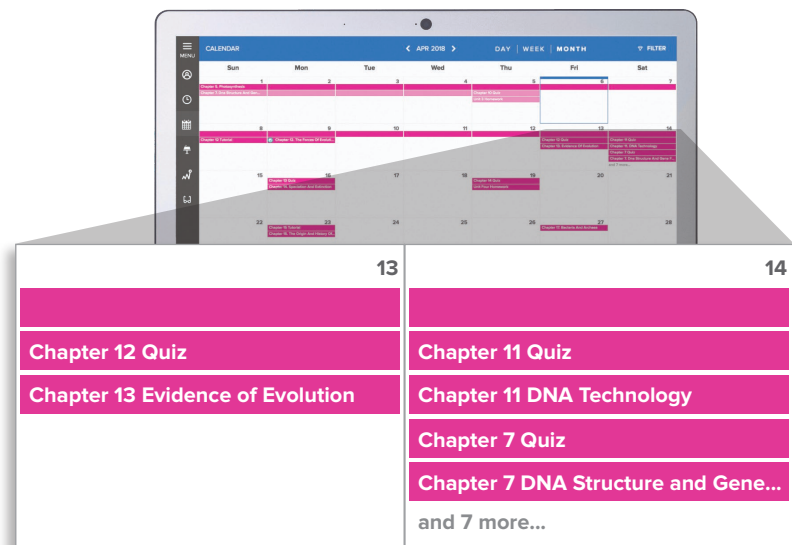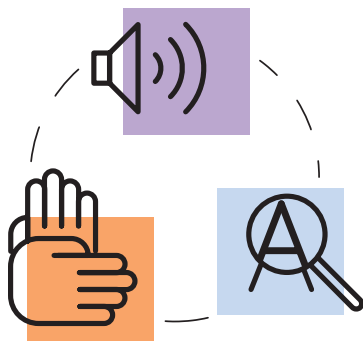
Learning for everyone.

McGraw-Hill works directly with Accessibility Services Departments and faculty to meet the learning needs of all students. Please contact your Accessibility Services office and ask them to email accessibility@mheducation.com, or visit **www.mheducation.com/about/accessibility.html** for more information.
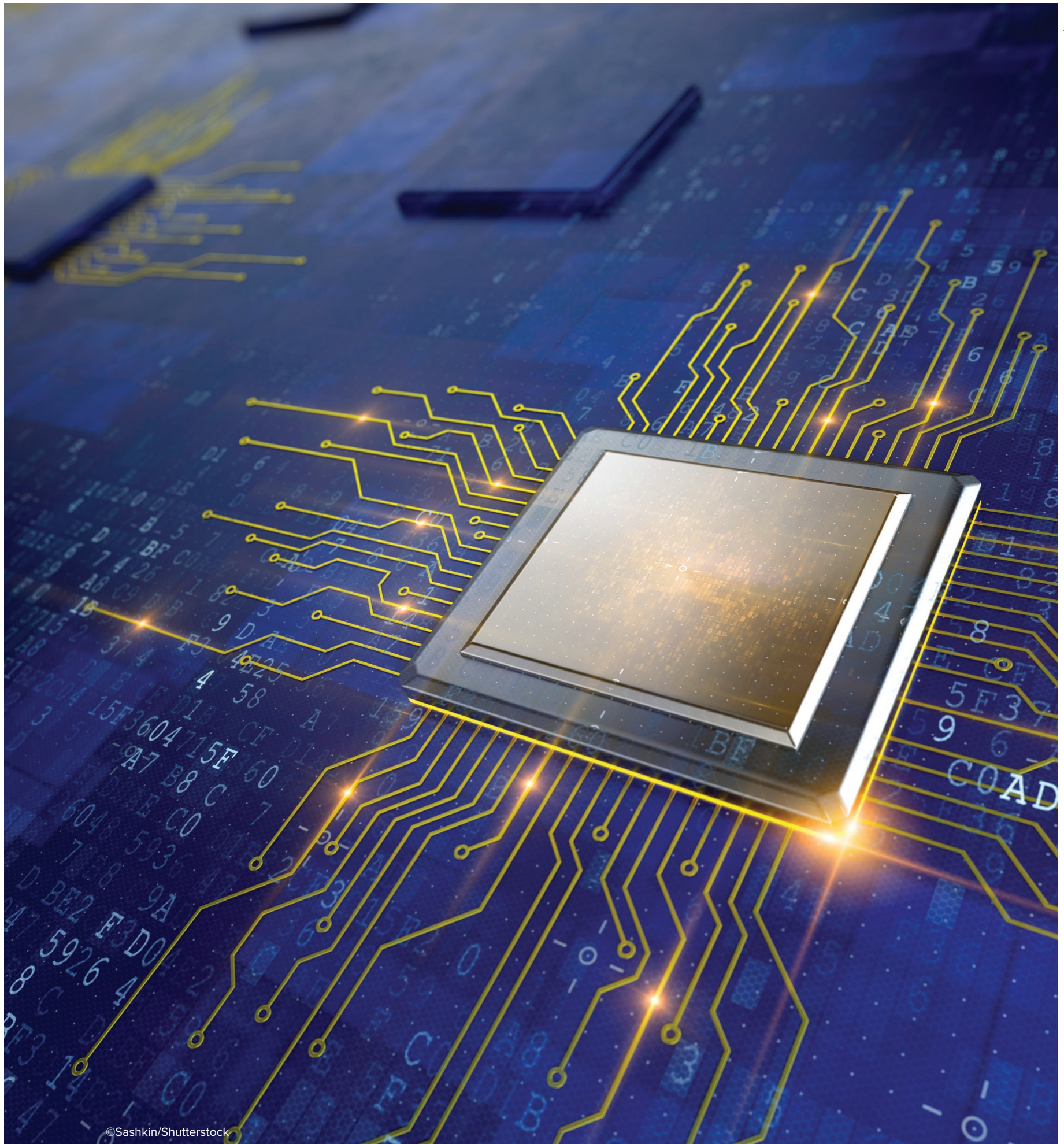
©Sashkin/Shutterstock

module one

coming up

BUSINESS DRIVEN MIS

Most companies today rely heavily on the use of management information systems (MIS) to run various aspects of their businesses. Whether they need to order and ship goods, interact with customers, or conduct other business functions, management information systems are often the underlying infrastructure performing the activities. Management information systems allow companies to remain competitive in today's fast-paced world and especially when conducting business on the Internet. Organizations must adapt to technological advances and innovations to keep pace with today's rapidly changing environment. Their competitors certainly will!

No matter how exciting technology is, successful companies do not use it simply for its own sake. Companies should have a solid business reason for implementing technology. Using a technological solution just because it is available is not a good business strategy.

The purpose of Module 1 is to raise your awareness of the vast opportunities made possible by the tight correlation between business and technology. Business strategies and processes should always drive your technology choices. Although awareness of an emerging technology can sometimes lead us in new strategic directions, the role of information systems, for the most part, is to support existing business strategies and processes. ∎

module one
BUSINESS DRIVEN MIS

module two
TECHNICAL FOUNDATIONS OF MIS

module three
ENTERPRISE MIS
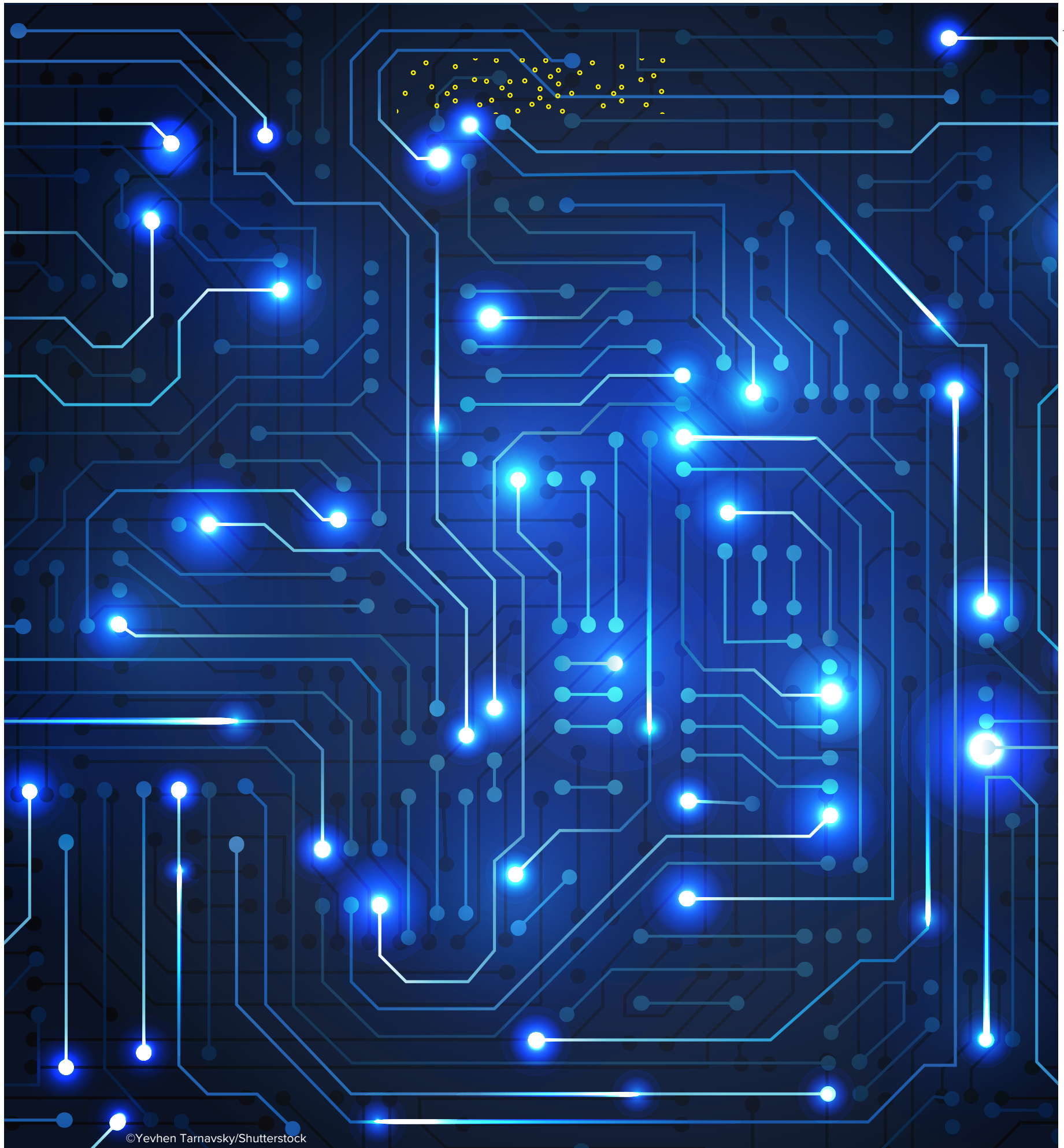
©Yevhen Tarnavsky/Shutterstock

chapter one

management information systems: business driven MIS

what's in IT for me?

This chapter sets the stage for the textbook. It starts from ground zero by providing a clear description of what information is and how it fits into business operations, strategies, and systems. It provides an overview of how companies operate in competitive environments and why they must continually define and redefine their business strategies to create competitive advantages. Doing so allows them to survive and thrive. Information systems are key business enablers for successful operations in competitive environments.

You, as a business student, must understand the tight correlation between

CHAPTER OUTLINE

SECTION 1.1 >>
Business Driven MIS

- Competing in the Information Age
- The Solution: Systems Thinking and the MIS Solution

SECTION 1.2 >>
Business Strategy

- Identifying Competitive Advantages
- The Five Forces Model— Evaluating Industry Attractiveness
- The Three Generic Strategies— Choosing a Business Focus
- Value Chain Analysis— Executing Business Strategies

fact The confirmation or validation of an event or object.

information age The present time, during which infinite quantities of facts are widely available to anyone who can use a computer.

Internet of Things A world where interconnected, Internet-enabled devices or "things" can collect and share data without human intervention.

machine to machine (M2M) Devices that connect directly to other devices.

continued from p. 5

business and technology. You must first recognize information's role in daily business activities, and then understand how information supports and helps implement global business strategies and competitive advantages. After reading this chapter, you should have a solid understanding of business driven information systems and their role in managerial decision making and problem solving. ∎

{SECTION 1.1}
Business Driven MIS

LEARNING OUTCOMES

LO1.1 Describe the information age and the differences among data, information, business intelligence, and knowledge.

LO1.2 Explain systems thinking and how management information systems enable business communications.

COMPETING IN THE INFORMATION AGE LO1.1

Did you know that . . .

- The movie *Avatar* took more than four years to create and cost $450 million.
- Lady Gaga's real name is Stefani Joanne Angelina Germanotta.
- Customers pay $2.6 million for a 30-second advertising time slot during the Super Bowl.[1]

A **fact** is the confirmation or validation of an event or object. In the past, people primarily learned facts from books. Today, by simply pushing a button people can find out anything, from anywhere, at any time. We live in the **information age**, when infinite quantities of facts are widely available to anyone who can use a computer. The impact of information technology on the global business environment is equivalent to the printing press's impact on publishing and electricity's impact on productivity. College student startups were mostly unheard of before

the information age. Now, it's not at all unusual to read about a business student starting a multimillion-dollar company from his or her dorm room. Think of Mark Zuckerberg, who started Facebook from his dorm, or Michael Dell (Dell Computers) and Bill Gates (Microsoft), who both founded their legendary companies as college students.

You may think only students well versed in advanced technology can compete in the information age. This is simply not true. Many business leaders have created exceptional opportunities by coupling the power of the information age with traditional business methods. Here are just a few examples:

- Amazon is not a technology company; its original business focus was to sell books, and it now sells nearly everything.
- Netflix is not a technology company; its primary business focus is to rent videos.
- Zappos is not a technology company; its primary business focus is to sell shoes, bags, clothing, and accessories.

Amazon's founder, Jeff Bezos, at first saw an opportunity to change the way people purchase books. Using the power of the information age to tailor offerings to each customer and speed the payment process, he in effect opened millions of tiny virtual bookstores, each with a vastly larger selection and far cheaper product than traditional bookstores. The success of his original business model led him to expand Amazon to carry many other types of products. The founders of Netflix and Zappos have done the same thing for videos and shoes. All these entrepreneurs were business professionals, not technology experts. However, they understood enough about the information age to apply it to a particular business, creating innovative companies that now lead entire industries.

Over 20 years ago a few professors at MIT began describing the **Internet of Things (IoT)**, a world where interconnected Internet-enabled devices or "things" have the ability to collect and share data without human intervention. Another term commonly associated with The Internet of Things is **machine-to-machine (M2M)**, which refers to devices that connect directly to other devices. With advanced technologies devices are connecting in ways not previously thought possible and researchers predict that over 50 billion IoT devices will be communicating by 2020. Kevin Ashton, cofounder and executive director of the Auto-ID Center at MIT, first mentioned the Internet of Things in a presentation he made to Procter & Gamble. Ashton's explanation of the Internet of Things states:

> To date, the 50 petabytes of data available on the Internet has been captured mostly by humans through such methods as

data Raw facts that describe the characteristics of an event or object.

structured data Data that has a defined length, type, and format and includes numbers, dates, or strings such as Customer Address.

machine-generated data Data created by a machine without human intervention.

human-generated data Data that humans, in interaction with computers, generate.

unstructured data Data that is not defined and does not follow a specified format and is typically free-form text such as emails, Twitter tweets, and text messages.

Living the DREAM

Opportunities for Everyone

Bill Gates, founder of Microsoft, stated that 20 years ago most people would rather have been a B student in New York City than a genius in China because the opportunities available to students in developed countries were limitless. Today, many argue that the opposite is now true due to technological advances making it easier to succeed as a genius in China than a B student in New York. As a group, discuss whether you agree or disagree with Bill Gates's statement.

---

typing, recording, and scanning text, photos, and voice recordings. Data entry is the process of gathering data from business documents and entering it into a computer. A vital process for any business. The issue with human data collection is the fact that humans make mistakes! Numbers are frequently transposed, addresses mistyped, and some files are skipped completely. Inaccurate data in a system will lead to incorrect reports and ultimately bad business decisions. Allowing computers to perform the data entry process greatly reduces human error. Computers are precise and accurate and would know when things need replaced, repaired, or recalled saving time and money for companies.[1a]

IoT is transforming our world into a living information system as we control our intelligent lighting from our smart phone to a daily health check from our smart toilet. Of course with all great technological advances come unexpected risks and you have to be prepared to encounter various security issues with IoT. Just imagine if your devices are hacked by someone who now has the ability to shut off your water, take control of your car, or unlock the doors of your home from thousands of miles away. We are just beginning to understand the security issues associated with IoT and M2M and you can be sure that sensitive data leakage from your IoT device is something you will most likely encounter in your life.

Students who understand business along with the power associated with the information age and IoT will create their own opportunities and perhaps even new industries. Realizing the value of obtaining real-time data from connected "things" will allow you to make more informed decisions, identify new opportunities, and analyze customer patterns to predict new behaviors. Our primary goal in this course is to arm you with the knowledge you need to compete in the information age. The core drivers of the information age include:

- Data
- Information
- Business intelligence
- Knowledge (see Figure 1.1)

LO1.1 Describe the information age and the differences among data, information, business intelligence, and knowledge.

Data

Data are raw facts that describe the characteristics of an event or object. Before the information age, managers manually collected and analyzed data, a time-consuming and complicated task without which they would have little insight into how to run their business. **Structured data** has a defined length, type, and format and includes numbers, dates, or strings such as Customer Address. Structured data is typically stored in a traditional system such as a relational database or spreadsheet and accounts for about 20 percent of the data that surrounds us. The sources of structured data include:

- **Machine-generated data** is created by a machine without human intervention. Machine-generated structured data includes sensor data, point-of-sale data, and web log data.

- **Human-generated data** is data that humans, in interaction with computers, generate. Human-generated structured data includes input data, click-stream data, or gaming data.

Unstructured data is not defined and does not follow a specified format and is typically free-form text such as emails, Twitter tweets, and text messages. Unstructured data accounts for about 80 percent of the data that surrounds us. The sources of unstructured data include:

- Machine-generated unstructured data includes satellite images, scientific atmosphere data, and radar data.

- Human-generated unstructured data includes text messages, social media data, and emails.

big data A collection of large, complex data sets, including structured and unstructured data, which cannot be analyzed using traditional database methods and tools.

snapshot A view of data at a particular moment in time.

information Data converted into a meaningful and useful context.

Big data is a collection of large, complex data sets, including structured and unstructured data, which cannot be analyzed using traditional database methods and tools. Lacking data, managers often found themselves making business decisions about how many products to make, how much material to order, or how many employees to hire based on intuition or gut feelings. In the information age, successful managers compile, analyze, and comprehend massive amounts of data daily, which helps them make more successful business decisions.

Walmart handles over 1 million purchase transactions per hour. Facebook processes over 250 million photo uploads every day. There are over 6 billion cell phone users generating text messages and voice calls, and browsing the web daily. As Google CEO Eric Schmidt has noted, the amount of data currently created every 48 hours is equivalent to the entire amount of data created from the dawn of civilization until the year 2003. In the information age, successful managers must be able to compile, analyze, and comprehend massive amounts of data or big data daily, which helps them make more successful business decisions.

A **snapshot** is a view of data at a particular moment in time. Figure 1.2 shows sales data for Tony's Wholesale Company, a fictitious business that supplies snacks to stores. The data highlight characteristics such as order date, customer, sales representative, product, quantity, and profit. The second line in Figure 1.2, for instance, shows that Roberta Cross sold 90 boxes of Ruffles to Walmart for $1,350, resulting in a profit of $450 (note that Profit = Sales − Costs). These data are useful for understanding individual sales; however, they do not provide us much insight into how Tony's business is performing as a whole. Tony needs to answer questions that will help him manage his day-to-day operations such as:

• Who are my best customers?
• Who are my least-profitable customers?
• What is my best-selling product?
• What is my slowest-selling product?
• Who is my strongest sales representative?
• Who is my weakest sales representative?

What Tony needs, in other words, is not data but *information*.

Information

Information is data converted into a meaningful and useful context. The simple difference between data and information is that computers or machines need data and humans need information.

FIGURE 1.1 The Differences among Data, Information, Business Intelligence, and Knowledge
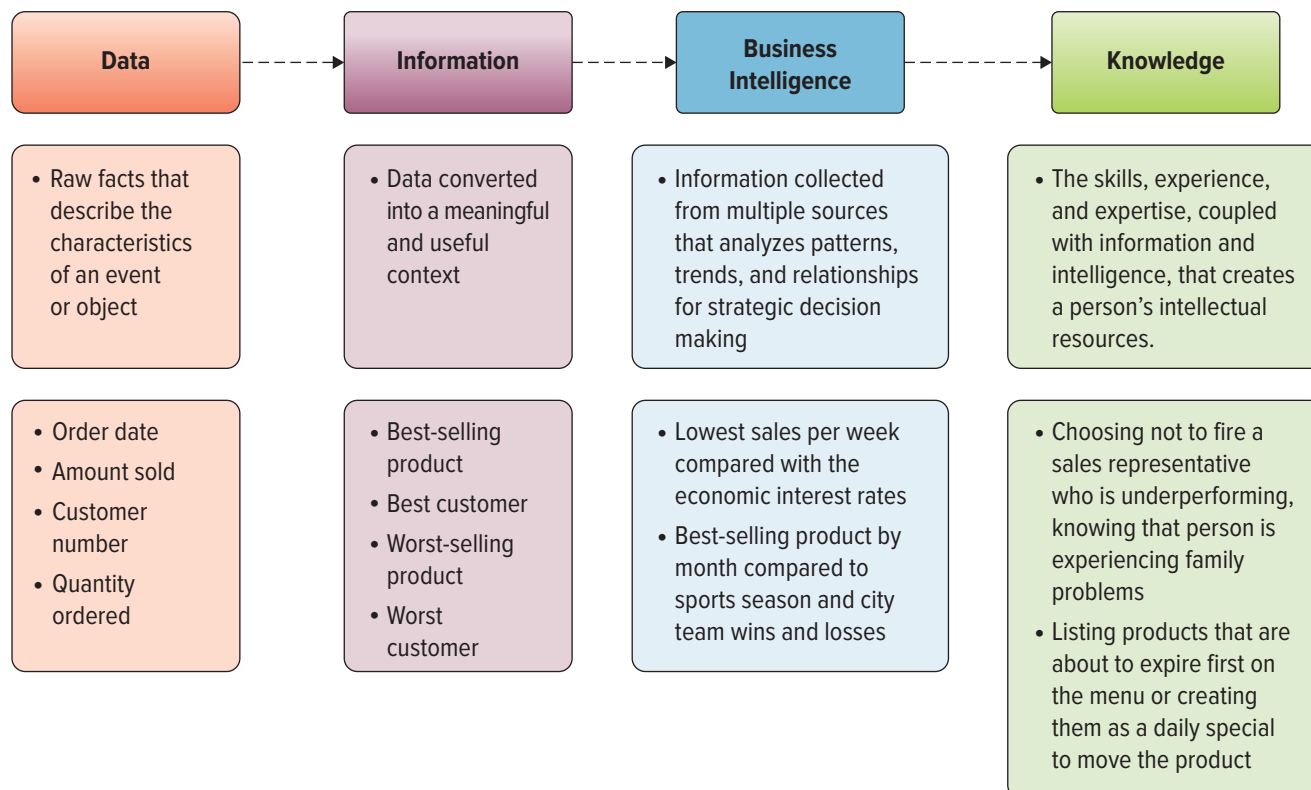
report A document containing data organized in a table, matrix, or graphical format allowing users to easily comprehend and understand information.

static report A report created once based on data that does not change.

dynamic report A report that changes automatically during creation.

fyi

People in China and India Are Starving for Your Jobs[2]

"When I was growing up in Minneapolis, my parents always said, 'Tom, finish your dinner. There are people starving in China and India.' Today I tell my girls, 'Finish your homework, because people in China and India are starving for your jobs.' And in a flat world, they can have them, because there's no such thing as an American job anymore." Thomas Friedman.

In his book, *The World Is Flat,* Thomas Friedman describes the unplanned cascade of technological and social shifts that effectively leveled the economic world and "accidentally made Beijing, Bangalore, and Bethesda next-door neighbors." The video of Thomas Friedman's lecture at MIT can be found with a Google search. If you want to be prepared to compete in a flat world, you must watch this video and answer the following questions:

- Do you agree or disagree with Friedman's assessment that the world is flat?
- What are the potential impacts of a flat world for a student performing a job search?
- What can students do to prepare themselves for competing in a flat world?

Source: Thomas L. Friedman, *The World Is Flat* (New Yorker: Farrar, Straus & Giroux, 2005); Thomas Friedman, "The World Is Flat," www.thomaslfriedman.com, accessed June 2010; Thomas L. Friedman, "The Opinion Pages," *The New York Times,* topics, nytimes.com/top/opinion/editorialsandoped/oped/columnist/thomaslfriedman, accessed June 2012.

©Blue Jean Images/Alamy Stock Photo

▼**FIGURE 1.2** Tony's Snack Company Data

Order Date	Customer	Sales Representative	Product	Qty	Unit Price	Total Sales	Unit Cost	Total Cost	Profit
4-Jan	Walmart	PJ Helgoth	Doritos	41	$24	$ 984	$18	$738	$246
4-Jan	Walmart	Roberta Cross	Ruffles	90	$15	$1,350	$10	$900	$450
5-Jan	Safeway	Craig Schultz	Ruffles	27	$15	$ 405	$10	$270	$135
6-Jan	Walmart	Roberta Cross	Ruffles	67	$15	$1,005	$10	$670	$335
7-Jan	7-Eleven	Craig Schultz	Pringles	79	$12	$ 948	$ 6	$474	$474
7-Jan	Walmart	Roberta Cross	Ruffles	52	$15	$ 780	$10	$520	$260
8-Jan	Kroger	Craig Schultz	Ruffles	39	$15	$ 585	$10	$390	$195
9-Jan	Walmart	Craig Schultz	Ruffles	66	$15	$ 990	$10	$660	$330
10-Jan	Target	Craig Schultz	Ruffles	40	$15	$ 600	$10	$400	$200
11-Jan	Walmart	Craig Schultz	Ruffles	71	$15	$1,065	$10	$710	$355

Data is a raw building block that has not been shaped, processed, or analyzed and frequently appears disorganized and unfriendly. Information gives meaning and context to analyzed data making it insightful for humans providing context and structure that is extremely valuable when making informed business decisions.

A **report** is a document containing data organized in a table, matrix, or graphical format allowing users to easily comprehend and understand information. Reports can cover a wide range of subjects or specific subject for a certain time period or event. A **static report** is created once based on data that does not change. Static reports can include a sales report from last year or salary report from five years ago. A **dynamic report** changes automatically during creation. Dynamic reports can include updating daily stock market prices or the calculation of available inventory.

Having the right information at the right moment in time can be worth a fortune. Having the wrong information at the right moment; or the right information at the wrong moment can be disastrous. The truth about information is that its value is only as good as the people who use it. People using the same information can make different decisions depending on how they interpret or analyze the information. Thus information has value only insofar as the people using it do as well.

Tony can analyze his sales data and turn them into information to answer all the above questions and understand how his

variable A data characteristic that stands for a value that changes or varies over time.

business intelligence (BI) Information collected from multiple sources such as suppliers, customers, competitors, partners, and industries that analyze patterns, trends, and relationships for strategic decision making.

business is operating. Figures 1.3 and 1.4, for instance, show us that Walmart is Roberta Cross's best customer, and that Ruffles is Tony's best product measured in terms of total sales. Armed with this information, Tony can identify and then address such issues as weak products and underperforming sales representatives.

A **variable** is a data characteristic that stands for a value that changes or varies over time. For example, in Tony's data, price and quantity ordered can vary. Changing variables allows managers to create hypothetical scenarios to study future possibilities. Tony may find it valuable to anticipate how sales or cost increases affect profitability. To estimate how a 20 percent increase in prices might

improve profits, Tony simply changes the price variable for all orders, which automatically calculates the amount of new profits. To estimate how a 10 percent increase in costs hurts profits, Tony changes the cost variable for all orders, which automatically calculates the amount of lost profits. Manipulating variables is an important tool for any business.

Business Intelligence

Business intelligence (BI) is information collected from multiple sources such as suppliers, customers, competitors, partners, and industries that analyzes patterns, trends, and relationships for strategic decision making. BI manipulates multiple variables and in some cases even hundreds of variables including such items as interest rates, weather conditions, and even gas prices. Tony could use BI to analyze internal data, such as company sales, along with external data about the environment such as competitors, finances, weather, holidays, and even sporting events. Both internal and external variables affect snack sales, and analyzing these variables will help Tony determine

▼ **FIGURE 1.3** Tony's Data Sorted by Customer "Walmart" and Sales Representative "Roberta Cross"

Order Date	Customer	Sales Representative	Product	Quantity	Unit Price	Total Sales	Unit Cost	Total Cost	Profit
26-Apr	Walmart	Roberta Cross	Fritos	86	$ 19	$ 1,634	$ 17	$ 1,462	$ 172
29-Aug	Walmart	Roberta Cross	Fritos	76	$ 19	$ 1,444	$ 17	$ 1,292	$ 152
7-Sep	Walmart	Roberta Cross	Fritos	20	$ 19	$ 380	$ 17	$ 340	$ 40
22-Nov	Walmart	Roberta Cross	Fritos	39	$ 19	$ 741	$ 17	$ 663	$ 78
30-Dec	Walmart	Roberta Cross	Fritos	68	$ 19	$ 1,292	$ 17	$ 1,156	$ 136
7-Jul	Walmart	Roberta Cross	Pringles	79	$ 18	$ 1,422	$ 8	$ 632	$ 790
6-Aug	Walmart	Roberta Cross	Pringles	21	$ 12	$ 252	$ 6	$ 126	$ 126
2-Oct	Walmart	Roberta Cross	Pringles	60	$ 18	$ 1,080	$ 8	$ 480	$ 600
15-Nov	Walmart	Roberta Cross	Pringles	32	$ 12	$ 384	$ 6	$ 192	$ 192
21-Dec	Walmart	Roberta Cross	Pringles	92	$ 12	$ 1,104	$ 6	$ 552	$ 552
28-Feb	Walmart	Roberta Cross	Ruffles	67	$ 15	$ 1,005	$ 10	$ 670	$ 335
6-Mar	Walmart	Roberta Cross	Ruffles	8	$ 15	$ 120	$ 10	$ 80	$ 40
16-Mar	Walmart	Roberta Cross	Ruffles	68	$ 15	$ 1,020	$ 10	$ 680	$ 340
23-Apr	Walmart	Roberta Cross	Ruffles	34	$ 15	$ 510	$ 10	$ 340	$ 170
4-Aug	Walmart	Roberta Cross	Ruffles	40	$ 15	$ 600	$ 10	$ 400	$ 200
18-Aug	Walmart	Roberta Cross	Ruffles	93	$ 15	$ 1,395	$ 10	$ 930	$ 465
5-Sep	Walmart	Roberta Cross	Ruffles	41	$ 15	$ 615	$ 10	$ 410	$ 205
12-Sep	Walmart	Roberta Cross	Ruffles	8	$ 15	$ 120	$ 10	$ 80	$ 40
28-Oct	Walmart	Roberta Cross	Ruffles	50	$ 15	$ 750	$ 10	$ 500	$ 250
21-Nov	Walmart	Roberta Cross	Ruffles	79	$ 15	$ 1,185	$ 10	$ 790	$ 395
29-Jan	Walmart	Roberta Cross	Sun Chips	5	$ 22	$ 110	$ 18	$ 90	$ 20
12-Apr	Walmart	Roberta Cross	Sun Chips	85	$ 22	$ 1,870	$ 18	$ 1,530	$ 340
16-Jun	Walmart	Roberta Cross	Sun Chips	55	$ 22	$ 1,210	$ 18	$ 990	$ 220
				1,206	**$383**	**$20,243**	**$273**	**$14,385**	**$5,858**

Sorting the data reveals the information that Roberta Cross's total sales to Walmart were $20,243 resulting in a profit of $5,858.
(Profit $5,858 = Sales $20,243 − Costs $14,385)

analytics The science of fact-based decision making.

business analytics The scientific process of transforming data into insight for making better decisions.

descriptive analytics Uses techniques that describe past performance and history.

predictive analytics Uses techniques that extract information from data and use it to predict future trends and identify behavioral patterns.

prescriptive analytics Uses techniques that create models indicating the best decision to make or course of action to take.

▼**FIGURE 1.4** Information Gained after Analyzing Tony's Data

Tony's Business Information	Name	Total Profit
Who is Tony's best customer by total sales?	Walmart	$ 560,789
Who is Tony's least-valuable customer by total sales?	Walgreens	$ 45,673
Who is Tony's best customer by profit?	7-Eleven	$ 324,550
Who is Tony's least-valuable customer by profit?	King Soopers	$ 23,908
What is Tony's best-selling product by total sales?	Ruffles	$ 232,500
What is Tony's weakest-selling product by total sales?	Pringles	$ 54,890
What is Tony's best-selling product by profit?	Tostitos	$ 13,050
What is Tony's weakest-selling product by profit?	Pringles	$ 23,000
Who is Tony's best sales representative by profit?	R. Cross	$1,230,980
Who is Tony's weakest sales representative by profit?	Craig Schultz	$ 98,980
What is the best sales representative's best-selling product by total profit?	Ruffles	$ 98,780
Who is the best sales representative's best customer by total profit?	Walmart	$ 345,900
What is the best sales representative's weakest-selling product by total profit?	Sun Chips	$ 45,600
Who is the best sales representative's weakest customer by total profit?	Krogers	$ 56,050

▼**FIGURE 1.5** Three Categories of Analytics

Descriptive Analytics
- Techniques that describes past performance and history.
- Example: Creating a report that includes charts and graphs that explains the data

Predictive Analytics
- Techniques that extract information from data and uses it to predict future trends and identify behavioral patterns.
- Example: Using past sales data to predict future sales

Prescriptive Analytics
- Techniques that create models indicating the best decision to make or course of action to take.
- Example: Airline using past purchasing data as inputs into a model that recommends the best pricing strategy across all flights allowing the company to maximize revenue

ordering levels and sales forecasts. For instance, BI can predict inventory requirements for Tony's business for the week before the Super Bowl if, say, the home team is playing, average temperature is above 80 degrees, and the stock market is performing well. This is BI at its finest, incorporating all types of internal and external variables to anticipate business performance.

Analytics is the science of fact-based decision making. **Business analytics** is the scientific process of transforming data into insight for making better decisions. Analytics is thought of as a broader category than business analytics, encompassing the use of analytical techniques in the sciences and engineering fields as well as business. In this text, we will use the terms *analytics* and *business analytics* as synonymous.

Analytics is used for data-driven or fact-based decision making, helping managers ensure they make successful decisions. A study conducted by MIT's Sloan School of Management and the University of Pennsylvania concluded that firms guided by data-driven decision making have higher productivity and market value along with increased output and profitability. Analytics can range from simple reports to advanced optimization models (models that highlight the best course of actions). **Descriptive analytics** uses techniques that describe past performance and history. **Predictive analytics** uses techniques that extract information from data and use it to predict future trends and identify behavioral patterns. **Prescriptive analytics** uses techniques that create models indicating the best decision to make or course of action to take. Figure 1.5 displays the three broad categories of analytics.

knowledge Skills, experience, and expertise coupled with information and intelligence that creates a person's intellectual resources.

knowledge worker Individuals valued for their ability to interpret and analyze information.

knowledge assets The human, structural, and recorded resources available to the organization.

knowledge facilitators Help harness the wealth of knowledge in the organization.

My **Not** To-Do List
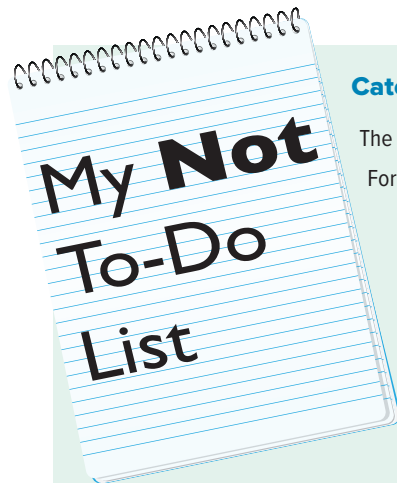
Categorizing Analytics

The three techniques for business analytics include descriptive analytics, predictive analytics, and prescriptive analytics.

For each of the below examples, determine which analytical technique is being used.

EXAMPLE	DESCRIPTIVE ANALYTICS	PREDICTIVE ANALYTICS	PRESCRIPTIVE ANALYTICS
Which candidate will win the election?			
What price for a product will maximize profit?			
How much money do I need to save each year to have enough money for retirement?			
How many products were sold last year?			
What is the best route for the delivery person to drop off packages to minimize the time needed to deliver all the packages?			
How many Valentine's Day cards should Hallmark print to maximize expected profit?			
How will marketing affect the daily sales of a product?			
How can a company minimize the cost of shipping products from plants to customers?			
What team will win the Superbowl?			
How can I schedule my workforce to minimize operating costs?			
What was the average purchase price for new customers last year?			
How will the placement of a product in a store determine product sales?			
How many customers do we have and where are they located?			

Knowledge

Knowledge includes the skills, experience, and expertise, coupled with information and intelligence, that creates a person's intellectual resources. **Knowledge workers** are individuals valued for their ability to interpret and analyze information. Today's workers are commonly referred to as knowledge workers and they use BI along with personal experience to make decisions based on both information and intuition, a valuable resource for any company.

Knowledge assets, also called *intellectual capital,* are the human, structural, and recorded resources available to the organization. Knowledge assets reside within the minds of members, customers, and colleagues, and include physical structures

and recorded media. **Knowledge facilitators** help harness the wealth of knowledge in the organization. Knowledge facilitators help acquire and catalog the knowledge assets in an organization.

Imagine that Tony analyzes his data and finds his weakest sales representative for this period is Craig Schultz. If Tony considered only this information, he might conclude that firing Craig was a good business decision. However, because Tony has knowledge about how the company operates, he knows Craig has been out on medical leave for several weeks; hence, his sales numbers are low. Without this additional knowledge, Tony might have executed a bad business decision, delivered a negative message to the other employees, and sent his best sales representatives out to look for other jobs.

The key point in this scenario is that it is simply impossible to collect all the information about every situation, and yet without that, it can be easy to misunderstand the problem. Using data, information, business intelligence, *and* knowledge to make decisions and solve problems is the key to finding success in business. These core drivers of the information age are the building blocks of business systems. Figure 1.6 offers a few different examples of data through knowledge.

▼**FIGURE 1.6** Transformation from Data to Knowledge

DATA: I have one item.

INFORMATION: The item I have is a product that has the most sales during the month of December.

BUSINESS INTELLIGENCE: The month of December this year is going to see interest rates raise by 10 percent and snow storms are expected to cause numerous problems throughout the East coast.

KNOWLEDGE: Given the unexpected financial issues caused by the storms and the interest rate hike we will offer a discount on purchase in November and December to ensure sales levels increase by 10 percent.

show me *the* MONEY

Computers Are Everywhere

A computer is a programmable machine that responds to a specific set of defined instructions. It consists of hardware (the machinery and housing for its electronics) and software (the programs that contain the data used by the computer). The hardware includes a central processing unit (CPU) that controls an operating system, which directs your inputs (keyboard, mouse), outputs (monitor or printer), memory, and storage. The first computers were enormous, slow machines designed to solve complicated mathematical questions. Built in 1954, the ENIAC (Electronic Numerical Integrator and Computer) was one of the first digital computers; it weighed 30 tons and was powered by thousands of vacuum tubes, capacitors, relays, and electrical equipment. IBM President Tom Watson famously remarked, "I think there is a world market for maybe five computers." Clearly the world market for computers was far more than five!

Today's computers can do almost anything from controlling the temperature in your house and driving your car, to solving advanced analytical equations, and they can be found everywhere; on our desks, in our laps, in our hands, on our wrists, and even in our eyeglasses. And there is so much more coming, including computers that learn on their own, brain-computer interfacing, and quantum computers that utilize fiber optic technology.

Think of your life five years ago, and list three computing devices you use today that were not invented five years ago. What types of computing devices will be introduced over the next five years? How will they change your life? What would life be like today if the computer had never been invented?

business unit
A segment of a company (such as accounting, production, marketing) representing a specific business function.

information silo
Occurs when one business unit is unable to freely communicate with other business units, making it difficult or impossible for organizations to work cross-functionally.

SYSTEMS THINKING AND MANAGEMENT INFORMATION SYSTEMS LO1.2

A *business unit* is a segment of a company (such as accounting, production, marketing) representing a specific business function. The terms *department, functional area,* and *business*

unit are used interchangeably, and corporations are typically organized by business unit such as:

- **Accounting:** Records, measures, and reports monetary transactions.
- **Finance:** Deals with strategic financial issues including money, banking, credit, investments, and assets.
- **Human resources:** Maintains policies, plans, and procedures for the effective management of employees.
- **Marketing:** Supports sales by planning, pricing, and promoting goods or services.
- **Operations management:** Manages the process of converting or transforming or resources into goods or services.
- **Sales:** Performs the function of selling goods or services (see Figure 1.7).

An *information silo* occurs when one business unit is unable to freely communicate with other business units, making it difficult or impossible for organizations to work cross-functionally. Information silos exist because management does not believe there is enough benefit from sharing information across business

▼**FIGURE 1.7**
Departments Working Independently

Accounting
Records, measures, and reports monetary transactions.

Sales
Performs the function of selling goods or services.

Finance
Tracks strategic financial issues including money, banking, credit, investments, and assets.

Operations management
Manages the process of converting or transforming or resources into goods or services.

Human resources
Maintains policies, plans, and procedures for the effective management of employees.

Marketing
Supports sales by planning, pricing, and promoting goods or services.

units and because information might not be useful to personnel in other business units. Figure 1.7 provides an example of how an organization operates functionally, causing information silos as each department performs its own activities.Sales and marketing focus on moving goods or services into the hands of consumers; they maintain transactional data. Finance and accounting focus on managing the company's resources and maintain monetary data. Operations management focuses on manufacturing and maintains production data, while human resources focuses on hiring and training people and maintains employee data. Although each department has its own focus and data, none can work independently if the company is to operate as a whole.

It is easy to see how a business decision made by one department can affect other departments. Marketing needs to analyze production and sales data to come up with product promotions and advertising strategies. Production needs to understand sales forecasts to determine the company's manufacturing needs. Sales needs to rely on information from operations to understand inventory, place orders, and forecast consumer demand. All departments need to understand the accounting and finance departments' information for budgeting. For the firm to be successful, all departments must work together as a single unit sharing common information and not operate independently or in a silo (see Figure 1.8).

FIGURE 1.8
Departments Working Together

Accounting
• Transactional data
• Purchasing data
• Payroll data
• Tax data

Sales
• Potential customer data
• Sales report data
• Commission data
• Customer support data

Finance
• Investment data
• Monetary data
• Reporting data

Business Decisions

Operations management
• Manufacturing data
• Distribution data
• Production data

Human resources
• Employee data
• Promotion data
• Vacation data

Marketing
• Promotion data
• Sales data
• Advertising data

BUSTED   The Interent of Things Is Wide Open—for Everyone!

IoT is transforming our world into a living information system as we control our intelligent lighting from our smart phone to a daily health check from our smart toilet. Of course, with all great technological advances come unexpected risks, and you have to be prepared to encounter various security issues with IoT. Just imagine if your devices were hacked by someone who now can shut off your water, take control of your car, or unlock the doors of your

home from thousands of miles away. We are just beginning to understand the security issues associated with IoT and M2M, and you can be sure that sensitive data leakage from your IoT device is something you will most likely encounter in your life.[3]

In a group, identify a few IoT devices you are using today. These can include fitness trackers that report to your iPhone, sports equipment that provides immediate feedback to an app,

or even smart vacuum cleaners. If you are not using any IoT devices today, brainstorm a few you might purchase in the future. How could a criminal or hacker use your IoT to steal your sensitive data? What potential problems or issues could you experience from these types of illegal data thefts? What might be some of the signs that someone had accessed your IoT data illegally? What could you do to protect the data in your device?

system A collection of parts that link to achieve a common purpose.

goods Material items or products that customers will buy to satisfy a want or need. Clothing, groceries, cell phones, and cars are all examples of goods that people buy to fulfill their needs.

service Tasks that customers will buy to satisfy a want or need.

production The process where a business takes raw materials and processes them or converts them into a finished product for its goods or services.

productivity The rate at which goods and services are produced based upon total output given total inputs.

▼**FIGURE 1.9** Different Types of Goods and Services

GOODS
Material items or products that customers will buy to satisfy a want or need.

- Cars
- Groceries
- Clothing

SERVICES
Tasks people perform that customers will buy to satisfy a want or need.

- Teaching
- Waiting tables
- Cutting hair
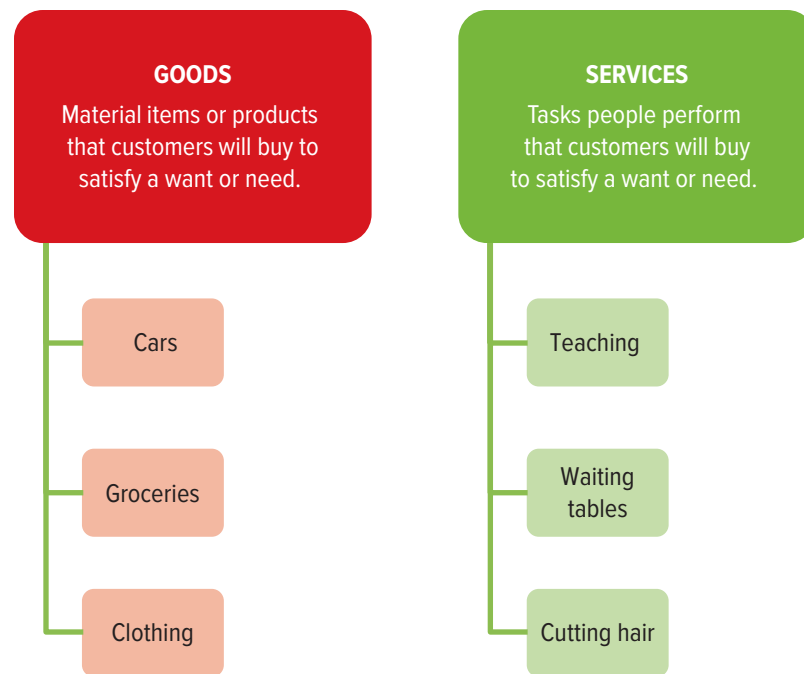
▼**FIGURE 1.10**
Input, Process, Output Example

Input	Process	Output
Lettuce, tomatoes, patty, bun, ketchup	Cook the patty, put the ingredients together	Hamburger
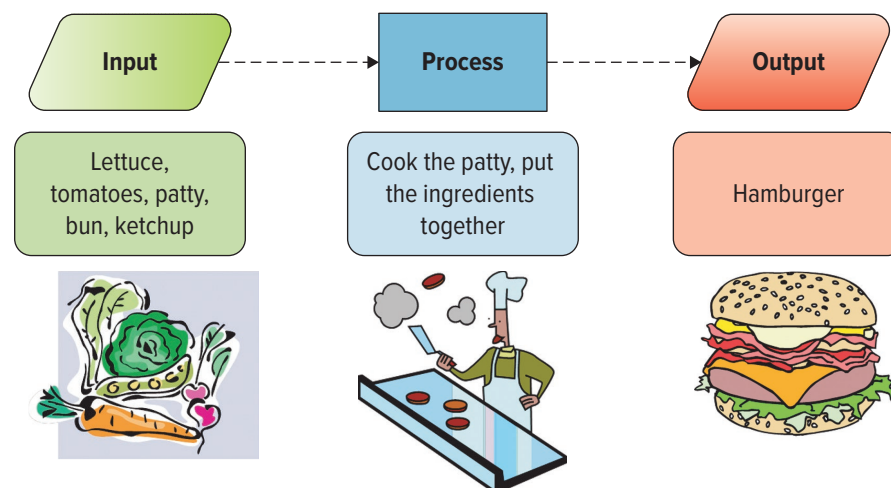
The MIS Solution

You probably recall the old story of three blind men attempting to describe an elephant. The first man, feeling the elephant's girth, said the elephant seemed very much like a wall. The second, feeling the elephant's trunk, declared the elephant was like a snake. The third man felt the elephant's tusks and said the elephant was like a tree or a cane. Companies that operate departmentally are seeing only one part of the elephant, a critical mistake that hinders successful operation.

Successful companies operate cross-functionally, integrating the operations of all departments. Systems are the primary enabler of cross-functional operations. A **system** is a collection of parts that link to achieve a common purpose. A car is a good example of a system, since removing a part, such as the steering wheel or accelerator, causes the entire system to stop working.

Before jumping into how systems work, it is important to have a solid understanding of the basic production process for goods and services. **Goods** are material items or products that customers will buy to satisfy a want or need. Clothing, groceries, cell phones, and cars are all examples of goods that people buy to fulfill their needs. **Services** are tasks performed by people that customers will buy to satisfy a want or need. Waiting tables, teaching, and cutting hair are all examples of services that people pay for to fulfill their needs (see Figure 1.9).

Production is the process where a business takes raw materials and processes them or converts them into a finished product for its goods or services. Just think about making a hamburger (see Figure 1.10). First, you must gather all of the *inputs* or raw materials such as the bun, patty, lettuce, tomato, and ketchup. Second, you *process* the raw materials, so in this example you would need to cook the patty, wash and chop the lettuce and tomato, and place all of the items in the bun. Finally, you would have your *output* or finished product—your hamburger! **Productivity** is the rate at which goods and services are produced

▼**FIGURE 1.11**   Overview of Systems Thinking

systems thinking A way of monitoring the entire system by viewing multiple inputs being processed or transformed to produce outputs while continuously gathering feedback on each part.

feedback Information that returns to its original transmitter (input, transform, or output) and modifies the transmitter's actions.

management information systems A business function, like accounting and human resources, which moves information about people, products, and processes across the company to facilitate decision making and problem solving.

based upon total output given total inputs. Given our previous example, if a business could produce the same hamburger with less expensive inputs or more hamburgers with the same inputs it would see a rise in productivity and possibly an increase in profits. Ensuring the input, process, and output of goods and services work across all of the departments of a company is where systems add tremendous value to overall business productivity.

Systems Thinking

Systems thinking is a way of monitoring the entire system by viewing multiple inputs being processed or transformed to produce outputs while continuously gathering feedback on each part (see Figure 1.11). **Feedback** is information that returns to its original transmitter (input, transform, or output) and modifies the transmitter's actions. Feedback helps the system maintain stability. For example, a car's system continuously monitors the fuel level and turns on a warning light if the gas level is too low. Systems thinking provides an end-to-end view of how operations work together to create a product or service. Business students who understand systems thinking are valuable resources because they can implement solutions that consider the entire process, not just a single component.

Management information systems (MIS) is a business function, like accounting and human resources, which moves information about people, products, and processes across the company to facilitate decision making and problem solving. MIS incorporates systems thinking to help companies operate cross-functionally. For example, to fulfill product orders, an MIS for sales moves a single customer order across all functional areas including sales, order fulfillment, shipping, billing, and finally customer service. Although different functional areas handle different parts of the sale, thanks to MIS, to the customer the sale is one continuous process. If one part of the company is experiencing problems, however, then, like the car without a steering wheel, the entire system fails. If order fulfillment packages the wrong product, it will not

matter that shipping, billing, and customer service did their jobs right, since the customer will not be satisfied when he or she opens the package.

MIS can be an important enabler of business success and innovation. This is not to say that MIS *equals* business success and innovation, or that MIS *represents* business success and innovation. MIS is a tool that is most valuable when it leverages the talents of people who know how to use and manage it effectively. To perform the MIS function effectively, almost all companies, particularly large and medium-sized ones, have an internal MIS department, often called information technology (IT), information systems (IS), or management information systems (MIS). For the purpose of this text, we will refer to it as MIS.

show me *the* MONEY

Is Technology Making Us Dumber or Smarter?

Choose a side and debate the following:

- **Side A** Living in the information age has made us smarter because we have a huge wealth of knowledge at our fingertips whenever or wherever we need it.
- **Side B** Living in the information age has caused people to become lazy and dumber because they are no longer building up their memory banks to solve problems; machines give them the answers they need to solve problems.
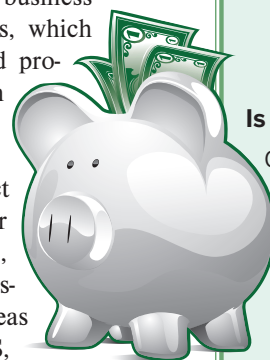
chief information officer (CIO) Responsible for (1) overseeing all uses of MIS and (2) ensuring that MIS strategically aligns with business goals and objectives.

chief data officer (CDO) Responsible for determining the types of information the enterprise will capture, retain, analyze, and share.

chief technology officer (CTO) Responsible for ensuring the throughput, speed, accuracy, availability, and reliability of an organization's information technology.

chief security officer (CSO) Responsible for ensuring the security of MIS systems and developing strategies and MIS safeguards against attacks from hackers and viruses.

chief privacy officer (CPO) Responsible for ensuring the ethical and legal use of information within a company.

MIS Department Roles and Responsibilities

Management information systems is a relatively new functional area, having been around formally in most organizations only for about 40 years. Job titles, roles, and responsibilities often differ dramatically from organization to organization. Nonetheless, clear trends are developing toward elevating some MIS positions within an organization to the strategic level.

Most organizations maintain positions such as chief executive officer (CEO), chief financial officer (CFO), and chief operations officer (COO) at the strategic level. Recently there are more MIS-related strategic positions such as chief information officer (CIO), chief data officer (CDO), chief technology officer (CTO), chief security officer (CSO), chief privacy officer (CPO), and chief knowledge officer (CKO). See Figure 1.12.

The **chief information officer (CIO)** is responsible for (1) overseeing all uses of information technology and (2) ensuring the strategic alignment of MIS with business goals and objectives. The CIO often reports directly to the CEO. CIOs must possess a solid and detailed understanding of every aspect of an organization coupled with tremendous insight into the capability of MIS. Broad functions of a CIO include:

1. *Manager*—ensure the delivery of all MIS projects, on time and within budget.

2. *Leader*—ensure the strategic vision of MIS is in line with the strategic vision of the organization.

3. *Communicator*—advocate and communicate the MIS strategy by building and maintaining strong executive relationships.

The **chief data officer (CDO)** is responsible for determining the types of information the enterprise will capture, retain, analyze, and share. The difference between the CIO and CDO is that the CIO is responsible for the *information systems* through which data is stored and processed, while the CDO is responsible for the *data,* regardless of the information system.

The **chief technology officer (CTO)** is responsible for ensuring the throughput, speed, accuracy, availability, and reliability of an organization's information technology. CTOs are similar to CIOs, except that CIOs take on the additional responsibility for effectiveness of ensuring that MIS is aligned with the organization's strategic initiatives. CTOs have direct responsibility for ensuring the *efficiency* of MIS systems

throughout the organization. Most CTOs possess well-rounded knowledge of all aspects of MIS, including hardware, software, and telecommunications.

The **chief security officer (CSO)** is responsible for ensuring the security of MIS systems and developing strategies and MIS safeguards against attacks from hackers and viruses. The role of a CSO has been elevated in recent years because of the number of attacks from hackers and viruses. Most CSOs possess detailed knowledge of networks and telecommunications because hackers and viruses usually find their way into MIS systems through networked computers.

The **chief privacy officer (CPO)** is responsible for ensuring the ethical and legal use of information within an organization. CPOs are the newest senior executive position in MIS. Recently, 150 of the *Fortune* 500 companies added the CPO position to their list of senior executives. Many CPOs are lawyers by training, enabling them to understand the often complex legal issues surrounding the use of information.

The **chief knowledge officer (CKO)** is responsible for collecting, maintaining, and distributing the organization's knowledge. The CKO designs programs and systems that make it easy for people to reuse knowledge. These systems create repositories of organizational documents, methodologies, tools, and practices, and they establish methods for filtering the information. The CKO must continuously encourage employee contributions to keep the systems up-to-date. The CKO can contribute directly to the organization's bottom line by reducing the learning curve for new employees or employees taking on new roles.

Danny Shaw was the first CKO at Children's Hospital in Boston. His initial task was to unite information from disparate systems to enable analysis of both the efficiency and effectiveness of the hospital's care. Shaw started by building a series of small, integrated information systems that quickly demonstrated value. He then gradually built on those successes, creating a knowledge-enabled organization one layer at a time. Shaw's information systems have enabled administrative and clinical operational analyses.

With the election of President Barack Obama came the appointment of the first-ever national chief technology officer (CTO). The job description states that the first CTO must "ensure the safety of our networks and lead an interagency effort, working with chief technology and chief information officers of each of the federal agencies, to ensure that they use best-in-class technologies

chief knowledge officer (CKO) Responsible for collecting, maintaining, and distributing company knowledge.

chief intellectual property officer Manage and defend intellectual property, copyrights, and patents.

chief automation officer Determines if a person or business process can be replaced by a robot or software.

chief user experience officer Create the optimal relationship between user and technology.

▼**FIGURE 1.12**
The Roles and Responsibilities of MIS

Chief security officer (CSO)

Responsible for ensuring the security of business systems and developing strategies and safeguards against attacks by hackers and viruses.

Chief knowledge officer (CKO)

Responsible for collecting, maintaining, and distributing company knowledge.

Chief technology officer (CTO)

Responsible for ensuring the speed, accuracy, availability, and reliability of the MIS.

MIS Department Roles and Responsibilities

Chief information officer (CIO)

Responsible for (1) overseeing all uses of MIS and (2) ensuring that MIS strategically aligns with business goals and objectives.

Chief privacy officer (CPO)

Responsible for ensuring the ethical and legal use of information within a company.

and share best practices." A federal-level CTO demonstrates the ongoing growth of technology positions outside corporate America. In the future expect to see many more technology positions in government and nonprofit organizations.

All the above MIS positions and responsibilities are critical to an organization's success. While many organizations may not have a different individual for each of these positions, they must have leaders taking responsibility for all these areas of concern. The individuals responsible for enterprise wide MIS and MIS-related issues must provide guidance and support to the organization's employees. According to *Fast Company* magazine a few executive levels you might see created over the next decade include:

- **Chief intellectual property officer** will manage and defend intellectual property, copyrights, and patents. The world of intellectual property law is vast and complicated as new innovations continually enter the market. Companies in the near

future will need a core leadership team member who can not only wade through the dizzying sea of intellectual property laws and patents to ensure their own compliance, but also remain vigilant to protect their own company against infringement.

- **Chief automation officer** determines if a person or business process can be replaced by a robot or software. As we continue to automate jobs a member of the core leadership team of the future will be put in charge of identifying opportunities for companies to become more competitive through automation.

- **Chief user experience officer** will create the optimal relationship between user and technology. User experience used to be an afterthought for hardware and software designers. Now that bulky instruction manuals are largely (and thankfully) a thing of the past, technology companies need to ensure that their products are intuitive from the moment they are activated.

MIS skills gap The difference between existing MIS workplace knowledge and the knowledge required to fulfill the business goals and strategies.

business strategy A leadership plan that achieves a specific set of goals or objectives such as increasing sales, decreasing costs, entering new markets, or developing new products or services.

stakeholder A person or group that has an interest or concern in an organization.

MIS skills gap is the difference between existing MIS workplace knowledge and the knowledge required to fulfill the business goals and strategies. Closing the MIS skills gap by aligning the current workforce with potential future business needs is a complicated proposition. Today, employers often struggle to locate and retain qualified MIS talent, especially individuals with application development, information security, and data analysis skills.

Common approaches to closing an MIS skills gap include social recruiting, off-site training, mentoring services, and partnerships with universities. In many instances, an MIS job will remain unfilled for an extended period of time when an employer needs to hire someone who has a very specific set of skills. In recruiting lingo, such candidates are referred to as purple squirrels. Because squirrels in the real world are not often purple, the implication is that finding the perfect job candidate with exactly the right qualifications, education and salary expectations can be a daunting—if not impossible—task.

LO1.2 Explain systems thinking and how management information systems enable business communications.

{SECTION 1.2}
Business Strategy

LEARNING OUTCOMES

LO1.3 Explain why competitive advantages are typically temporary.

LO1.4 Identify the four key areas of a SWOT analysis.

LO1.5 Describe Porter's Five Forces Model and explain each of the five forces.

LO1.6 Compare Porter's three generic strategies.

LO1.7 Demonstrate how a company can add value by using Porter's value chain analysis.

IDENTIFYING COMPETITIVE ADVANTAGES LO1.3

Running a company today is similar to leading an army; the top manager or leader ensures all participants are heading in the right direction and completing their goals and objectives. Companies lacking leadership quickly implode as employees head in different directions attempting to achieve conflicting goals. To combat these challenges, leaders communicate and execute business strategies (from the Greek word *stratus* for army and *ago* for leading).

A **business strategy** is a leadership plan that achieves a specific set of goals or objectives such as increasing sales, decreasing costs, entering new markets, or developing new products or services. A **stakeholder** is a person or group that has an interest or concern in an organization. Stakeholders drive business strategies, and depending on the stakeholder's perspective, the business strategy can change. It is not uncommon to find stakeholders' business strategies have conflicting interests such as investors looking to increase profits by eliminating employee jobs. Figure 1.13 displays the different stakeholders found in an organization and their common business interests.

Good leaders also anticipate unexpected misfortunes, from strikes and economic recessions to natural disasters. Their business strategies build in buffers or slack, allowing the company the ability to ride out any storm and defend against competitive or environmental threats. Of course, updating business strategies is a continuous undertaking as internal and external environments rapidly change. Business strategies that match core

Due Diligence //:
Safekeeping Data

In the past few years, data collection rates have skyrocketed, and some estimate we have collected more data in the past four years than since the beginning of time. According to International Data Corporation, data collection amounts used to double every four years. With the massive growth of smart phones, tablets, and wearable technology devices, it seems as though data is being collected from everything, everywhere, all the time. It is estimated that data collection is doubling every two years, and soon it will double every six months. That is a lot of data! With the explosion of

data collection, CTOs, CIOs, and CSOs are facing extremely difficult times as the threats to steal corporate sensitive data also growing exponentially. Hackers and criminals have recently stolen sensitive data from retail giant Target and even the Federal Reserve Bank.[4]

To operate, sensitive data has to flow outside an organization to partners, suppliers, community, government, and shareholders. List 10 types of sensitive data found in a common organization. Review the list of stakeholders; determine which types of sensitive data each has access to and whether you have any concerns about sharing this data. Do you have to worry about employees and sensitive data? How can using one of the four business strategies discussed in this section help you address your data leakage concerns?

company competencies to opportunities result in competitive advantages, a key to success!

A **competitive advantage** is a feature of a product or service on which customers place a greater value than they do on similar offerings from competitors. Competitive advantages provide the same product or service either at a lower price or with additional value that can fetch premium prices. Unfortunately, competitive advantages are typically temporary, because competitors often quickly seek ways to duplicate them. In turn, organizations must develop a strategy based on a new competitive advantage. Ways that companies duplicate competitive advantages include acquiring the new technology, copying the business operations, and hiring away key employees. The introduction of Apple's iPod and iTunes, a brilliant merger of technology, business, and entertainment, offers an excellent example.

In early 2000, Steve Jobs was fixated on developing video editing software when he suddenly realized that millions of people were using computers to listen to music, a new trend in the industry catapulted by illegal online services such as Napster. Jobs was worried that he was looking in the wrong direction and had missed the opportunity to jump on the online music bandwagon. He moved fast, however, and within four months he had developed the first version of iTunes for the Mac. Jobs' next challenge was to make a portable iTunes player that could hold thousands of songs and be completely transportable. Within nine months the iPod was born. With the combination of iTunes and iPod, Apple created a significant competitive advantage in the marketplace. Many firms began following Apple's lead by creating portable music players to compete with the iPod. In addition, Apple continues to create new and exciting products to gain competitive advantages, such as its iPad, a larger version of the iPod that functions more as a computer than a music player.[5]

When a company is the first to market with a competitive advantage, it gains a particular benefit, such as Apple did with its iPod. This **first-mover advantage** occurs when a company

competitive advantage A feature of a product or service on which customers place a greater value than on similar offerings from competitors.

first-mover advantage An advantage that occurs when a company can significantly increase its market share by being first to market with a competitive advantage.

▼FIGURE 1.13
Stakeholders' Interests

competitive intelligence
The process of gathering information about the competitive environment, including competitors' plans, activities, and products, to improve a company's ability to succeed.

SWOT analysis
Evaluates an organization's strengths, weaknesses, opportunities, and threats to identify significant influences that work for or against business strategies.

can significantly increase its market share by being first with a new competitive advantage. FedEx created a first-mover advantage by developing its customer self-service software, which allows people to request parcel pickups, print mailing slips, and track parcels online. Other parcel delivery companies quickly began creating their own online services. Today, customer self-service on the Internet is a standard feature of the parcel delivery business.

Competitive intelligence is the process of gathering information about the competitive environment, including competitors' plans, activities, and products, to improve a company's ability to succeed. It means understanding and learning as much as possible as soon as possible about what is occurring outside the company to remain competitive. Frito-Lay, a premier provider of snack foods such as Cracker Jacks and Cheetos, does not send its sales representatives into grocery stores just to stock shelves; they carry handheld computers and record the product offerings, inventory, and even product locations of competitors. Frito-Lay uses this information to gain competitive intelligence on everything from how well competing products are selling to the strategic placement of its own products. Managers use four common tools to analyze competitive intelligence and develop competitive advantages as displayed in Figure 1.14.

▼ **FIGURE 1.14** Business Tools for Analyzing Business Strategies

SWOT ANALYSIS
Evaluates Project Position

THE FIVE FORCES MODEL
Evaluates Industry Attractiveness

THE THREE GENERIC STRATEGIES
Chooses Business Focus

VALUE CHAIN ANALYSIS
Executes Business Strategy

LO1.3 Explain why competitive advantages are temporary.

FOUR KEY AREAS OF A SWOT ANALYSIS LO1.4

A **SWOT analysis** evaluates an organization's strengths, weaknesses, opportunities, and threats to identify significant influences that work for or against business strategies (see Figure 1.15). Strengths and weaknesses originate inside an organization, or internally. Opportunities and threats originate outside an organization, or externally and cannot always be anticipated or controlled.

- **Potential Internal Strengths (Helpful):** Identify all key strengths associated with the competitive advantage including cost advantages, new and/or innovative services,

---

My Not To-Do List
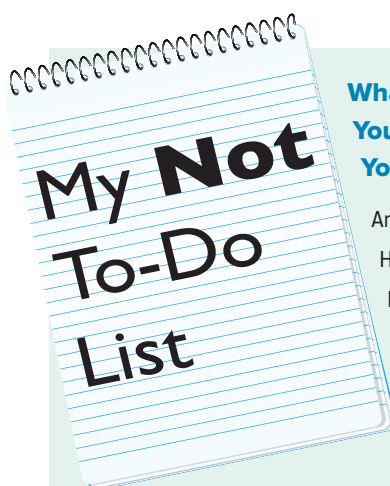
What Happens on YouTube Stays on YouTube—FOREVER[6]

Are you looking for great career advice? Here it is: **Never** post anything on publicly accessible websites that you would not feel comfortable showing a recruiter or hiring manager. This includes inappropriate photos; negative comments about jobs, professors, or people; and binge drinking at a holiday party. Future employers will Google you!

The bad news: You have to continue to keep your cyber profile squeaky clean for the rest of your life. Companies can and will fire you for inappropriate website postings. One interesting story occurred when two employees created a private, password-protected group on Facebook where they would complain about their jobs, post derogatory comments about their managers, and highlight new top-secret product information. The managers, being computer savvy, obtained the password and immediately fired the two individuals after reviewing the site. Now one of the individuals is suing the former managers for invasion of privacy.

Do you agree that if you post something online it is open for the world to see? What do you consider is inappropriate material that you should never post to the web? What can you do to remove inappropriate material posted to the web by a friend that identifies you? How do efficiency and effectiveness enter into this scenario? What is the potential argument each of these sides might use in order to win the lawsuit?

▼FIGURE 1.15 Sample SWOT Analysis

	HELPFUL	HARMFUL
INTERNAL	**STRENGTHS** Core Competencies Market Leaders Cost Advantages Excellent Management	**WEAKNESSES** Lack of Strategic Direction Obsolete Technologies Lack of Managerial Talent Outdated Product Line
EXTERNAL	**OPPORTUNITES** Expanded Product Line Increase in Demand New Markets New Regulations	**THREATS** New Entrants Substitute Products Shrinking Markets Costly Regulatory Requirements

special expertise and/or experience, proven market leader, and improved marketing campaigns.

- **Potential Internal Weaknesses (Harmful):** Identify all key areas that require improvement. Weaknesses focus on the absence of certain strengths, including absence of an Internet marketing plan, damaged reputation, problem areas for service, and outdated technology employee issues.

- **Potential External Opportunities (Helpful):** Identify all significant trends along with how the organization can benefit from each, including new markets, additional customer groups, legal changes, innovative technologies, population changes, and competitor issues.

show me *the* MONEY

SWOT Your Student

What is your dream job? Do you have the right skills and abilities to land the job of your dreams? If not, do you have a plan to acquire those sought-after skills and abilities? Do you have a personal career plan or strategy? Just like a business, you can perform a personal SWOT analysis to ensure your career plan will be successful. You want to know your strengths and recognize career opportunities while mitigating your weaknesses and any threats that can potentially derail your career plans. A key area where many people struggle is technology, and without the right technical skills, you might find you are not qualified for your dream job. One of the great benefits of this course is its ability to help you prepare for a career in business by understanding the key role technology plays in the different industries and functional areas. Regardless of your major, you will all use business driven information systems to complete the tasks and assignments associated with your career.

Perform a personal SWOT analysis for your career plan, based on your current skills, talents, and knowledge. Be sure to focus on your personal career goals, including the functional business area in which you want to work and the potential industry you are targeting, such as health care, telecommunications, retail, or travel.

PERSONAL CAREER SWOT ANALYSIS

STRENGTHS	WEAKNESSES
OPPORTUNITES	**THREATS**

After completing your personal SWOT analysis, take a look at the table of contents in this text and determine whether this course will eliminate any of your weaknesses or create new strengths. Determine whether you can find new opportunities or mitigate threats based on the material we cover over the next several weeks. For example, Chapter 9 covers project management in detail—a key skill for any business professional who must run a team. Learning how to assign and track work status will be a key tool for any new business professional. Where would you place this great skill in your SWOT analysis? Did it help eliminate any of your weaknesses? When you have finished this exercise, compare your SWOT with your peers to see what kind of competition you will encounter when you enter the workforce.

Porter's Five Forces Model A model for analyzing the competitive forces within the environment in which a company operates, to assess the potential for profitability in an industry.

buyer power The ability of buyers to affect the price they must pay for an item.

switching costs Costs that make customers reluctant to switch to another product or service.

- Competition can steal customers.
- New market entrants can steal potential investment capital.
- Substitute products can steal customers.

Formally defined, **Porter's Five Forces Model** analyzes the competitive forces within the environment in which a company operates to assess the potential for profitability in an industry. Its purpose is to combat these competitive forces by identifying opportunities, competitive advantages, and competitive intelligence. If the forces are strong, they increase competition; if the forces are weak, they decrease competition. This section details each of the forces and its associated MIS business strategy (see Figure 1.16).[7]

- **Potential External Threats (Harmful):** Identify all threats or risks detrimental to your organization, including new market entrants, substitute products, employee turnover, differentiating products, shrinking markets, adverse changes in regulations, and economic shifts.

LO1.4 Identify the four key areas of a SWOT analysis.

LO1.5 Describe Porter's Five Forces Model and explain each of the five forces.

THE FIVE FORCES MODEL—EVALUATING INDUSTRY ATTRACTIVENESS LO1.5

Michael Porter, a university professor at Harvard Business School, identified the following pressures that can hurt potential sales:

- Knowledgeable customers can force down prices by pitting rivals against each other.
- Influential suppliers can drive down profits by charging higher prices for supplies.

Buyer Power

Buyer power is the ability of buyers to affect the price they must pay for an item. Factors used to assess buyer power include number of customers, their sensitivity to price, size of orders, differences between competitors, and availability of substitute products. If buyer power is high, customers can force a company and its competitors to compete on price, which typically drives prices down.

One way to reduce buyer power is by manipulating **switching costs**, costs that make customers reluctant to switch to another product or service. Switching costs include financial as well as intangible values. The cost of switching doctors, for instance, includes the powerful intangible components of having to build

FIGURE 1.16 Porter's Five Forces Model
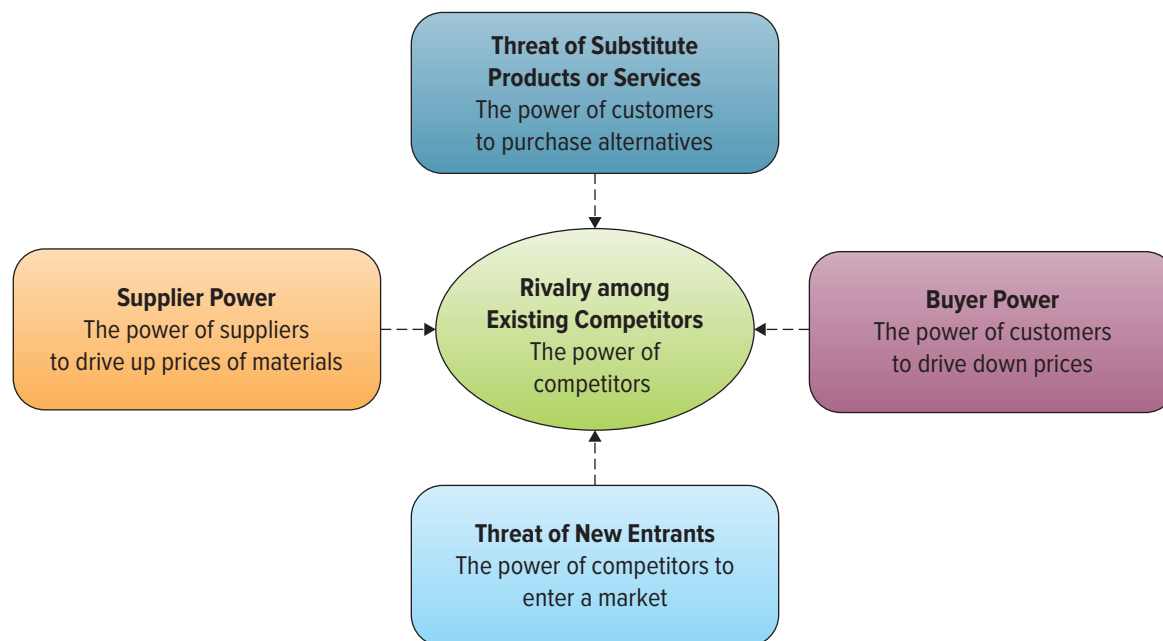
loyalty program
A program to reward customers based on spending.

supply chain All parties involved, directly or indirectly, in obtaining raw materials or a product.

supplier power One of Porter's five forces; measures the suppliers' ability to influence the prices they charge for supplies (including materials, labor, and services).

threat of substitute products or services One of Porter's five forces, high when there are many alternatives to a product or service and low when there are few alternatives from which to choose.

threat of new entrants One of Porter's five forces, high when it is easy for new competitors to enter a market and low when there are significant entry barriers to joining a market.

relationships with the new doctor and nurses, as well as transferring all your medical history. With MIS, however, patients can store their medical records on DVDs or thumb drives, allowing easy transferability. The Internet also lets patients review websites for physician referrals, which takes some of the fear out of trying someone new.[8]

Companies can also reduce buyer power with **loyalty programs**, which reward customers based on their spending. The airline industry is famous for its frequent-flyer programs, for instance. Because of the rewards travelers receive (free airline tickets, upgrades, or hotel stays), they are more likely to be loyal to or give most of their business to a single company. Keeping track of the activities and accounts of many thousands or millions of customers covered by loyalty programs is not practical without large-scale business systems, however. Loyalty programs are thus a good example of using MIS to reduce buyer power.[9]

Supplier Power

A **supply chain** consists of all parties involved, directly or indirectly, in obtaining raw materials or a product. In a typical supply chain, a company will be both a supplier (to customers) and a customer (of other suppliers), as illustrated in Figure 1.17. **Supplier power** is the suppliers' ability to influence the prices they charge for supplies (including materials, labor, and services). Factors used to appraise supplier power include number of suppliers, size of suppliers, uniqueness of services, and availability of substitute products. If supplier power is high, the supplier can influence the industry by:

- Charging higher prices.
- Limiting quality or services.
- Shifting costs to industry participants.[10]

Typically, when a supplier raises prices, the buyers will pass on the increase to their customers by raising prices on the end product. When supplier power is high, buyers lose revenue because they cannot pass on the raw material price increase to

▼ **FIGURE 1.17** Traditional Supply Chain

their customers. Some powerful suppliers, such as pharmaceutical companies, can exert a threat over an entire industry when substitutes are limited and the product is critical to the buyers. Patients who need to purchase cancer-fighting drugs have no power over price and must pay whatever the drug company asks because there are few available alternatives.

Using MIS to find alternative products is one way of decreasing supplier power. Cancer patients can now use the Internet to research alternative medications and practices, something that was next to impossible just a few decades ago. Buyers can also use MIS to form groups or collaborate with other buyers, increasing the size of the buyer group and reducing supplier power. For a hypothetical example, the collective group of 30,000 students from a university has far more power over price when purchasing laptops than a single student.[11]

Threat of Substitute Products or Services

The **threat of substitute products or services** is high when there are many alternatives to a product or service and low when there are few alternatives from which to choose. For example, travelers have numerous substitutes for airline transportation including automobiles, trains, and boats. Technology even makes videoconferencing and virtual meetings possible, eliminating the need for some business travel. Ideally, a company would like to be in a market in which there are few substitutes for the products or services it offers.

Polaroid had this unique competitive advantage for many years until it forgot to observe competitive intelligence. Then the firm went bankrupt when people began taking digital pictures with everything from video cameras to cell phones.

A company can reduce the threat of substitutes by offering additional value through wider product distribution. Soft-drink manufacturers distribute their products through vending machines, gas stations, and convenience stores, increasing the availability of soft drinks relative to other beverages. Companies can also offer various add-on services, making the substitute product less of a threat. For example, iPhones include capabilities for games, videos, and music, making a traditional cell phone less of a substitute.[12]

Threat of New Entrants

The **threat of new entrants** is high when it is easy for new competitors to enter a market and low when there are significant

entry barrier A feature of a product or service that customers have come to expect and entering competitors must offer the same for survival.

rivalry among existing competitors One of Porter's five forces; high when competition is fierce in a market and low when competitors are more complacent.

product differentiation An advantage that occurs when a company develops unique differences in its products with the intent to influence demand.

entry barriers to joining a market. An **entry barrier** is a feature of a product or service that customers have come to expect and entering competitors must offer the same for survival. For example, a new bank must offer its customers an array of MIS-enabled services, including ATMs, online bill paying, and online account monitoring. These are significant barriers to new firms entering the banking market. At one time, the first bank to offer such services gained a valuable first-mover advantage, but only temporarily, as other banking competitors developed their own MIS services.[13]

Rivalry among Existing Competitors

Rivalry among existing competitors is high when competition is fierce in a market and low when competitors are more complacent. Although competition is always more intense in some industries than in others, the overall trend is toward increased competition in almost every industry. The retail grocery industry is intensively competitive. Kroger, Safeway, and Albertsons in the United States compete in many different ways, essentially trying to beat or match each other on price. Most supermarket chains have implemented loyalty programs to provide customers special discounts while gathering valuable information about their purchasing habits. In the future, expect to see grocery stores using wireless technologies that track customer movements throughout the store to determine purchasing sequences.

Product differentiation occurs when a company develops unique differences in its products or services with the intent to influence demand. Companies can use differentiation to reduce rivalry. For example, while many companies sell books and videos on the Internet, Amazon differentiates itself by using customer profiling. When a customer visits Amazon.com repeatedly, Amazon begins to offer products tailored to that particular customer based on his or her profile. In this way, Amazon has reduced its rivals' power by offering its customers a differentiated service.

To review, the Five Forces Model helps managers set business strategy by identifying the competitive structure and economic environment of an industry. If the forces are strong, they increase competition; if the forces are weak, they decrease it (see Figure 1.18).[14]

Analyzing the Airline Industry

Let us bring Porter's five forces together to look at the competitive forces shaping an industry and highlight business strategies to help it remain competitive. Assume a shipping company is deciding whether to enter the commercial airline industry. If performed correctly, an analysis of the five forces should determine that this is a highly risky business strategy because all five forces are strong. It will thus be difficult to generate a profit.

- **Buyer power:** Buyer power is high because customers have many airlines to choose from and typically make purchases based on price, not carrier.

- **Supplier power:** Supplier power is high since there are limited plane and engine manufacturers to choose from, and unionized workforces (suppliers of labor) restrict airline profits.

- **Threat of substitute products or services:** The threat of substitute products is high from many transportation alternatives including automobiles, trains, and boats, and from transportation substitutes such as videoconferencing and virtual meetings.

- **Threat of new entrants:** The threat of new entrants is high because new airlines are continuously entering the market, including sky taxies offering low-cost on-demand air taxi service.

- **Rivalry among existing competitors:** Rivalry in the airline industry is high, and websites such as Travelocity and Priceline force them to compete on price (see Figure 1.19).[15]

▼**FIGURE 1.18** Strong and Weak Examples of Porter's Five Forces

	Weak Force: Decreases Competition or Few Competitors	Strong Force: Increases Competition or Lots of Competitors
Buyer Power	An international hotel chain purchasing milk	A single consumer purchasing milk
Supplier Power	A company that makes airline engines	A company that makes pencils
Threat of Substitute Products or Services	Cancer drugs from a pharmaceutical company	Coffee from McDonald's
Threat of New Entrants	A professional hockey team	A dog walking business
Rivalry among Existing Competitors	Department of Motor Vehicles	A coffee shop

FIGURE 1.19 Five Forces Model in the Airline Industry

	Strong (High) Force: Increases Competition or Lots of Competitors
Buyer Power	Many airlines for buyers to choose from forcing competition based on price.
Supplier Power	Limited number of plane and engine manufacturers to choose from along with unionized workers.
Threat of Substitute Products or Services	Many substitutes including cars, trains, and buses. Even substitutes to travel such as video conferencing and virtual meetings.
Threat of New Entrants	Many new airlines entering the market all the time including the latest sky taxis.
Rivalry among Existing Competitors	Intense competition—many rivals.

Porter's three generic strategies
Generic business strategies that are neither organization nor industry specific and can be applied to any business, product, or service.

fyi

Cool College Start-Ups

Not long ago, people would call college kids who started businesses quaint. Now they call them the boss. For almost a decade, *Inc.* magazine has been watching college start-ups and posting a list of the nation's top start-ups taking campuses by storm. Helped in part by low-cost technologies and an increased prevalence of entrepreneurship training at the university level, college students—and indeed those even younger—are making solid strides at founding companies. And they're not just launching local pizza shops and fashion boutiques. They are starting up businesses that could scale into much bigger companies and may already cater to a national audience.

Research *Inc.* magazine at www.inc.com and find the year's current Coolest College Startup listing. Choose one of the businesses and perform a Porter's Five Forces analysis. Be sure to highlight each force, including switching costs, product differentiation, and loyalty programs.

THE THREE GENERIC STRATEGIES— CHOOSING A BUSINESS FOCUS LO1.6

Once top management has determined the relative attractiveness of an industry and decided to enter it, the firm must formulate a strategy for doing so. If our sample company decided to join the airline industry, it could compete as a low-cost, no-frills airline or as a luxury airline providing outstanding service and first-class comfort. Both options offer different ways of achieving competitive advantages in a crowded marketplace. The low-cost operator saves on expenses and passes the savings along to customers in the form of low prices. The luxury airline spends on high-end service and first-class comforts and passes the costs on to the customer in the form of high prices.

Porter's three generic strategies are generic business strategies that are neither organization nor industry specific and can be applied to any business, product, or service. These three generic business strategies for entering a new market are: (1) broad cost leadership, (2) broad differentiation, and (3) focused strategy. Broad strategies reach a large market segment, while focused strategies target a niche or unique market with either cost leadership or differentiation. Trying to be all things to all people is a recipe for disaster, since doing so makes it difficult to project a consistent image to the entire marketplace. For this reason, Porter suggests adopting only one of the three generic strategies illustrated in Figure 1.20.

Figure 1.21 applies the three strategies to real companies, demonstrating the relationships among strategies (cost leadership versus differentiation) and market segmentation (broad versus focused).

- **Broad market and low cost:** Walmart competes by offering a broad range of products at low prices. Its business strategy is to be the low-cost provider of goods for the cost-conscious consumer.

FIGURE 1.20 Porter's Three Generic Strategies

	Cost Strategy	
	Low Cost	**High Cost**
Broad Market	Cost Leadership	Differentiation
Narrow Market	Focused Strategy	
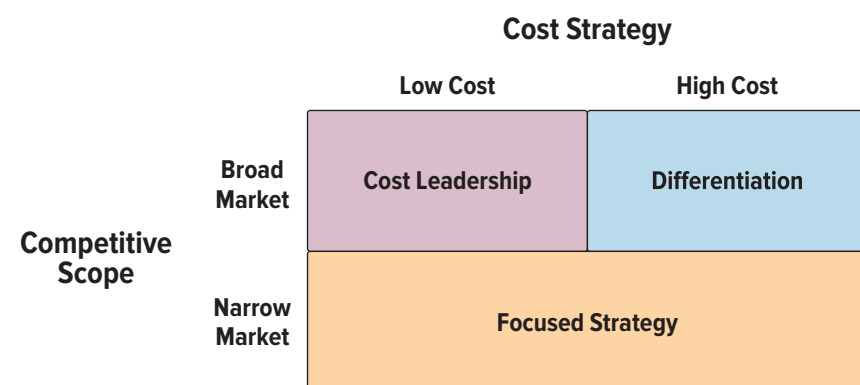
Competitive Scope

▼ FIGURE 1.21 Examples of Porter's Three Generic Strategies

Cost Strategy

	Low Cost	High Cost
Broad Market	Walmart	Neiman Marcus
Narrow Market	Payless Shoes	Tiffany & Co.

Competitive Scope

- **Broad market and high cost:** Neiman Marcus competes by offering a broad range of differentiated products at high prices. Its business strategy offers a variety of specialty and upscale products to affluent consumers.

- **Narrow market and low cost:** Payless competes by offering a specific product, shoes, at low prices. Its business strategy is to be the low-cost provider of shoes. Payless competes with Walmart, which also sells low-cost shoes, by offering a far bigger selection of sizes and styles.

- **Narrow market and high cost:** Tiffany & Co. competes by offering a differentiated product, jewelry, at high prices. Its business strategy allows it to be a high-cost provider of premier designer jewelry to affluent consumers.

LO1.6 Compare Porter's three generic strategies.

show me *the* MONEY

Death of a Product

Porter's Five Forces Model is an essential framework for understanding industries and market forces. Choose one of the categories listed here and analyze what happened to the market using Porter's Five Forces:

- On-demand movies and Blu-ray players.
- Digital camera and Polaroid camera.
- GPS device and a road atlas.
- Digital books and printed books.
- High-definition TV and radio.

Living the DREAM

One Laptop per Child[16]

Nicholas Negroponte is the founder of the MIT Media Lab and has spent his career pushing the edge of the information revolution as an inventor, thinker, and angel investor. His latest project, One Laptop per Child, plans to build $100 laptops that he hopes to put in the hands of the millions of children in developing countries around the globe. The XO (the "$100 laptop") is a wireless Internet-enabled, pedal-powered computer costing roughly $100. What types of competitive advantages could children gain from Negroponte's $100 laptop? What types of issues could result from the $100 laptop? Which of Porter's three generic strategies is Negroponte following?

©MIGUEL ROJO/Stringer/Getty Images

business process Standardized set of activities that accomplish a specific task.

value chain analysis Views a firm as a series of business processes that each add value to the product or service.

primary value activities Found at the bottom of the value chain, these include business processes that acquire raw materials and manufacture, deliver, market, sell, and provide after-sales services.

support value activities Found along the top of the value chain and includes business processes, such as firm infrastructure, human resource management, technology development, and procurement, that support the primary value activities.

VALUE CHAIN ANALYSIS—EXECUTING BUSINESS STRATEGIES LO1.7

Firms make profits by taking raw inputs and applying a business process to turn them into a product or service that customers find valuable. A **business process** is a standardized set of activities that accomplish a specific task, such as processing a customer's order. Once a firm identifies the industry it wants to enter and the generic strategy it will focus on, it must then choose the business processes required to create its products or services. Of course, the firm will want to ensure the processes add value and create competitive advantages. To identify these competitive advantages, Michael Porter created **value chain analysis**, which views a firm as a series of business processes that each add value to the product or service.

Value chain analysis is a useful tool for determining how to create the greatest possible value for customers (see Figure 1.22). The goal of value chain analysis is to identify processes in which the firm can add value for the customer and create a competitive advantage for itself, with a cost advantage or product differentiation.

The *value chain* groups a firm's activities into two categories, primary value activities, and support value activities. **Primary value activities**, shown at the bottom of the value chain in Figure 1.22, acquire raw materials and manufacture, deliver, market, sell, and provide after-sales services.

1. **Inbound logistics:** acquires raw materials and resources and distributes to manufacturing as required.

2. **Operations:** transforms raw materials or inputs into goods and services.

3. **Outbound logistics:** distributes goods and services to customers.

4. **Marketing and sales:** promotes, prices, and sells products to customers.

5. **Service:** provides customer support after the sale of goods and services.[17]

Support value activities, along the top of the value chain in Figure 1.22, include firm infrastructure, human resource management, technology development, and procurement. Not surprisingly, these support the primary value activities.

- **Firm infrastructure:** includes the company format or departmental structures, environment, and systems.

- **Human resource management:** provides employee training, hiring, and compensation.

- **Technology development:** applies MIS to processes to add value.

- **Procurement:** purchases inputs such as raw materials, resources, equipment, and supplies.

It is easy to understand how a typical manufacturing firm takes raw materials such as wood pulp and transforms it into paper.

FIGURE 1.22 The Value Chain

Support Value Activities	Firm infrastructure (3.1%)				
	Human resource management (7.1%)				
	Technology development (and R&D) (4.2%)				
	Procurement (27%)				
Primary Value Activities	Receive and store raw materials (5.2%)	Make the product or service (40.3%)	Deliver the product or service (6.6%)	Market and sell the product or service (4.3%)	Service after the sale (2.2%)

Value Added
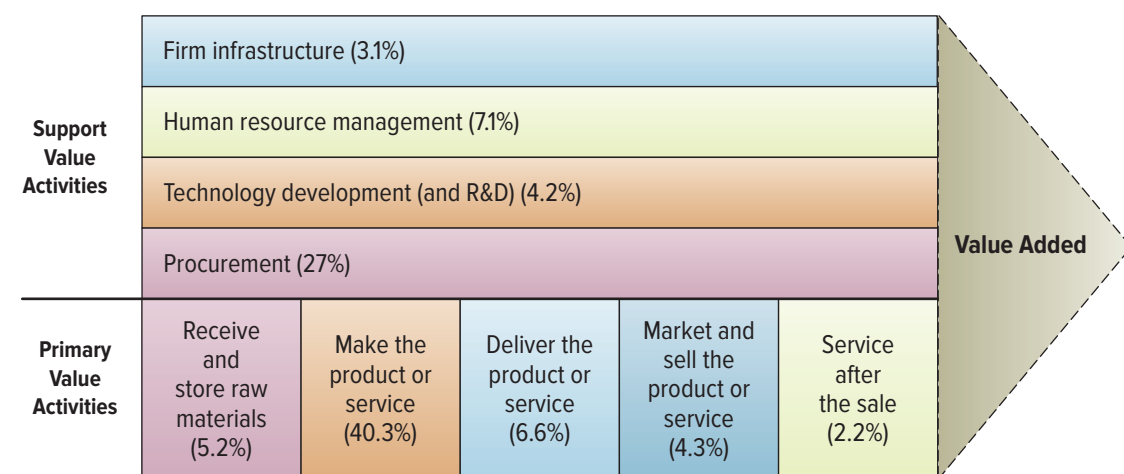
BUSTED Listen to Spider-Man; He Knows What He's Talking About![18]

Spider-Man's infamous advice—"With great power comes great responsibility"—should be applied to every type of technology you encounter in business. Technology provides countless opportunities for businesses, but it can also lead to countless pitfalls and traps. A great example is how many companies profited from online trading and how many people lost their life savings in online trading scams. For example, Bernard Madoff, the owner of a high-profile New York investment company, was able to forge investment statements and allegedly spent almost $50 billion of his client's money. Craigslist allows anyone to become a provider of goods and services. Unfortunately, Craigslist does not describe exactly what types of goods and services are allowed. Adam Vitale was sentenced to two years in prison after he was found running an online prostitution ring through Craigslist.

The IOT is generating massive amounts of data from millions of sensors. Research the Internet and find an example of unethical behavior with IOT data and share the examples with your peers. What can businesses to do to prevent IOT data from being used unethically?

©Ingram Publishing

Adding value in this example might include using high-quality raw materials or offering next-day free shipping on any order. How, though, might a typical service firm take raw inputs such as time, knowledge, and MIS and transform them into valuable customer service knowledge? A hotel might use MIS to track customer reservations and then inform front-desk employees when a loyal customer is checking in so the employee can call the guest by name and offer additional services, gift baskets, or upgraded rooms. Examining the firm as a value chain allows managers to identify the important business processes that add value for customers and then find MIS solutions that support them.

When performing a value chain analysis, a firm could survey customers about the extent to which they believe each activity adds value to the product or service. This step generates responses the firm can measure, shown as percentages in Figure 1.23, to

▼FIGURE 1.23 The Value Chain and Porter's Five Forces Model

Threat of Substitute Products or Services
The power of customers to purchase alternatives

Firm infrastructure (3.1%)

Human resource management (7.1%)

Technology development (and R&D) (4.2%)

Procurement (27%)

| Receive and store raw materials (5.2%) | Make the product or service (40.3%) | Deliver the product or service (6.6%) | Market and sell the product or service (4.3%) | Service after the sale (2.2%) |

Supplier Power
The power of suppliers to drive up prices of materials

Value Added

Buyer Power
The power of customers to drive down prices

Threat of New Entrants
The power of competitors to enter a market

describe how each activity adds (or reduces) value. Then the competitive advantage decision for the firm is whether to (1) target high value-adding activities to further enhance their value, (2) target low value-adding activities to increase their value, or (3) perform some combination of the two.

MIS adds value to both primary and support value activities. One example of a primary value activity facilitated by MIS is the development of a marketing campaign management system that could target marketing campaigns more efficiently, thereby reducing marketing costs. The system would also help the firm better pinpoint target market needs, thereby increasing sales. One example of a support value activity facilitated by MIS is the development of a human resources system that could more efficiently reward employees based on performance. The system could also identify employees who are at risk of quitting, allowing managers' time to find additional challenges or opportunities that would help retain these employees and thus reduce turnover costs.

Value chain analysis is a highly useful tool that provides hard and fast numbers for evaluating the activities that add value to products and services. Managers can find additional value by analyzing and constructing the value chain in terms of Porter's Five Forces Model (see Figure 1.23). For example, if the goal is to decrease buyer power, a company can construct its value chain activity of "service after the sale" by offering high levels of customer service. This will increase customers' switching costs and reduce their power. Analyzing and constructing support value activities can help decrease the threat of new entrants. Analyzing and constructing primary value activities can help decrease the threat of substitute products or services.[21]

Revising Porter's three business strategies is critical. Firms must continually adapt to their competitive environments, which can cause business strategy to shift. In the remainder of this text we discuss how managers can formulate business strategies using MIS to create competitive advantages. Figure 1.24 gives an overview of the remaining chapters, along with the relevant business strategy and associated MIS topics. ■

LO1.7 Demonstrate how a company can add value by using Porter's value chain analysis.

▼**FIGURE 1.24** Overview of Information Systems

MODULE 1: BUSINESS DRIVEN MIS

	Business Strategy	MIS Topics
Chapter 1: Management Information Systems	Understanding Business Driven MIS	Data Information Business Intelligence Knowledge Systems Thinking Porter's Business Strategies
Chapter 2: Decisions and Processes	Creating Value Driven Businesses	Transaction Processing Systems Decision Support Systems Executive Information Systems Artificial Intelligence Business Process Reengineering
Chapter 3: Ebusiness	Finding Electronic Business Value	eBusiness eBusiness Models Social Networking Knowledge Management Collaboration
Chapter 4: Ethics and Information Security	Identifying MIS Business Concerns	Information Security Policies Authentication and Authorization Prevention and Resistance Detection and Response

MODULE 2: TECHNICAL FOUNDATIONS OF MIS

	Business Strategy	MIS Topics
Chapter 5: Infrastructures	Deploying Organizational MIS	Grid Computing Cloud Computing Virtualization Sustainable MIS Infrastructures
Chapter 6: Data	Uncovering Business Intelligence	Database Data Management Systems Data Warehousing Data Mining
Chapter 7: Networks	Supporting Mobile Business	Business Networks Web 1.0, Web 2.0, Web 3.0 Mobile MIS Wireless MIS GPS, GIS, and LBS

MODULE 3: ENTERPRISE MIS

	Business Strategy	MIS Topics
Chapter 8: Enterprise Applications	Enhancing Business Communications	Customer Relationship Management Supply Chain Management Enterprise Resource Planning
Chapter 9: Systems Development and Project Management	Leading MIS Projects	MIS Development Methodologies Project Management Outsourcing

©John Kellerman/Alamy

chapter seven

Networks:
Mobile Business

What's in IT for me?

The pace of technological change never ceases to amaze as kindergarten classes are now learning PowerPoint and many elementary school children have their own cell phones. What used to take hours to download over a dial-up modem connection can now transfer in a matter of seconds through an invisible, wireless network connection from a computer thousands of miles away. We are living in an increasingly wireless present and hurtling ever faster toward a wireless future. The tipping point of ubiquitous, wireless, handheld, mobile computing is approaching quickly.

As a business student, understanding network infrastructures and wireless

CHAPTER OUTLINE

SECTION 7.1 >>
Connectivity: The Business Value of a Networked World
- The Connected World
- Benefits and Challenges of a Connected World

SECTION 7.2 >>
Mobility: The Business Value of a Wireless World
- Wireless Networks
- Business Applications of Wireless Networks

technologies allows you to take advantage of mobile workforces. Understanding the benefits and challenges of mobility is a critical skill for business executives, regardless if you are a novice or a seasoned *Fortune* 500 employee. By learning about the various concepts discussed in this chapter, you will develop a better understanding of how business can leverage networking technologies to analyze network types, improve wireless and mobile business processes, and evaluate alternative networking options. ■

{SECTION 7.1}
Connectivity: The Business Value of a Networked World

LEARNING OUTCOMES

LO7.1 Explain the five different networking elements creating a connected world.

LO7.2 Identify the benefits and challenges of a connected world.

THE CONNECTED WORLD LO7.1

Computer networks are continuously operating all over the globe supporting our 24/7/365 always on and always connected lifestyles. You are probably using several different networks right now without even realizing it. You might be using a school's network to communicate with teachers, a phone network to communicate with friends, and a cable network to watch TV or listen to the radio. Networks enable telecommunications or the exchange of information (voice, text, data, audio, video). The telecommunication industry has morphed from a government-regulated monopoly to a deregulated market where many suppliers ferociously compete. Competing telecommunication companies offer local and global telephony services, satellite service, mobile radio, cable television, cellular phone services, and Internet access (all of which are detailed in this chapter). Businesses everywhere are increasingly using networks to communicate and collaborate with customers, partners, suppliers, and employees. As a manager, you will face many different communication alternatives, and the focus of this chapter is to provide you with an initial understanding of the different networking elements you will someday need to select (see Figure 7.1).

LO7.1 Explain the five different networking elements creating a connected world.

FIGURE 7.1
Networking Elements Creating a Connected World

NETWORK CATEGORIES
LAN, WAN, MAN

NETWORK PROVIDERS
ISP, NSP, RSP

NETWORK ACCESS TECHNOLOGIES
DSL, Cable Modem, Broadband

NETWORK PROTOCOLS
TCP/IP, DNS, DHCP

NETWORK CONVERGENCE
VoIP, UC, IPTV
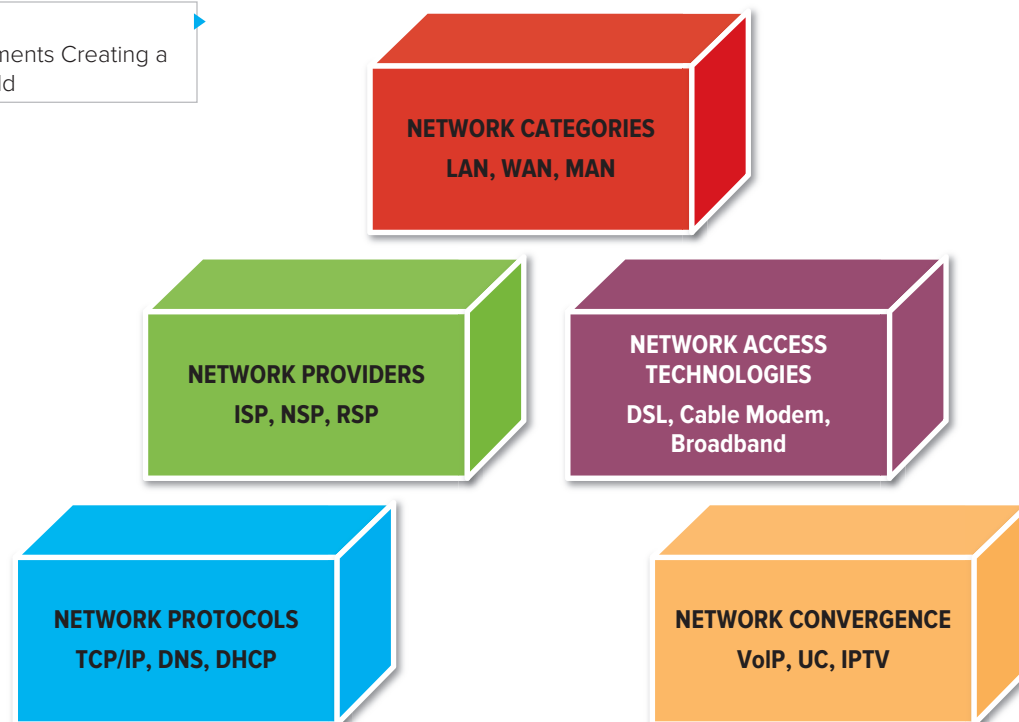
Network Categories

The general idea of a network is to allow multiple devices to communicate at the highest achievable speeds and, very importantly, to reduce the cost of connecting. How a particular network achieves these goals depends in part on how it is physically constructed and connected. Networks are categorized based on geographic span: local area networks, wide area networks, and metropolitan area networks. Today's business networks include a combination of all three.

A **local area network (LAN)** connects a group of computers in close proximity, such as in an office building, school, or home. LANs allow sharing of files, printers, games, and other resources. A LAN also often connects to other LANs, and to wide area networks. A **wide area network (WAN)** spans a large geographic area such as a state, province, or country. Perhaps the best example is the Internet. WANs are essential for carrying out the day-to-day activities of many companies and government organizations, allowing them to transmit and receive information among their employees, customers, suppliers, business partners, and other organizations across cities, regions, and countries and around the world. In networking, **attenuation** represents the loss of a network signal strength measured in decibels (dB) and occurs because the transmissions gradually dissipate in strength over longer distances or because of radio interference or physical obstructions such as walls. A **repeater** receives and repeats a signal to extend its attenuation or range.

WANs often connect multiple smaller networks, such as local area networks or metropolitan area networks. A **metropolitan area network (MAN)** is a large computer network usually spanning a city. Most colleges, universities, and large companies that span a campus use an infrastructure supported by a MAN. Figure 7.2 shows the relationships and a few differences between a LAN, WAN, and MAN. A cloud image often represents the Internet or some large network environment.

While LANs, WANs, and MANs all provide users with an accessible and reliable network infrastructure, they differ in many dimensions; two of the most important are cost and performance. It is easy to establish a network between two computers in the same room or building, but much more difficult if they are in different states or even countries. This means someone looking to build or support a WAN either pays more or gets less performance, or both. Ethernet is the most common connection type for wired networking and is available in speeds from 10 Mbps all the way up to 10,000 Mbps (10 Gbit). The most common wire used for Ethernet networking is Cat5 (Category 5) and the connectors used are RJ45, slightly larger than the RJ11 connectors used by phones, but the same shape.

Network Providers

The largest and most important network, the Internet has evolved into a global information superhighway. Think of it as a network made up of millions of smaller networks, each with the ability to operate independently of, or in harmony with, the others. Keeping the Internet operational is no simple task. No one owns or runs it, but it does have an organized network topology. The Internet is a hierarchical structure linking different levels of service providers, whose millions of devices, LANs, WANs, and MANs supply all the interconnections. At the top of the hierarchy are **national service providers (NSPs)**, private companies that own and maintain the worldwide backbone that supports the Internet. These include Sprint, Verizon, MCI (previously UUNet/WorldCom), AT&T, NTT, Level3, Century Link, and Cable & Wireless Worldwide. Network access points (NAPs) are traffic exchange points in the routing hierarchy of the Internet that connects NSPs. They typically have regional or national coverage and connect to only a few NSPs. Thus, to reach a large portion of the global Internet, a NAP needs to route traffic through one of the NSPs to which it is connected.[1]

One step down in the hierarchy is the regional service provider. **Regional service providers (RSPs)** offer Internet service by connecting to NSPs, but they also can connect directly to each other. Another level down is an Internet service provider (ISP), which specializes in providing management, support, and maintenance to a network. ISPs vary services provided and available bandwidth rates. ISPs link to RSPs and, if they are geographically close, to other ISPs. Some also connect directly to NSPs, thereby sidestepping the hierarchy. Individuals and companies use local ISPs to connect to the Internet, and large companies tend to connect directly using an RSP. Major ISPs in the United States include AOL, AT&T, Comcast, Earthlink, and NetZero. The further up the hierarchy, the faster the connections and the greater the bandwidth. The backbone shown in Figure 7.3 is greatly simplified, but it illustrates the concept that basic global interconnections are provided by the NSPs, RSPs and ISPs.[2]

local area network (LAN) Connects a group of computers in proximity, such as in an office building, school, or home.

wide area network (WAN) Spans a large geographic area such as a state, province, or country.

attenuation Represents the loss of a network signal strength measured in decibels (dB) and occurs because the transmissions gradually dissipate in strength over longer distances or because of radio interference or physical obstructions such as walls.

repeater Receives and repeats a signal to extend its attenuation or range.

metropolitan area network (MAN) A large computer network usually spanning a city.

national service providers (NSPs) Private companies that own and maintain the worldwide backbone that supports the Internet.

regional service providers (RSPs) Offer Internet service by connecting to NSPs, but they also can connect directly to each other.

▼ **FIGURE 7.2** Network Categories: LAN, WAN, and MAN

Local Area Network (LAN)
Example : City Library

Metropolitan Area Network (MAN)
Example: University Campus

West Campus   East Campus

Wide Area Network (WAN)
Example: Internet

Sydney, Australia   London, England

Denver, Colorado   Boston, Massachusetts
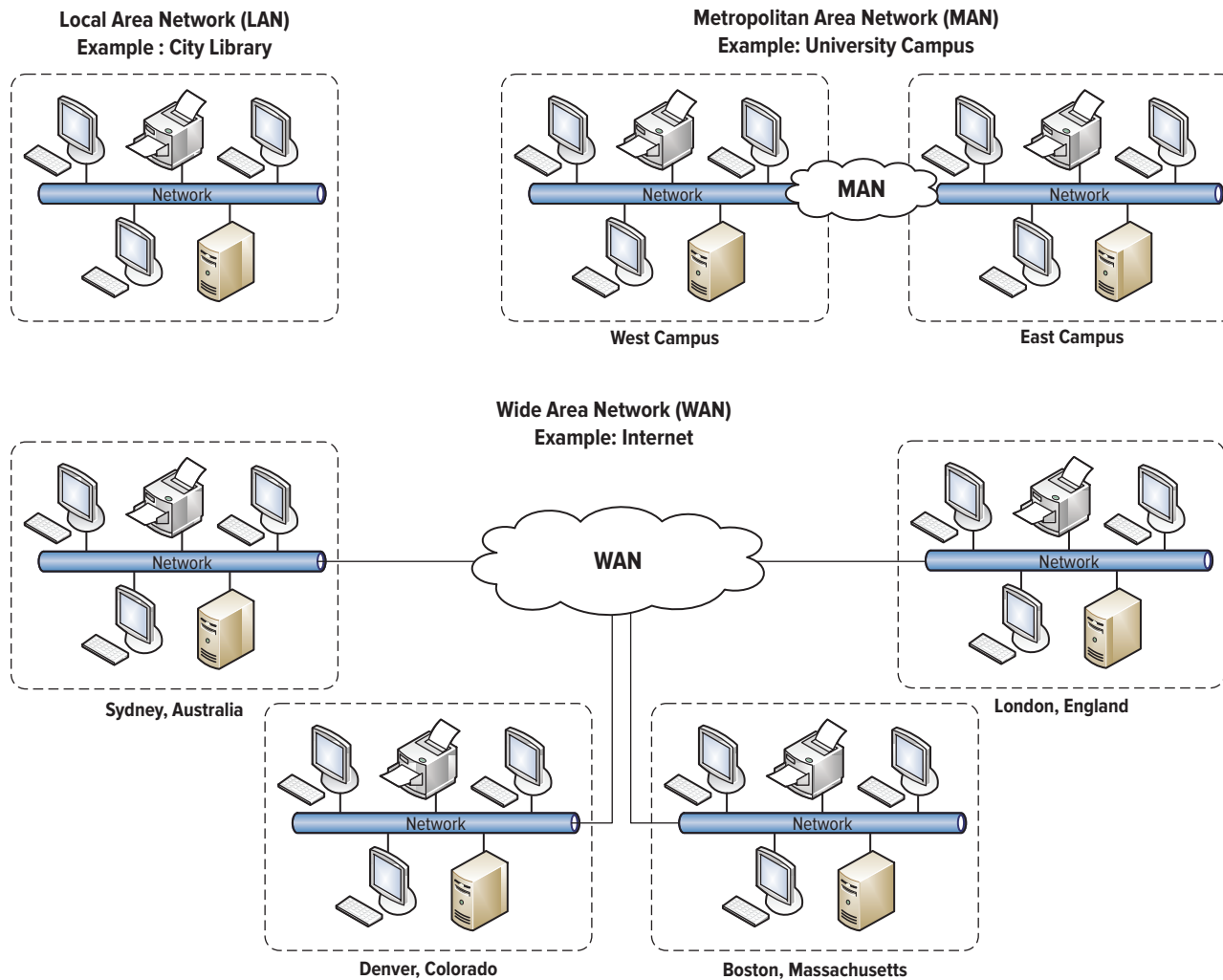
▼ **FIGURE 7.3**
Internet Topology
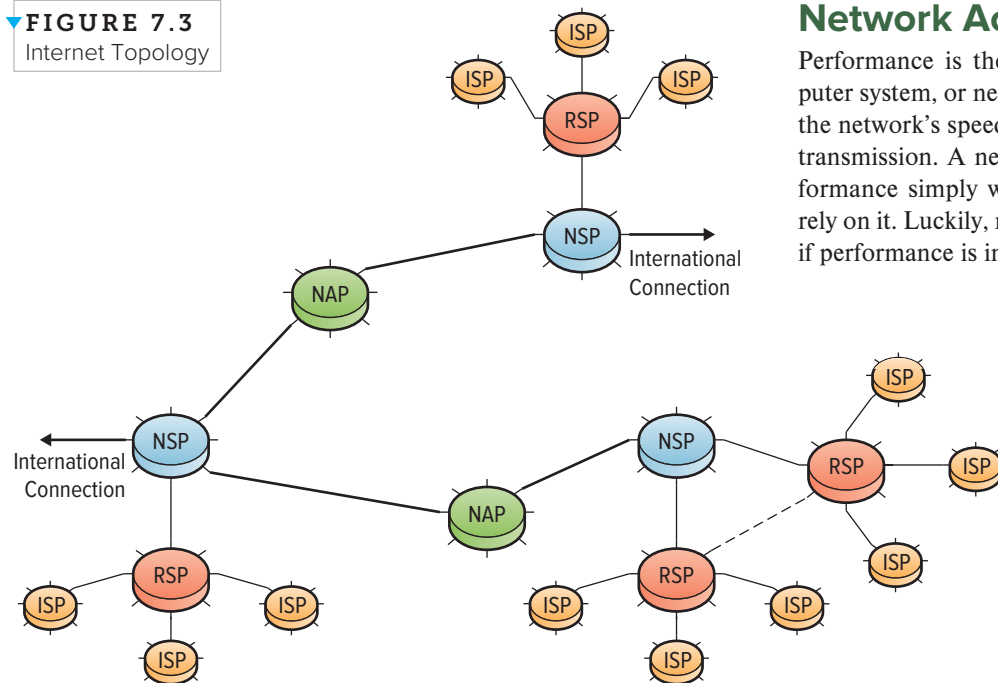
Network Access Technologies

Performance is the ultimate goal of any computer, computer system, or network. Performance is directly related to the network's speed of data transfer and capacity to handle transmission. A network that does not offer adequate performance simply will not get the job done for those who rely on it. Luckily, networks can be upgraded and expanded if performance is inadequate.

We measure network performance in terms of **bandwidth**, the maximum amount of data that can pass from one point to another in a unit of time. Bandwidth is similar to water traveling through a hose. If the hose is large, water can flow through it quickly. Data differs from a hose in that it must travel great distances, especially on a WAN, and not all areas of the network have the same bandwidth.

▼**FIGURE 7.4** Bandwidth Speeds

Bandwidth	Abbreviation	Bits per Second (bps)	Example
Kilobits	Kbps	1 Kbps = 1,000 bps	Traditional modem = 56 Kbps
Megabits	Mbps	1 Mbps = 1,000 Kbps	Traditional Ethernet = 10 Mbps
			Fast Ethernet = 100 Mbps
Gigabits	Gbps	1 Gbps = 1,000 Mbps	Gigabit Ethernet = 1,000 Mbps

A network essentially has many different hoses of unequal capacity connected together, which will restrict the flow of data when one is smaller than the others. Therefore, the speed of transmission of a network is determined by the speed of its smallest bandwidth.

A **bit** (short for binary digit) is the smallest element of data and has a value of either 0 or 1. Bandwidth is measured in terms of **bit rate** (or data rate), the number of bits transferred or received per unit of time. Figure 7.4 represents bandwidth speeds in terms of bit rates. Bandwidth is typically given in bits per second (abbreviated as bps) and bytes per second (abbreviated as Bps). It is important to note that these two terms are not interchangeable.

A **modem** is a device that enables a computer to transmit and receive data. A connection with a traditional telephone line and a modem, which most residential users had in the 1990s, is called dial-up access. Today, many users in underdeveloped countries and in rural areas in developed countries still use dial-up. It has two drawbacks. First, it is slow, providing a maximum rate of 56 Kbps. (At 56 Kbps, it takes eight minutes to download a three-minute song and more than a day to download a two-hour movie.) Second, dial-up modem access ties up the telephone line so the user cannot receive and make phone calls while online. The good news is this is not as big an issue as it once was as many people have cell phones and no longer require using the telephone line for making phone calls.[3]

Once the most common connection method worldwide, dialup is quickly being replaced by broadband. **Broadband** is a high-speed Internet connection that is always connected. High-speed in this case refers to any bandwidth greater than 2 Mbps. Not long ago, broadband speeds were available only at a premium price to support large companies' high-traffic networks. Today, inexpensive access is available for home use and small companies.

The two most prevalent types of broadband access are digital subscriber lines and high-speed Internet cable connections. **Digital subscriber line (DSL)** provides high-speed digital data transmission over standard telephone lines using broadband modem technology, allowing both Internet and telephone services to work over the same phone lines. Consumers typically obtain DSL Internet access from the same company that provides their wired local telephone access, such as AT&T or Century Link. Thus, a customer's telephone provider is also its ISP,

and the telephone line carries both data and telephone signals using a DSL modem. DSL Internet services are used primarily in homes and small businesses.

DSL has two major advantages over dial-up. First, it can transmit and receive data much faster—in the 1 to 2 Mbps range for downloading and 128 Kbps to 1 Mbps for uploading. (Most high-speed connections are designed to download faster than they upload, because most users download more—including viewing web pages—than they upload.) The second major advantage is that because they have an "always on" connection to their ISP, users can simultaneously talk on the phone and access the Internet. DSL's disadvantages are that it works over a limited physical distance and remains unavailable in many areas where the local telephone infrastructure does not support DSL technology.[4]

While dial-up and DSL use local telephone infrastructure, **high-speed Internet cable connections** provide Internet access using a cable television company's infrastructure and a special cable modem. A **cable modem (or broadband modem)** is a type of digital modem used with high-speed cable Internet service. Cable modems connect a home computer (or network of home computers) to residential cable TV service, while DSL modems connect to residential public telephone service. The ISP typically supplies the cable and DSL modems. Cisco Systems is one of the largest companies producing computer networking products and services, including the Linksys brand of networking components. Typically, broadband or high-speed Internet service has an average

bandwidth The maximum amount of data that can pass from one point to another in a unit of time.

bit The smallest element of data and has a value of either 0 or 1.

bit rate The number of bits transferred or received per unit of time.

modem A device that enables a computer to transmit and receive data.

broadband A high-speed Internet connection that is always connected.

digital subscriber line (DSL) Provides high-speed digital data transmission over standard telephone lines using broadband modem technology allowing both Internet and telephone services to work over the same phone lines.

high-speed Internet cable connection Provides Internet access using a cable television company's infrastructure and a special cable modem.

cable modem (or broadband modem) A type of digital modem used with high-speed cable Internet service.

telecommuting (virtual workforce) Allows users to work from remote locations such as a home or hotel, using high-speed Internet to access business applications and data.

broadband over power line (BPL) Technology makes possible high-speed Internet access over ordinary residential electrical lines and offers an alternative to DSL or high-speed cable modems.

packet A single unit of binary data routed through a network.

standard packet format Includes a packet header, packet body containing the original message, and packet footer.

packet header Lists the destination (for example, in IP packets the destination is the IP address) along with the length of the message data.

packet footer Represents the end of the packet or transmission end.

transfer rate 10 times faster than conventional dial-up service. **Telecommuting (virtual workforce)** allows users to work from remote locations, such as home or a hotel, using high-speed Internet to access business applications and data.

Unlike DSL, high-speed Internet cable is a shared service, which means everyone in a certain radius, such as a neighborhood, shares the available bandwidth. Therefore, if several users are simultaneously downloading a video file, the actual transfer rate for each will be significantly lower than if only one person were doing so. On average, the available bandwidth using cable can range from 512 Kbps to 50 Mbps for downloading and 786 Kbps for uploading.[5]

Another alternative to DSL or high-speed Internet cable is dedicated communications lines leased from AT&T or another provider. The most common are T1 lines, a type of data connection able to transmit a digital signal at 1.544 Mpbs. Although this speed might not seem impressive, and T1 lines are more expensive than DSL or cable, they offer far greater reliability because each is composed of 24 channels, creating 24 separate connections through one line. If a company has three separate plants that experience a high volume of data traffic, it might make sense to lease lines for reliability of service.[6]

A company must match its needs with Internet access methods. If it always needs high bandwidth access to communicate with customers, partners, or suppliers, a T1 line may be the most cost-effective method. Figure 7.5 provides an overview of the main methods for Internet access. The bandwidths in the figure represent average speeds; actual speeds vary depending upon the service provider and other factors such as the type of cabling and speed of the computer.[7]

Broadband over power line (BPL) technology makes possible high-speed Internet access over ordinary residential electrical lines and offers an alternative to DSL or high-speed cable modems. BPL works by transmitting data over electrical lines using signaling frequencies higher than the electrical (or voice in the case of DSL) signals. BPL allows computer data to be sent back and forth across the network with no disruption to power output in the home. Many homeowners are surprised to learn that their electrical system can serve as a home network running speeds between 1 and 3 Mbps with full Internet access. Unfortunately, limitations such as interference and availability have affected BPL's popularity.

Network Protocols

A **packet** is a single unit of binary data routed through a network. Packets directly impact network performance and reliability by subdividing an electronic message into smaller, more manageable packets. **Standard packet formats** include a packet header, packet body containing the original message, and packet footer. The **packet header** lists the destination (for example, in IP packets the destination is the IP address) along with the length of the message data. The **packet footer** represents the end of the packet or transmission end. The packet header and packet footer contain error-checking information to ensure the entire message is sent and received. The receiving device reassembles the individual packets into the original by stripping off the headers and footers and then piecing together

▼**FIGURE 7.5** Types of Internet Access

Access Technology	Description	Bandwidth	Comments
Dial-up	On-demand access using a modem and regular telephone line.	Up to 56 Kbps	Cheap but slow compared with other technologies.
DSL	Always-on connection. Special modem needed.	Download: 1 Mbps to 2 Mbps Upload: 128 Kbps to 1 Mbps	Makes use of the existing local telephone infrastructure.
Cable	Always-on connection. Special cable modem and cable line required.	Download: 512 Kbps to 50 Mbps Upload: 786 Kbps	It is a shared resource with other users in the area.
T1	Leased lines for high bandwidth.	1.544 Mbps	More expensive than dial-up, DSL, or cable.

the packets in the correct sequence. **Traceroute** is a utility application that monitors the network path of packet data sent to a remote computer. Traceroute programs send a series of test messages over the network (using the name or IP address) until the last message finally reaches its destination. When finished, traceroute displays the path from the initial computer to the destination computer. A **proxy** is software that prevents direct communication between a sending and receiving computer and is used to monitor packets for security reasons.

A **protocol** is a standard that specifies the format of data as well as the rules to be followed during transmission. Computers using the same protocol can communicate easily, providing accessibility, scalability, and connectability between networks. **File transfer protocol (FTP)** is a simple network protocol that allows the transfer of files between two computers on the Internet. To transfer files with FTP, the FTP client program initiates a connection to a remote computer running FTP "server" software. After completing the connection the client can choose to send and/or receive files electronically. Network access technologies use a standard Internet protocol called **transmission control protocol/Internet protocol (TCP/IP)**, which provides the technical foundation for the public Internet as well as for large numbers of private networks. One of the primary reasons for developing TCP/IP was to allow diverse or differing networks to connect and communicate with each other, essentially allowing LANs, WANs, and MANs to grow with each new connection. An **IP address** is a unique number that identifies where computers are located on the network. IP addresses appear in the form of xxx.xxx.xxx.xxx, though each grouping can be as short as a single digit.

TCP (the TCP part of TCP/IP) verifies the correct delivery of data because data can become corrupt when traveling over a network. TCP ensures the size of the data packet is the same throughout its transmission and can even retransmit data until delivered correctly. IP (the IP part of TCP/IP) verifies the data are sent to the correct IP address, numbers represented by four strings of numbers ranging from 0 to 255 separated by periods. For example, the IP address of www.apple.com is 97.17.237.15.

Here is another way to understand TCP/IP. Consider a letter that needs to go from the University of Denver to Apple's headquarters in Cupertino, California. TCP makes sure the envelope is delivered and does not get lost along the way. IP acts as the sending and receiving labels, telling the letter carrier where to deliver the envelope and whom it was from. The Postal Service mainly uses street addresses and zip codes to get letters to their destinations, which is really what IP does with its addressing method. Figure 7.6 illustrates this example. However, unlike the Postal Service, which allows multiple people to share the same physical address, each device using an IP address to connect to the Internet must have a unique address or else it could not detect which individual device a request should be sent to.

One of the most valuable characteristics of TCP/IP is how scalable its protocols have proven to be as the Internet has grown from a small network with just a few machines to a huge internetwork with millions of devices. While some changes have been required periodically to support this growth, the core of TCP/IP is the same as it was more than 25 years ago.[8] **Dynamic host configuration protocol (DHCP)** allows dynamic IP address allocation so users do not have to have a preconfigured IP address to use the network. DHCP allows a computer to access and locate information about a computer on the server, enabling users to locate and renew their IP address. ISPs usually use DHCP to allow customers to join the Internet with minimum effort. DHCP assigns unique IP addresses to devices, then releases and renews these addresses as devices leave and return to the network.

▼ **FIGURE 7.6** Example of TCP/IP
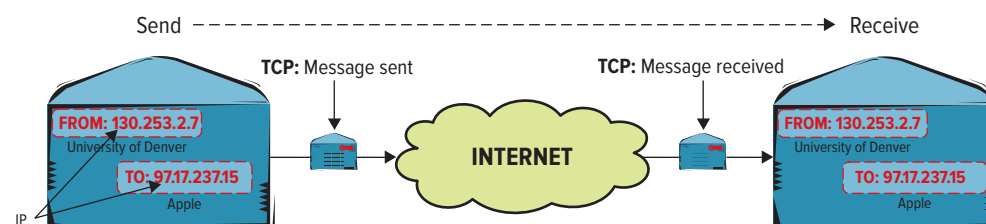
domain name system (DNS)
Converts IP address into domains, or identifying labels that use a variety of recognizable naming conventions.

FIGURE 7.7 Internet Domains

Domain Name		Use
.biz	------➤	Reserved for businesses
.com	------➤	Reserved for commercial organizations and businesses
.edu	------➤	Reserved for accredited postsecondary institutions
.gov	------➤	Reserved for U.S. government agencies
.info	------➤	Open to any person or entity, but intended for information providers
.mil	------➤	Reserved for U.S. military
.net	------➤	Open to any person or entity
.org	------➤	Reserved for nonprofit organizations

If there is one flaw in TCP/IP, it is the complexity of IP addresses. This is why we use a **domain name system (DNS)** to convert IP addresses into *domains,* or identifying labels that use a variety of recognizable naming conventions. Therefore, instead of trying to remember 97.17.237.15, users can simply specify a domain name to access a computer or website, such as www.apple.com. Figure 7.7 lists the most common Internet domains.[10]

The list of domain names is expected to expand in the coming years to include entities such as .pro (for accountants, lawyers, and physicians), .aero (for the air-transport industry), and .museum (for museums). The creation of an .xxx domain was recently approved for pornographic content. Countries also have domain names such as .au (Australia), .fr (France), and .sp (Spain).

Websites with heavy traffic often have several computers working together to share the load of requests. This offers load balancing and fault tolerance, so when requests are made to a popular site such as www.facebook.com, they will not overload a single computer and the site does not go down if one computer fails. A single computer can also have several host names—for instance, if a company is hosting several websites on a single server, much as an ISP works with hosting.

Domain names are essentially rented, with renewable rights, from a domain name registrar, such as godaddy.com. Some registrars only register domain names, while others provide hosting services for a fee. ICANN (Internet Corporation for Assigning Names and Numbers) is a nonprofit governance and standards organization that certifies all domain name registrars throughout

BUSTED Never Run with Your iPod[9]

Jennifer Goebel, a 27-year-old female, was disqualified from her first place spot in the Lakefront Marathon in Milwaukee after race officials spotted her using an iPod. Officials nullified Goebel's first place time of 3:02:50 because of a controversial 2007 rule put into place banning headphones or portable music devices by U.S. Track and Field (USTAF), the governing body for running events. Race officials only decided to take action after viewing online photos of Goebel using her iPod during the last part of the race. The interesting part of this story— Goeble posted the photos herself on her website. USTAF claims the ban is required because music could give some runners a competitive advantage, as well as safety

©JGI/Jamie Grill/Getty Images

concerns when runners can't hear race announcements.

Do you agree with the USTAF's decision to disqualify Jennifer Goebel? How could an iPod give a runner a competitive advantage? With so many wireless devices entering the market, it is almost impossible to keep up with the surrounding laws. Do you think Goebel was aware of the headphone ban? In your state, what are the rules for using wireless devices while driving? Do you agree with these rules? How does a business keep up with the numerous, ever-changing rules surrounding wireless devices? What could happen to a company that fails to understand the laws surrounding wireless devices?

the world. With the certification, each registrar is authorized to register domain names, such as .com, .edu, or .org.[11]

Network Convergence

In part due to the explosive use of the Internet and connectivity of TCP/IP, there is a convergence of network devices, applications, and services. Consumers, companies, educational institutions, and government agencies extensively engage in texting, web surfing, videoconference applications, online gaming, and ebusiness. **Network convergence** is the efficient coexistence of telephone, video, and data communication within a single network, offering convenience and flexibility not possible with separate infrastructures. Almost any type of information can be converted into digital form and exchanged over a network. Network convergence then allows the weaving together of voice, data, and video. The benefits of network convergence allow for multiple services, multiple devices, but one network, one vendor, and one bill, as suggested by Figure 7.8.

One of the challenges associated with network convergence is using the many different tools efficiently and productively. Knowing which communication channel—PC, text message, videoconference—to use with each business participant can be a challenge. **Unified communications (UC)** is the integration of communication channels into a single service. UC integrates communication channels allowing participants to communicate using the method that is most convenient for them. UC merges instant messaging, videoconferencing, email, voice mail, and VoIP. This can decrease the communication costs for a business while enhancing the way individuals communicate and collaborate.

One area experiencing huge growth in network convergence is the use of the Internet for voice transmission. **Voice over IP (VoIP)** uses IP technology to transmit telephone calls. For the first time in more than 100 years, VoIP is providing an opportunity to bring about significant change in the way people communicate using the telephone. VoIP service providers—specialists as well as traditional telephone and cable companies and some ISPs—allow users to call anyone with a telephone number, whether local, long distance, cellular, or international.

Two ways to use VoIP for telephone calls are through a web interface that allows users to make calls from their computer and through a phone attached to a VoIP adapter that links directly to the Internet through a broadband modem. Figure 7.9 illustrates these two ways along with the use of VoIP-enabled phones, bypassing the need for an adapter.

VoIP services include fixed-price unlimited local and long-distance calling plans (at least within the United States and Canada), plus a range of interesting features, such as:

- The ability to have more than one phone number, including numbers with different area codes.

- Integrating email and voice mail so users can listen to their voice mail using their computer.

- The ability to receive personal or business calls via computer, no matter where the user is physically located.[12]

network convergence The efficient coexistence of telephone, video, and data communication within a single network, offering convenience and flexibility not possible with separate infrastructures.

unified communications (UC) The integration of communication channels into a single service.

voice over IP (VoIP) Uses IP technology to transmit telephone calls.

▼ **FIGURE 7.8** The Benefits of Network Convergence

Network Convergence

Multiple Services
- Internet Access
- VoIP
- IPTV

One Provider
- One bill
- One point of contact
- One customer support center
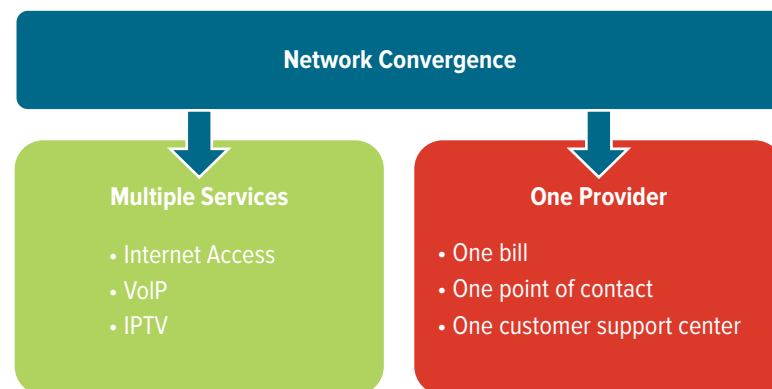
▼ **FIGURE 7.9** VoIP Connectivity

PC · Broadband Modem · VoIP Phone · INTERNET · Broadband Modem · VoIP Phone Adaptor · PC · Standard Phone
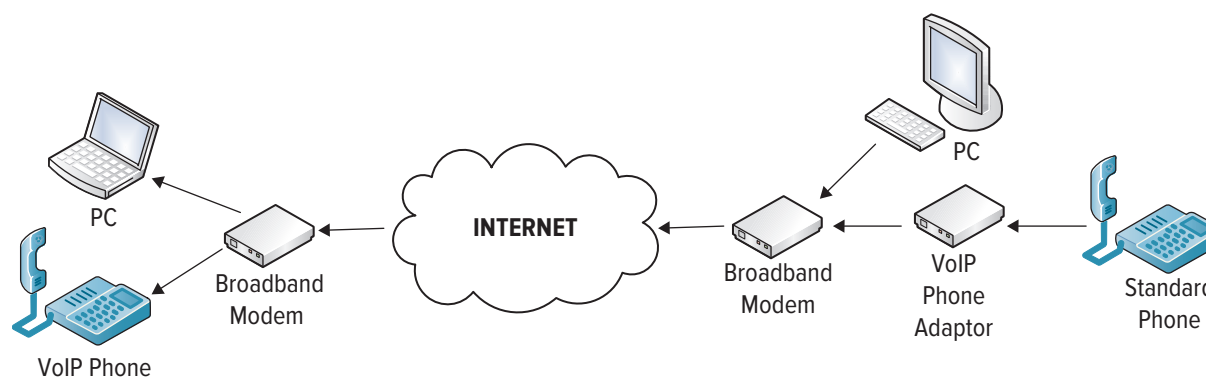
peer-to-peer (P2P) network A computer network that relies on the computing power and bandwidth of the participants in the network rather than a centralized server.

Internet protocol TV (IPTV) Distributes digital video content using IP across the Internet and private IP networks.

The biggest benefit of VoIP is its low cost. Because it relies on the Internet connection, however, service can be affected if the bandwidth is not appropriate or Internet access is not available.

Skype is a perfect example of IP applied to telephone use. Unlike typical VoIP systems that use a client and server infrastructure, Skype uses a peer-to-peer network. **Peer-to-peer network (P2P)** is a computer network that relies on the computing power and bandwidth of the participants in the network rather than a centralized server. Skype's user directory is distributed among the users in its network, allowing scalability without a complex and expensive centralized infrastructure. Peer-to-peer networks became an overnight sensation years ago through a service called Napster that distributed digital music illegally. Skype has found a way to use this resource to provide value to its users.[13]

As the popularity of VoIP grows, governments are becoming more interested in regulating it as they do traditional telephone services. In the United States, the Federal Communications Commission requires compliance among VoIP service providers comparable to those for traditional telephone providers such as support for local number portability, services for the disabled, and law enforcement for surveillance, along with regulatory and other fees.

An exciting and new convergence is occurring in the area of television with **Internet Protocol TV (IPTV)**, which distributes digital video content using IP across the Internet and private IP networks. Comcast provides an example of a private IP network that also acts as a cable TV provider. Traditional television sends all program signals simultaneously to the television, allowing the user to select the program by selecting a channel. With IPTV, the user selects a channel and the service provider sends only that single program to the television. Like cable TV, IPTV uses a box that acts like a modem to send and receive the content (see Figure 7.10). A few IPTV features include:

- Support of multiple devices: PCs and televisions can access IPTV services.
- Interactivity with users: Interactive applications and programs are supported by IPTV's two-way communication path.
- Low bandwidth: IPTV conserves bandwidth because the provider sends only a single channel.
- Personalization: Users can choose not only what they want to watch, but also when they want to watch it.[14]

show me *the* MONEY

Net Neutrality

Net neutrality—the great debate has been raging for some time now, with the battle lines clearly drawn. *Net neutrality* is about ensuring that everyone has equal access to the Internet. It is the founding principle that all consumers should be able to use the Internet and be free to access its resources without any form of discrimination.

On one side of the debate are the ISPs, such as Comcast, that are building the Internet infrastructure and want to charge customers relative to their use, namely, the amount of bandwidth they consume. The ISPs argue that more and more users accessing bandwidth-intense resources provided by the likes of YouTube and Netflix place huge demands on their networks. They want Internet access to move from a flat-rate pricing structure to a metered service.

On the other hand, content providers, such as Google, support the counterargument that if ISPs move toward metered schemes, this may limit the usage of many resources on the Internet such as iTunes and Netflix. A metered service may also stifle the innovative opportunities the open Internet provides.

The U.S. Court of Appeals for the District of Columbia Circuit struck down the Federal Communications Commission's net neutrality rules, which would have required Internet service providers to treat all Web traffic equally. The ruling will allow ISPs to charge companies such as Netflix and Amazon fees for faster content delivery.

Do you agree that the government should control the Internet? Should website owners be legally forced to receive or transmit information from competitors or other websites they find objectionable? Provide examples of when net neutrality might be good for a business and when net neutrality might be bad for a business. Overall, is net neutrality good or bad for business?[15]

▼**FIGURE 7.10** IPTV Components

World TV Broadcasts

INTERNET

IPTV Set-Top Box

HDTV

IPTV Service Provider
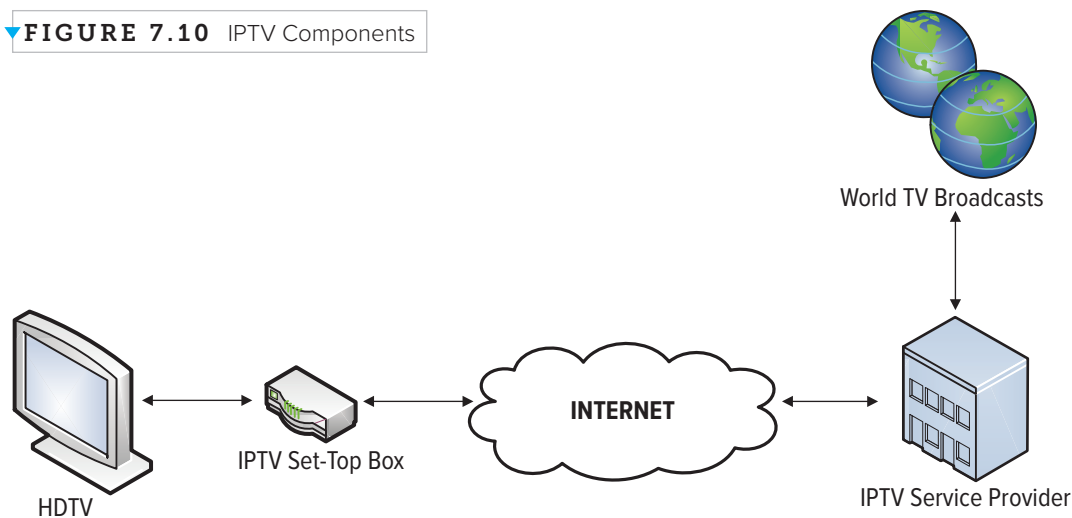
intranet A restricted network that relies on Internet technologies to provide an Internet-like environment within the company for information sharing, communications, collaboration, web publishing, and the support of business process.

BENEFITS AND CHALLENGES OF A CONNECTED WORLD LO7.2

Before networks, transferring data between computers was time-consuming and labor-intensive. People had to physically copy data from machine to machine using a disk.

LO7.2 Identify the benefits and challenges of a connected world.

Resource sharing makes all applications, equipment (such as a high-volume printer), and data available to anyone on the network, without regard to the physical location of the resource or the user. Sharing physical resources also supports a sustainable MIS infrastructure, allowing companies to be agile, efficient, and responsible at the same time. Cloud computing (see Chapter 5) and virtualization consolidate information as well as systems that enhance the use of shared resources. By using shared resources, cloud computing and virtualization allow for collective computing power, storage, and software, in an on-demand basis.

Perhaps even more important than sharing physical resources is sharing data. Most companies, regardless of size, depend not just on their customer records, inventories, accounts

receivable, financial statements, and tax information, but also on their ability to share these, especially with operations in remote locations. Networking with a LAN, WAN, or MAN allows employees to share data quickly and easily and to use applications such as databases and collaboration tools that rely on sharing. By sharing data, networks have made business processes more efficient. For example, as soon as an order is placed, anyone in the company who needs to view it—whether in marketing, purchasing, manufacturing, shipping, or billing—can do so.

Intranets and extranets let firms share their corporate information securely. An **intranet** is a restricted network that relies on Internet technologies to provide an Internet-like environment within the company for information sharing, communications, collaboration, web publishing, and the support of business processes, as suggested in Figure 7.11. This network is protected by security measures such as passwords, encryption, and firewalls,

▼**FIGURE 7.11** Intranet Uses

Intranets

Business Operations and Management

Example: Developing custom applications like order processing, inventory control, and sales management. Employees within the company can access and run such applications using web browsers from anywhere on the network whenever needed.

Communications and Collaboration

Example: Using a browser to send and receive email, voice mail, documents, and web pages to communicate with others within the organization, as well as externally through the Internet.

Web Publishing

Example: Newsletters, technical documentations, and product catalogs can be published in a variety of ways, including web pages, email, and as part of organizational business applications.

extranet An extension of an intranet that is only available to authorized outsiders, such as customers, partners, and suppliers.

virtual private network (VPN) Companies can establish direct private network links among themselves or create private, secure Internet access, in effect a "private tunnel" within the Internet.

▼ **FIGURE 7.12** Using a VPN

and thus only authorized users can access it. Intranets provide a central location for all kinds of company-related information such as benefits, schedules, strategic directions, and employee directories.[17]
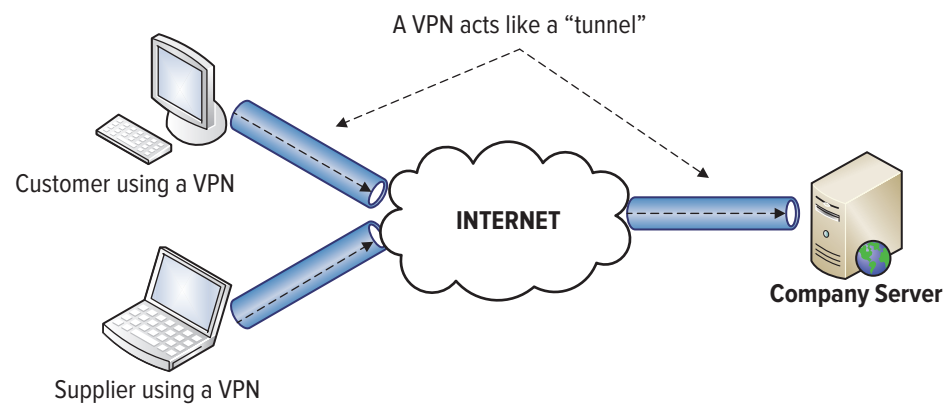
An **extranet** is an extension of an intranet that is available only to authorized outsiders, such as customers, partners, and suppliers. Having a common area where these parties can share information with employees about, for instance, order and invoice processing can be a major competitive advantage in product development, cost control, marketing, distribution, and supplier relations. Companies can establish direct private network links among themselves or create private, secure Internet access, in effect a "private tunnel" within the Internet, called a **virtual private network (VPN)**. Figure 7.12 illustrates using a VPN to connect to a corporate server.

fyi

Music in the Clouds[16]

Years ago, if you wanted to save music to your computer, you were required to have an enormous hard drive, which was rather expensive. Today, you can listen to music in the cloud. Of course, we do not mean real clouds, but the term *cloud* is now used as a metaphor for the Internet. Most songs exist somewhere in the cloud, and websites such as YouTube, Pandora, or HypeMachine are all services allowing you to listen to streaming music without saving a single song to your own device. Wherever those elusive songs actually live—somewhere in the cloud—you can play, collect, and share them without downloading a single thing. Five sites you can use to access music in the cloud include:

- **Fizy:** A Turkish site compiles audio from around the net into a database from which you can create your own playlists.
- **Muziic:** Developed by high school student David Nelson with help from his dad. This upstart accesses the songs on YouTube via an iTunes interface.

- **Songza:** Songza wraps the music of Imeem and YouTube in a sweet, simple web interface.
- **Spotify:** A P2P streaming architecture lets users in supported countries create collections from a massive in-house music archive.
- **Twones:** Twones allows you to download software for playback and tracks user activity on multiple online service and offline players through a single web interface.

The world of online music is a dream come true for most music lovers because you can listen to any song your heart desires with a quick Google search. What role do copyright laws play in the world of online music? If you were to start an online music business, what types of technologies would you use? Where is the future of online music headed? What are the risks associated with the online music business? If you were just starting a band, where would you post your music to gain the most exposure? What would be the risks of posting your band's music online?
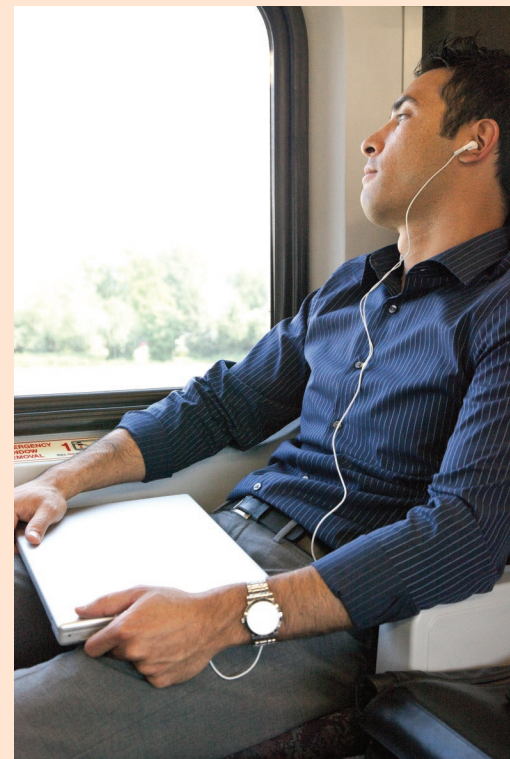
©ML Harris/Getty Images

Extranets enable customers, suppliers, consultants, subcontractors, business prospects, and others to access selected intranet websites and other company network resources that allow the sharing of information. Consultants and contractors can facilitate the design of new products or services. Suppliers can ensure that the raw materials necessary for the company to function are in stock and can be delivered in a timely fashion. Customers can access ordering and payment functions and check order status. The extranet links the company to the outside world in a way that improves its operations.

Extranets provide business value in several ways. First, by relying on web browsers they make customer and supplier access to company resources easy and fast. Second, they enable a company to customize interactive web-enabled services for the intended audience, to build and strengthen strategic relationships with customers and suppliers. Finally, extranets can allow and improve collaboration with customers and other business partners.

Networks have created a diverse, yet globally connected world. By eliminating time and distance, networks make it possible to communicate in ways not previously imaginable. Even though networks provide many business advantages, they also create increased challenges in (1) security and (2) social, ethical, and political issues.

Security

Networks are a tempting target for mischief and fraud. A company first has to ensure proper identification of users and authorization of network access. Outside suppliers might be allowed to access production plans via the company's extranet, for example, but they must not be able to see other information such as financial records. The company should also preserve the integrity of its data; only qualified users should be allowed to change and update data, and only well-specified data. Security problems intensify on the Internet where companies need to guard against fraud, invalid purchases, and misappropriation of credit card information.

Two methods for encrypting network traffic on the web are secure sockets layer and secure hypertext transfer protocol. **Secure sockets layer (SSL)** is a standard security technology for establishing an encrypted link between a web server and a browser, ensuring that all data passed between them remain private. Millions of websites use SSL to protect their online transactions with their customers.

To create an SSL connection, a web server requires an **SSL Certificate**, an electronic document that confirms the identity of a website or server and verifies that a public key belongs to a trustworthy individual or company. (Public key is described in Chapter 4.) Typically, an SSL Certificate will contain a domain name, the company name and address, and the expiration date of the certificate and other details. Verisign is the leading Internet Certification Authority that issues SSL Certificates. When a browser connects to a secure site, it retrieves the site's SSL Certificate, makes sure it has not expired, and confirms a Certification Authority has issued it. If the certificate fails on any one of these validation measures, the browser will display a warning to the end user that the site is not secure. If a website is using SSL, a lock icon appears in the lower right-hand corner of the user's web browser.

Secure hypertext transfer protocol (SHTTP or HTTPS) is a combination of HTTP and SSL to provide encryption and

secure sockets layer (SSL) A standard security technology for establishing an encrypted link between a web server and a browser, ensuring that all data passed between them remains private.

SSL Certificate An electronic document that confirms the identity of a website or server and verifies that a public key belongs to a trustworthy individual or company.

secure hypertext transfer protocol (SHTTP or HTTPS) A combination of HTTP and SSL to provide encryption and secure identification of an Internet server.
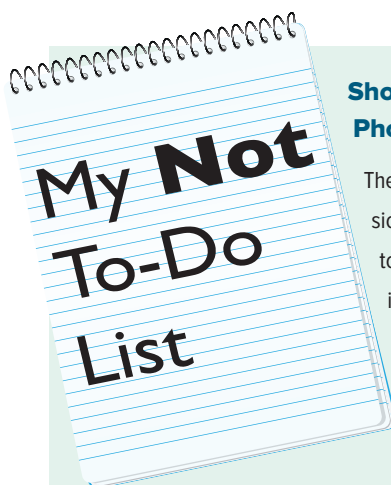
Should Airlines Allow Cell Phones on Flights?[18]

The Federal Communications Commission has proposed allowing passengers to use their mobile wireless devices, including cell phones, while flying above 10,000 feet. Cell phones on airplanes would not be using the traditional cellular networks because they are not designed to operate at 35,000 feet. Rather, calls would be batched and bounced down to the ground through a satellite or specialized air-to-ground cellular system, forcing airlines to charge much more per minute than standard carrier rates.

Supporters say that cell phone use does not interfere with aviation safety and that on foreign airlines where it is permitted, passengers' calls tend to be short and unobtrusive.

Critics argue that allowing voice calls in flight would compromise flight attendants' ability to maintain order in an emergency, increase cabin noise and tension among passengers, and add unacceptable risk to aviation security. They also point out that a majority of the traveling public want the cell phone ban maintained. Do you agree or disagree with the use of cell phones on airlines?

digital divide A worldwide gap giving advantage to those with access to technology.

secure identification of an Internet server. HTTPS protects against interception of communications, transferring credit card information safely and securely with special encryption techniques. When a user enters a web address using *https://* the browser will encrypt the message. However, the server receiving the message must be configured to receive HTTPS messages.

In summary, each company needs to create a network security policy that specifies aspects of data integrity availability and confidentiality or privacy as well as accountability and authorization. With a variety of security methods, such as SSL and SHTTP, a company can protect its most important asset, its data.

Social, Ethical, and Political Issues

Only a small fraction of the world's population has access to the Internet, and some people who have had access in the past have lost it due to changes in their circumstances such as unemployment or poverty. Providing network access to those who want or need it helps to level the playing field and removes the **digital divide**, a worldwide gap giving advantage to those with access to technology. Organizations trying to bridge the divide include the Boston Digital Bridge Foundation, which concentrates on local schoolchildren and their parents, helping to make them knowledgeable about computers, programs, and the Internet. Other organizations provide inexpensive laptops and Internet access in low-income areas in developing countries.[19]

Another social issue with networking occurs with newsgroups or blogs where like-minded people can exchange messages. If the topics are technical in nature or sports related such as cycling, few issues arise. Problems can begin when social media feature topics people can be sensitive about, such as politics, religion, or sex, or when someone posts an offensive message to someone else. Different countries have different and even conflicting laws about Internet use, but because the Internet knows no physical boundaries, communication is hard to regulate, even if anyone could. Some people believe network operators should be responsible for the content they carry, just as newspapers and magazines are. Operators, however, feel that like the post office or phone companies, they cannot be expected to police what users say. If they censored messages, how would they avoid violating users' rights to free speech?

Many employers read and censor employee emails and limit employee access to distracting entertainment such as YouTube and social networks such as Facebook. Spending company time "playing" is not a good use of resources, they believe.

Social issues can even affect the government and its use of networks to snoop on citizens. The FBI has installed a system at many ISPs to scan all incoming and outgoing email for nuggets of interest. The system was originally called Carnivore but bad publicity caused it to be renamed DCS1000. While the name is much more generic, its goal is the same—locate information on illegal activities by spying on millions of people. A common conception associated with networking technologies is "Big Brother is watching!" People are wary of how much information is available on the Internet and how easily it can fall into the wrong hands.[20]

{SECTION 7.2}
Mobility: The Business Value of a Wireless World

LEARNING OUTCOMES

LO7.3 Describe the different wireless network categories.

LO7.4 Explain the different wireless network business applications.

Due Diligence //:
Teddy the Guardian

Two London-based entrepreneurs are building an Internet of huggable things for sick children to make any hospital visit more like a trip to Disneyland. Teddy the Guardian captures heart rate, temperatures, and blood-oxygen levels when a child grabs it by the paw to give it a cuddle. All measurements are sent wirelessly to nurses and parents, mobile devices. The new cute, cuddly teddy bear is packed full of sensors designed to track children's vital signs and help quickly find out potential issues. Teddy the Guardian takes from 5 to 7 seconds to record measurements and is programmed to run five times per hour. Future versions of Teddy the Guardian will be interactive, using machine learning to find out the child's favorite song or bedtime story and then play the related content for a more soothing hospital visit. Big pharmaceutical companies in the United States have already placed over $500,000 in orders and plan to donate the bears to hospitals and clinics.

This is clearly a brilliant idea, and soon we will see Teddy the Guardian in many local hospitals and clinics. Can you identify any additional markets where Teddy the Guardian should focus? Can you think of any ethical issues related to huggable things? Can you think of any security issues related to huggable things?

personal area network (PAN) Provide communication over a short distance that is intended for use with devices that are owned and operated by a single user.

bluetooth Wireless PAN technology that transmits signals over short distances between cell phones, computers, and other devices.

wireless LAN (WLAN) A local area network that uses radio signals to transmit and receive data over distances of a few hundred feet.

access point (AP) The computer or network device that serves as an interface between devices and the network.

wireless access point (WAP) Enables devices to connect to a wireless network to communicate with each other.

WIRELESS NETWORKS LO7.3

As far back as 1896, Italian inventor Guglielmo Marconi demonstrated a wireless telegraph, and in 1927, the first radiotelephone system began operating between the United States and Great Britain. Automobile-based mobile telephones were offered in 1947. In 1964, the first communications satellite, Telstar, was launched, and soon after, satellite-relayed telephone service and television broadcasts became available. Wireless networks have exploded since then, and newer technologies are now maturing that allow companies and home users alike to take advantage of both wired and wireless networks.[21]

Before delving into a discussion of wireless networks, we should distinguish between mobile and wireless, terms that are often used synonymously but actually have different meanings. *Mobile* means the technology can travel with the user, for instance, users can download software, email messages, and web pages onto a laptop or other mobile device for portable reading or reference. Information collected while on the road can be synchronized with a PC or company server. *Wireless,* on the other hand, refers to any type of operation accomplished without the use of a hard-wired connection. There are many environments in which the network devices are wireless but not mobile, such as wireless home or office networks with stationary PCs and printers. Some forms of mobility do not require a wireless connection; for instance, a worker can use a wired laptop at home, shut down the laptop, drive to work, and attach the laptop to the company's wired network.

In many networked environments today, users are both wireless and mobile; for example, a mobile user commuting to work on a train can maintain a VoIP call and multiple TCP/IP connections at the same time. Figure 7.13 categorizes wireless networks by type.

**LO7.3** Describe the different wireless network categories.

Personal Area Networks

A **personal area network (PAN)** provides communication for devices owned by a single user that work over a short distance. PANs are used to transfer files, including email, calendar appointments, digital photos, and music. A PAN can provide communication between a wireless headset and a cell phone or between a computer and a wireless mouse or keyboard. Personal area networks generally cover a range of less than 10 meters (about 30 feet). **Bluetooth** is a wireless PAN technology that transmits signals over short distances among cell phones, computers, and other devices. The name is borrowed from Harald Bluetooth, a king in Denmark more than 1,000 years ago. Bluetooth eliminates the need for wires, docking stations, or cradles, as well as all the special attachments that typically accompany personal computing devices. Bluetooth operates at speeds up to 1 Mbps within a range of 33 feet or less. Devices that are Bluetooth-enabled communicate directly with each other in pairs, like a handshake. Up to eight can be paired simultaneously. And Bluetooth is not just for technology devices. An array of Bluetooth-equipped appliances, such as a television set, a stove, and a thermostat, can be controlled from a cell phone—all from a remote location.[22]

Wireless LANs

A **wireless LAN (WLAN)** is a local area network that uses radio signals to transmit and receive data over distances of a few hundred feet. An **access point (AP)** is the computer or network device that serves as an interface between devices and the network. Each computer initially connects to the access point and then to other computers on the network. A **wireless access point (WAP)** enables devices to connect to a wireless network to communicate with

▼ **FIGURE 7.13** Wireless Communication Network Categories
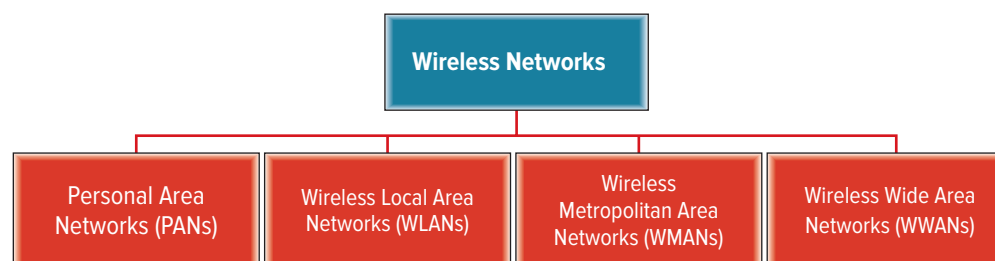
multiple-in/ multiple-out (MIMO) technology Multiple transmitters and receivers allow sending and receiving greater amounts of data than traditional networking devices.

wireless fidelity (Wi-Fi) A means by which portable devices can connect wirelessly to a local area network, using access points that send and receive data via radio waves.

Wi-Fi infrastructure Includes the inner workings of a Wi-Fi service or utility, including the signal transmitters, towers, or poles, along with additional equipment required to send a Wi-Fi signal.

hotspot Designated locations where Wi-Fi access points are publicly available.

Institute of Electrical and Electronics Engineers (IEEE) An organization that researches and institutes electrical standards for communication and other technologies.

IEEE 802.11n (or Wireless-N) The newest standard for wireless networking.

each other. WAPs with **multiple-in/multiple-out (MIMO) technology** have multiple transmitters and receivers, allowing them to send and receive greater amounts of data than traditional networking devices. **Wireless fidelity (Wi-Fi)** is a means by which portable devices can connect wirelessly to a local area network, using access points that send and receive data via radio waves. Wi-Fi has a maximum range of about 1,000 feet in open areas such as a city park and 250 to 400 feet in closed areas such as an office building. **Wi-Fi infrastructure** includes the inner workings of a Wi-Fi service or utility, including the signal transmitters, towers, or poles, along with additional equipment required to send out a Wi-Fi signal. Most WLANs use a Wi-Fi infrastructure in which a wireless device, often a laptop, communicates through an access point or base station by means of, for instance, wireless fidelity.

Areas around access points where users can connect to the Internet are often called hotspots. **Hotspots** are designated locations where Wi-Fi access points are publicly available. Hotspots are found in places such as restaurants, airports, and hotels—places where business professionals tend

to gather. Hotspots are extremely valuable for those business professionals who travel extensively and need access to business applications. By positioning hotspots at strategic locations throughout a building, campus, or city, network administrators can keep Wi-Fi users continuously connected to a network or the Internet, no matter where they roam.[23]

In a Wi-Fi network, the user's laptop or other Wi-Fi-enabled device has a wireless adapter that translates data into a radio signal and transmits it to the wireless access point. The wireless access point, which consists of a transmitter with an antenna that is often built into the hardware, receives the signal and decodes it. The access point then sends the information to the Internet over a wired broadband connection, as illustrated in Figure 7.14. When receiving data, the wireless access point takes the information from the Internet, translates it into a radio signal, and sends it to the computer's wireless adapter. If too many people try to use the Wi-Fi network at one time, they can experience interference or dropped connections. Most laptop computers come with built-in wireless transmitters and software to enable computers to automatically discover the existence of a Wi-Fi network.

Wi-Fi operates at considerably higher frequencies than cell phones use, which allows greater bandwidth. The bandwidths associated with Wi-Fi are separated according to several wireless networking standards, known as 802.11, for carrying out wireless local area network communication. The **Institute of Electrical and Electronics Engineers (IEEE)** researches and institutes electrical standards for communication and other technologies. **IEEE 802.11n (or Wireless-N)** is the newest standard for wireless networking. Compared with earlier standards such as 802.11b, Wireless-N offers faster speeds, more flexibility, and greater range. The organization denotes different versions of the standard—for example, Wireless-G and Wireless-N—by a lowercase letter at the end of this number. Figure 7.15 outlines the bandwidths associated with a few of these standards.[24]

▼**FIGURE 7.14** Wi-Fi Networks

Wireless Network

Access Point

Broadband Modem

INTERNET
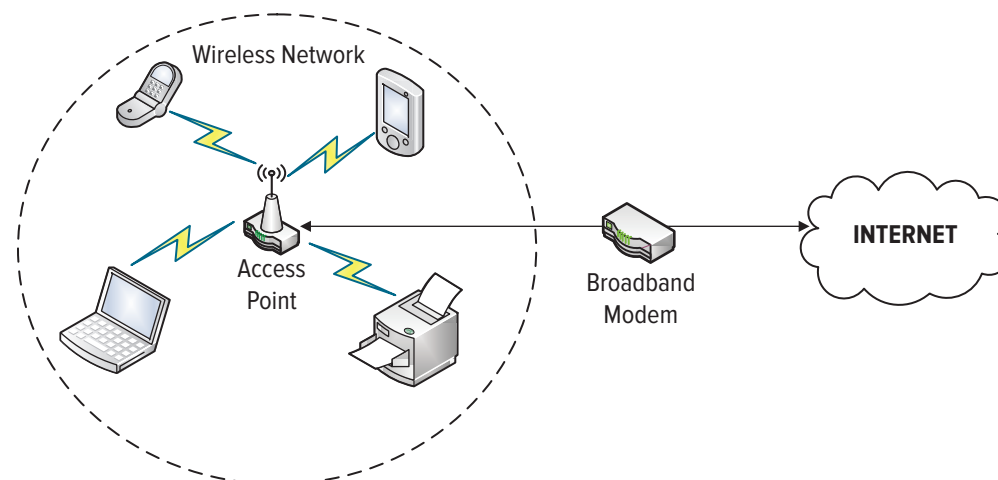
FIGURE 7.15 Wi-Fi Standards and Bandwidths

Wi-Fi Standard	Bandwidth
802.11a	54 Mbps
802.11b	11 Mbps
802.11g	54 Mbps
802.11n	140 Mbps

An increasing number of digital devices, including most laptops, netbooks, tablets such as the iPad, and even printers are incorporating Wi-Fi technology into their design. Cell phones are incorporating Wi-Fi so they can automatically switch from the cell network to a faster Wi-Fi network where available for data communications. BlackBerrys and iPhones can connect to an access point for data communications such as email and web browsing, but not for voice unless they use the services of Skype or another VoIP.

Wireless MANs

A **wireless MAN (WMAN)** is a metropolitan area network that uses radio signals to transmit and receive data. WMAN technologies have not been highly successful to date, mainly because they are not widely available, at least in the United States. One with the potential for success is **Worldwide Interoperability for Microwave Access (WiMAX)**, a communications technology aimed at providing high-speed wireless data over metropolitan area networks. In many respects, WiMAX operates like Wi-Fi, only over greater distances and with higher bandwidths. A WiMAX tower serves as an access point and can connect to the Internet or another tower. A single tower can provide up to 3,000 square miles of coverage, so only a few are needed to cover an entire city. WiMAX can support data communications at a rate of 70 Mbps. In New York City, for example, one or two WiMAX access points around the city might meet the heavy demand more cheaply than hundreds of Wi-Fi access points. WiMAX can also cover remote or rural areas where cabling is limited or nonexistent, and where it is too expensive or physically difficult to install wires for the relatively few users.[25]

WiMAX can provide both line-of-sight and non-line-of-sight service. A non-line-of-sight service uses a small antenna on a mobile device that connects to a WiMAX tower less than six miles away where transmissions are disrupted by physical obstructions. This form of service is similar to Wi-Fi but has much broader coverage area and higher bandwidths. A line-of-sight option offers a fixed antenna that points at the WiMAX tower from a rooftop or pole. This option is much faster than non-line-of-sight service, and the distance between the WiMAX tower and antenna can be as great as 30 miles. Figure 7.16 illustrates the WiMAX infrastructure.[26]

Some cellular companies are evaluating WiMAX as a means of increasing bandwidth for a variety of data-intensive applications such as those used by smartphones. Sprint Nextel and Clearwire are building a nationwide WiMAX network in the United States. WiMAX-capable gaming devices, laptops, cameras, and even cell phones are being manufactured by companies including Intel, Motorola, Nokia, and Samsung.[27]

**wireless MAN (WMAN)** A metropolitan area network that uses radio signals to transmit and receive data.

Worldwide Interoperability for Microwave Access (WiMAX) A communications technology aimed at providing high-speed wireless data over metropolitan area networks.

FIGURE 7.16 WiMAX Infrastructure

INTERNET

ISP

WiMAX Tower

Non-Line-of-Sight Transmission

Line-of-Sight Transmission
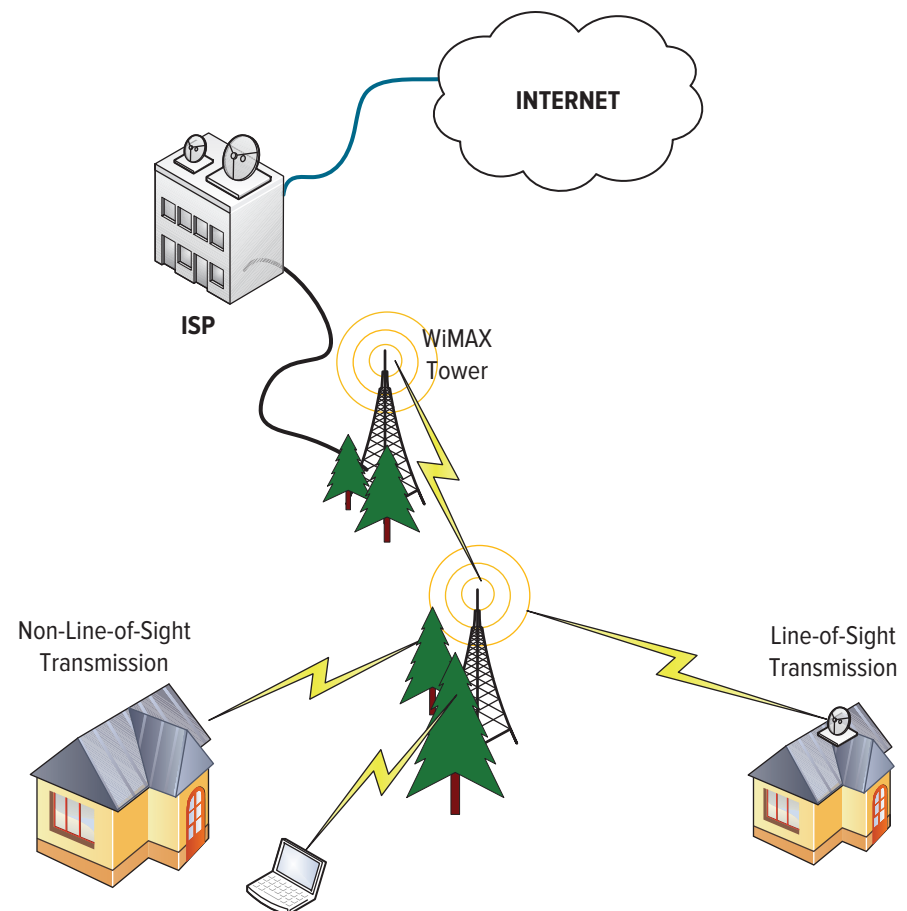
wireless WAN (WWAN) A wide area network that uses radio signals to transmit and receive data.

smartphones Offer more advanced computing ability and connectivity than basic cell phones.

3G A service that brings wireless broadband to mobile phones.

streaming A method of sending audio and video files over the Internet in such a way that the user can view the file while it is being transferred.

Voice over LTE (VoLTE) Allows mobile voice calls to be made over broadband networks, creating—under the right network conditions—clearer audio and fewer dropped calls.

Wireless WAN—Cellular Communication System

A **wireless WAN (WWAN)** is a wide area network that uses radio signals to transmit and receive data. WWAN technologies can be divided into two categories: cellular communication systems and satellite communication systems.

Although mobile communications have been around for generations, including the walkie-talkies of the 1940s and mobile radiophones of the 1950s, it was not until 1983 that cellular telephony became available commercially. A cell phone is a device for voice and data, communicating wirelessly through a collection of stationary ground-based sites called base stations, each of which is linked to its nearest neighbor stations. Base station coverage areas are about 10 square miles and are called cells, as Figure 7.17 illustrates.[28]

The first cell phone was demonstrated in 1973 by Motorola (it weighed almost 2 pounds), but it took 10 years for the technology to become commercially available. The Motorola Dyna-TAC, marketed in 1983, weighed one pound and cost about $4,000. Cellular technology has come a long way since then.[29]

Cellular systems were originally designed to provide voice services to mobile customers and thus were designed to interconnect cells to the public telephone network. Increasingly, they provide data services and Internet connectivity. There are more cell phones than landline phones in many countries today, and it is no longer uncommon for cell phones to be the only phones people have.

Cell phones have morphed into **smartphones** that offer more advanced computing ability and connectivity than basic cell phones. They allow for web browsing, emailing, listening to music, watching video, computing, keeping track of contacts, sending text messages, and taking and sending photos. The Apple iPhone and RIM BlackBerry are examples of smartphones.

Cell phones and smartphones, or mobile phones as they are collectively called, need a provider to offer services, much as computer users need an ISP to connect to the Internet. The most popular mobile phone providers in the United States are

show me *the* MONEY

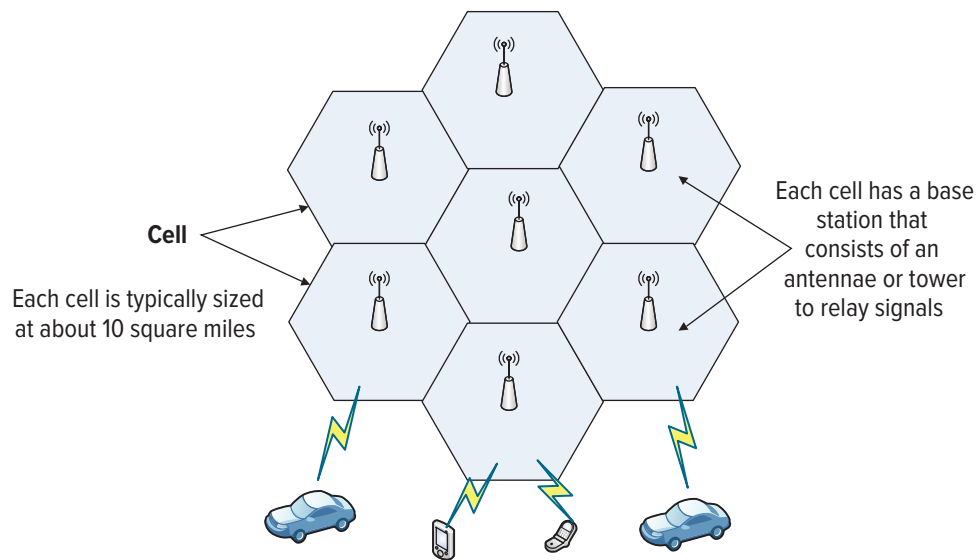**Wireless Networks and Streetlamps[30]**

Researchers at Harvard University and BBN Technologies have designed CitySense, a wireless network capable of reporting real-time sensor data across the entire city of Cambridge, Massachusetts. CitySense is unique because it solves a constraint on previous wireless networks—battery life. The network mounts each node on a municipal streetlamp, where it draws power from city electricity. Researchers installed 100 sensors on streetlamps throughout Cambridge using a grant from the National Science Foundation. Each node will include an embedded PC running the Linux OS, an 802.11 Wi-Fi interface, and weather sensors.

One of the challenges in the design was how the network would allow remote nodes to communicate with the central server at Harvard and BBN. CitySense will do that by letting each node form a mesh with its neighbors, exchanging data through multiple-hop links. This strategy allows a node to download software or upload sensor data to a distant server hub using a small radio with only a one-kilometer range.

You are responsible for deploying a CitySense network around your city. What goals would you have for the system besides monitoring urban weather and pollution? What other benefits could a CitySense network provide? How could local businesses and citizens benefit from the network? What legal and ethical concerns should you understand before deploying the network? What can you do to protect your network and your city from these issues?

AT&T, Sprint, T-Mobile, and Verizon. They offer different cell phones, features, coverage areas, and services. One of the services is third-generation, or **3G**, services that bring wireless broadband to mobile phones. Figure 7.18 lists the cell phone generations. The 3G networks let users surf web pages, enjoy streaming music, watch video-on-demand programming, download and play 3-D games, and participate in social media and teleconferencing. **Streaming** is a method of sending audio and video files over the Internet in such a way that the user can view the file while it is being transferred. Streaming is not limited to cellular usage; all wireless and even wired networks can take advantage of this method. The most obvious advantage is speed, a direct benefit for mobile and wireless devices since they are still not as fast as their wired counterparts. **Voice over LTE (VoLTE)** allows mobile voice calls to be made

▼**FIGURE 7.17** Cell Phone Communication System Overview

Cell

Each cell is typically sized at about 10 square miles

Each cell has a base station that consists of an antennae or tower to relay signals

over broadband networks, creating—under the right network conditions—clearer audio and fewer dropped calls. One easy way to think of VoLTE is as, essentially, a VoIP call on your mobile phone. The functionality is still the same, but the data transfers in a faster and more efficient manner.[31]
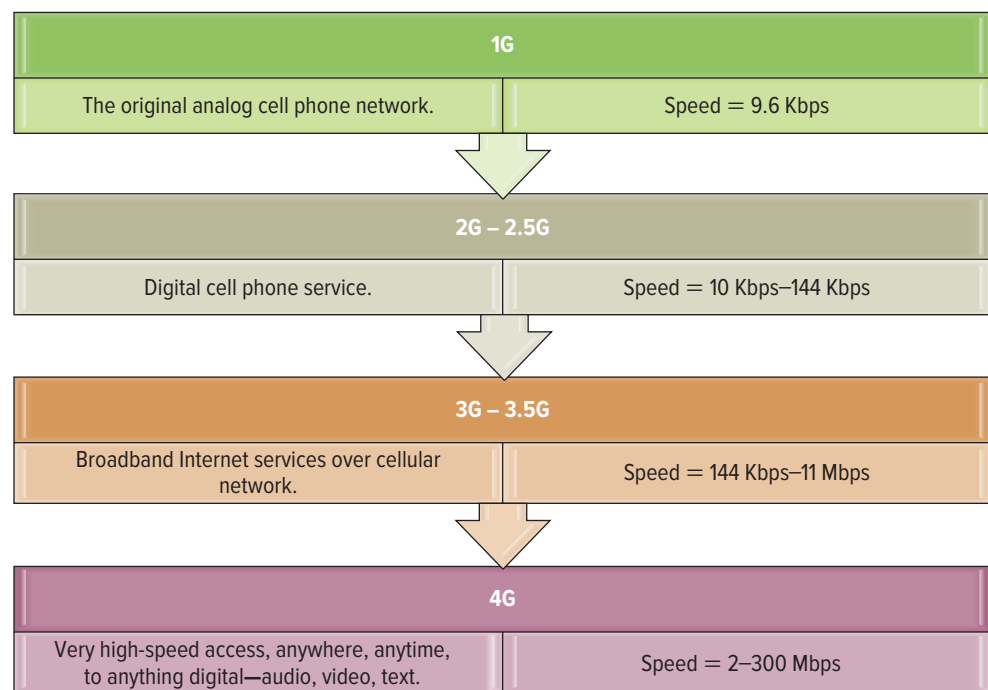
Wireless WAN—Satellite Communication System

The other wireless WAN technology is a satellite communication system. A **satellite** is a space station that orbits the Earth receiving and transmitting signals from Earth-based stations over a wide area. When satellite systems first came into consideration in the 1990s, the goal was to provide wireless voice and data coverage for the entire planet, without the need for mobile phones to roam between many different provider networks. But by the time satellite networks were ready for commercial use, they had already been overtaken by cellular systems.

The devices used for satellite communication range from handheld units to mobile base stations to fixed satellite dish receivers. The peak data transmission speeds range from 2.4 Kbps to 2 Mbps. For the everyday mobile professional, satellite communication may not provide a compelling benefit, but for people

requiring voice and data access from remote locations or guaranteed coverage in nonremote locations, satellite technology is a viable solution.

Conventional communication satellites move in stationary orbits approximately 22,000 miles above Earth. A newer satellite medium, the low-orbit satellite, travels much closer to Earth and is able to pick up signals from weak transmitters. Low-orbit satellites also consume less power and cost less to launch than conventional satellites. With satellite networks, businesspeople almost anywhere in the world have access to full communication capabilities, including voice, videoconferencing, and Internet access. Figure 7.19 briefly illustrates the satellite communication system.[32]

Protecting Wireless Connections

Network intrusions can occur if access codes or passwords are stored on a device that is lost or stolen. However, anytime a wireless network connects to a wired one, the wireless network

▼**FIGURE 7.18** Cell Phone Generations

1G	
The original analog cell phone network.	Speed = 9.6 Kbps

2G – 2.5G	
Digital cell phone service.	Speed = 10 Kbps–144 Kbps

3G – 3.5G	
Broadband Internet services over cellular network.	Speed = 144 Kbps–11 Mbps

4G	
Very high-speed access, anywhere, anytime, to anything digital—audio, video, text.	Speed = 2–300 Mbps

▼ **FIGURE 7.19** Satellite Communication System

22,000 miles above Earth

Fixed Locations   Portable Communications   Vehicles

can serve as a conduit for a hacker to gain entry into an otherwise secure wired network. This risk is especially high if the wireless network is not sufficiently secured in its own right.

Before the emergence of the Internet, hackers generally had to be physically present within the corporate complex to gain access to a wired network. The thousands, if not millions, of access points enabled by the Internet now allow hackers to work from a distance. This threat has spawned a variety of security techniques, from firewalls to VPNs to SSL and HTTPS.

Several techniques can secure wireless networks from unauthorized access whether used separately or in combination. One method is authenticating Wi-Fi access points. Because Wi-Fi communications are broadcast, anyone within listening distance can intercept communications. Every time someone uses an unsecured website via a public Wi-Fi access point, his or her logon name and password are sent over the open airwaves with a high risk that someone might eavesdrop or capt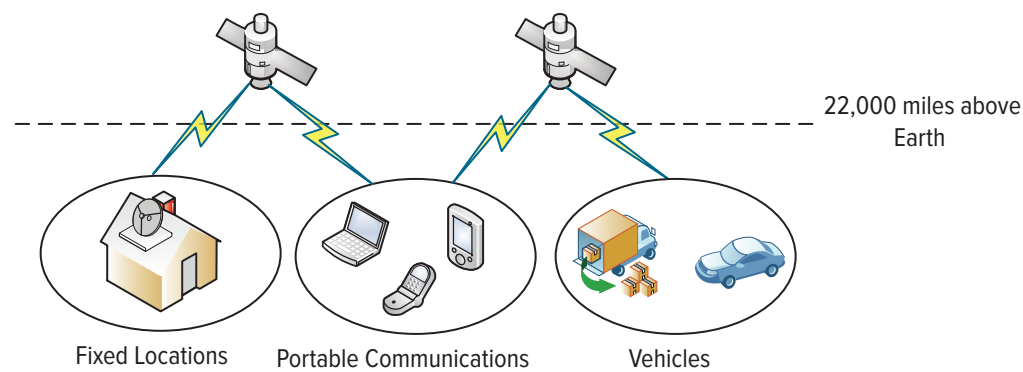ure logon names, passwords, credit card numbers, and other vital information. **Wired equivalent privacy (WEP)** is an encryption algorithm designed to protect wireless transmission data. If you are

using a Wi-Fi connection, WEP encrypts the data by using a key that converts the data to a nonhuman readable form. The purpose of WEP was to provide wireless networks with the equivalent level of security as wired networks. Unfortunately, the technology behind WEP has been demonstrated to be relatively insecure compared to newer protocols such as WPA. WLANs that use Wi-Fi have a built-in security mechanism called **Wi-Fi protected access (WPA)**, a wireless security protocol to protect Wi-Fi networks. It is an improvement on the original Wi-Fi security standard, wired equivalent privacy (WEP), and provides more sophisticated data encryption and user authentication. Anyone who wants to use an access point must know the WPA encryption key to access the Wi-Fi connection.

War chalking is the practice of tagging pavement with codes displaying where Wi-Fi access is available. The codes for war chalking tell other users the kind of access available, the speed of the network, and if the network is secured. **War driving** is deliberately searching for Wi-Fi signals while driving by in a vehicle. Many individuals who participate in war driving simply map where Wi-Fi networks are available. Other individuals have a more malicious intent and use war driving to hack or break into these networks. War driving has been a controversial practice since its inception and has raised the awareness of the importance of wireless network security.

Living the
DREAM

Saving the World One Phone at a Time

The mobile phone is helping to fight poverty and increase world economic development. It can dramatically improve living standards for people living on a few dollars a day by helping them find work, providing information about crop prices, or calling for medical help. By using mobile phones to find the best local marketplace prices for sardines, a group of poor fishermen in Kerala, India, increased their profits by an average of 8 percent. The fishermen were able to call ahead to a port to identify a buyer. In Muruguru, Kenya, Grace Wachira runs a small knitting company. Before using a mobile phone, she would walk hours to the nearest town to buy her supplies or meet customers. Using her mobile phone, she can now call for her supplies to be delivered and to communicate with her customers.

What type of mobile phones are these people buying? What other uses can a mobile phone provide for people living in poor, rural regions? How can people in rural areas turn owning a mobile phone into a small-scale business?[33]

Managing Mobile Devices

IT consumerization is the blending of personal and business use of technology devices and applications. Today's workforce grew up with the Internet and its members do not differentiate between corporate and personal technology. Employees want to use the same technology they have at home in the office. This blending of personal and business technology is having a significant impact on corporate MIS departments, which traditionally choose all of the technology for the organization. Today, MIS departments must determine how to protect their networks and manage technology that they did not authorize or recommend. Two ways an MIS department can manage IT consumerization is through mobile device management and mobile application management.

Mobile device management (MDM) remotely controls smartphones and tablets, ensuring data security. MIS departments implement MDM by requiring passcodes on organizational smartphones to ensure data encryption and, in the event of a lost smartphone, that all data on the device can be deleted remotely. MDM tools can also enforce policies, track inventory, and perform real-time monitoring and reporting. One problem with MDM is that the full-device approach can be too heavy-handed in an era when employees, not their employers, own their smartphones and tablets. Users may wonder, "If I only use my phone to check email at night, why do I have to enter my work password every time I want to use the phone?" or "If I lose my phone, why does my IT department want to wipe pictures of my dog remotely?"

Mobile application management (MAM) administers and delivers applications to corporate and personal smartphones and tablets. MAM software assists with software delivery, licensing, and maintenance and can limit how sensitive data can be shared among apps. An important feature of MAM is that it provides corporate network administrators with the ability to wipe corporate mobile apps from an end user's device remotely.

IT consumerization
The blending of personal and business use of technology devices and applications.

mobile device management (MDM) Remotely controls smartphones and tablets, ensuring data security.

BUSINESS APPLICATIONS OF WIRELESS NETWORKS LO7.4

Companies of all types and sizes have relied on wireless technology for years. Shipping and trucking companies developed some of the earliest wireless applications to help track vehicles and valuable cargo, optimize the logistics of their global operations, perfect their delivery capabilities, and reduce theft and damage. Government agencies such as the National Aeronautics and Space Administration and the Department of Defense have relied on satellite technologies for decades to track the movement of troops, weaponry, and military assets; to receive and broadcast data; and to communicate over great distances.

Wireless technologies have also aided the creation of new applications. Some build upon and improve existing capabilities. UPS, for example, is combining several types of wireless network technologies from Bluetooth to WWANs and deploying scanners and wearable data-collection terminals to automate and standardize package management and tracking across all its delivery centers. Figure 7.20 displays the three business applications taking advantage of wireless technologies.

LO7.4 Explain the different wireless network business applications.

fyi Sports Sensors

A sensor is a device that detects or measures a physical property such as heat, light, sound, or motion and records, indicates, or otherwise reacts to it in a particular way. With wireless apps and sensors, a number of new, high-tech tools for amateurs provide coach-quality feedback to athletes of all levels, including:

- **Tennis (Sony):** Sony recently created a tennis-tracking device and app that will let users collect the kind of game-play data that used to be available only to professionals.
- **Golf (Swingbyte):** The ultralight sensor clips to the club and monitors speed, acceleration, arc, and other statistics.
- **Hockey (Fwd Powershot):** The ultralight sensor fits into the handle end of the stick and measures swing speed, angle, and acceleration.
- **Basketball (94Fifty Smart Sensor):** Embedded in a standard ball, the sensor tracks shot speed, arc, and backspin plus dribble speed and force.
- **Baseball (Zepp):** Stuck to the knob of the bat, the sensor tracks the speed and plane of a swing and the angle of impact.[34]

In a group, create a product that takes advantage of sensors, including what the sensor would measure and how it would deliver the feedback to the user.

▼ FIGURE 7.20 Wireless Business Applications

Radio-Frequency Identification (RFID)

Global Positioning Systems (GPS)

Geographic Information Systems (GIS)

Radio-Frequency Identification (RFID)

Radio-frequency identification (RFID) uses electronic tags and labels to identify objects wirelessly over short distances. It holds the promise of replacing existing identification technologies such as the bar code. RFID wirelessly exchanges information between a tagged object and a reader/writer. An **RFID t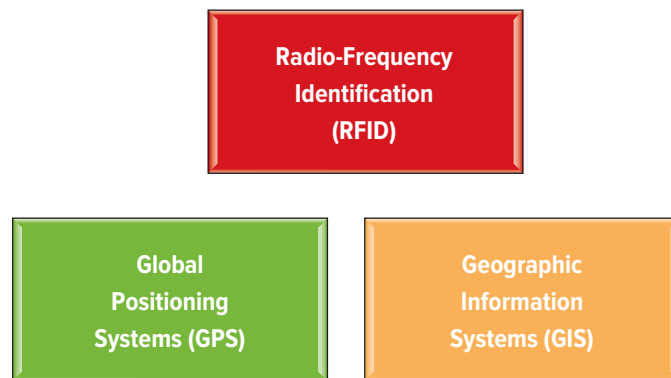ag** is an electronic identification device that is made up of a chip and antenna. An **RFID reader (RFID interrogator)** is a transmitter/receiver that reads the contents of RFID tags in the area. A RFID system is comprised of one or more RFID tags, one or more RFID readers, two or more antennas (one on the tag and one on each reader), RFID application software, and a computer system or server, as Figure 7.21 illustrates. Tags, often smaller than a grain of rice, can be applied to books or clothing items as part of an adhesive bar-code label, or included in items such as ID cards or packing labels. Readers can be stand-alone devices, such as for self-checkout in a grocery store, integrated with a mobile device for portable use, or built in as in printers. The reader sends a wireless request that is received by all tags in the area that have been programmed to listen to wireless signals. Tags receive the signal via their antennas and respond by transmitting their stored data. The tag

can hold many types of data, including a product number, installation instructions, and history of activity (such as the date the item was shipped). The reader receives a signal from the tag using its antenna, interprets the information sent, and transfers the data to the associated computer system or server.

Passive RFID tags do not have a power source, whereas **active RFID tags** have their own transmitter and a power source (typically a battery). The power source runs the microchip's circuitry and broadcasts a signal to the reader (similar to the way a cell phone transmits signals to a base station). Passive RFID tags draw power from the RFID reader, which sends out electromagnetic waves that induce a current in the tag's antenna. **Semi-passive RFID tags** use a battery to run the microchip's circuitry, but communicate by drawing power from the RFID reader. **Asset tracking** occurs when a company places active or semi-passive RFID tags on expensive products or assets to gather data on the items' location with little or no manual intervention. Asset tracking allows a company to focus on its supply chain, reduce theft, identify the last known user of assets, and automate maintenance routines. Active and semi-passive tags are useful for tracking high-value goods that need to be scanned over long ranges, such as railway cars on a track. The cost of active and semi-passive RFID tags is significant; hence, low-cost items typically use passive RFID tags.

The **RFID accelerometer** is a device that measures the acceleration (the rate of change of velocity) of an item and is used to track truck speeds or taxi cab speeds. **Chipless RFID tags** use plastic or conductive polymers instead of silicon-based microchips,

▼ FIGURE 7.21 Elements of an RFID system

Tagged Products — RFID Reader/Writer — Network — Computer System or Server
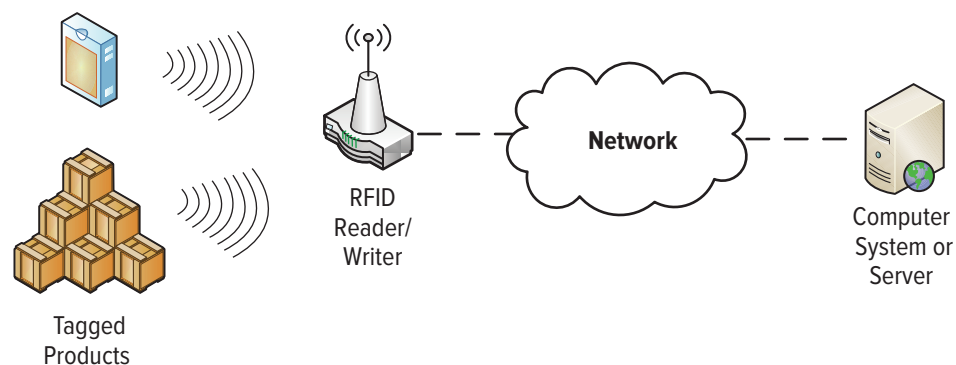
allowing them to be washed or exposed to water without damaging the chip. Examples of the innovative uses of RFID include:

- RFID chips injected under the skin of animals using a syringe can help ranchers meet regulations, track wild animals for ecological studies, and return lost pets to their owners.

- Retail stores use RFID to track and monitor inventory. Hospitals and pharmaceutical companies meet government regulations and standards with RFID. Even local libraries are using RFID to control theft and speed up the checkout process.

- Car manufacturers install RFID antitheft systems. Toll roads use RFID to collect payments from passing cars.

- Hospitals track patients', doctors', and nurses' locations to facilitate emergency situations and ensure safety. RFID also tracks equipment location to ensure quick response times during an emergency.

- American Express and MasterCard use RFID for automatic payments.

- Walmart and other large retailers use RFID to maintain inventory, stop shoplifting, and speed customer checkout processes.[35]

Global Positioning System (GPS)

A **global positioning system (GPS)** is a satellite-based navigation system providing extremely accurate position, time, and speed information. The U.S. Department of Defense developed the technology in the early 1970s and later made it available to the public. GPS uses 24 global satellites that orbit Earth, sending signals to a receiver that can communicate with three or four satellites at a time. A GPS receiver can be a separate unit connected to a mobile device using cable or wireless technology such as Bluetooth, or it can be included in devices such as mobile phones or vehicle navigation systems. **Automatic vehicle location (AVL)** uses GPS tracking to track vehicles. AVL systems use a GPS receiver in the vehicle that links to a control center. Garmin is one of the more popular manufacturers of GPS tracking systems, offering vehicle tracking, phone and laptop integration, and hiker navigation for water and air.

The satellites broadcast signals constantly, while the receiver measures the time it takes for the signals to reach it. This measurement, which uses the speed of the signal to determine the distance, is taken from three distinct satellites to provide precise location information. The time measurements depend on high-powered clocks on each satellite and must be precise, because an error of one-thousandth of a second can result in a location variation of more than 200 miles. GPS can produce very accurate results, typically within 5 to 50 feet of the actual location (military versions have higher accuracy). GPS also provides latitude, longitude, and elevation information. **Latitude** represents a north/south measurement of position. **Longitude** represents an east/west measurement of position. **Geocache** is a GPS technology adventure game that posts the longitude and latitude location for an item on the Internet for users to find. GPS users find the geocache and typically sign a guest book or take an item

and leave an item for the next adventure players to find. Caches are often placed in locations that are interesting or challenging for people to discover. A **geocoin**, a round coin-sized object, is uniquely numbered and hidden in geocache. Geocoins can also be shaped to match a theme such as the state of Colorado or a birthday party hat. Geocoins are often decorative or commemorative, making them collectible and highly valuable for technology adventures.

GPS applications are in every kind of company vehicle these days—from police cars to bulldozers, from dump trucks to mayoral limousines. Emergency response systems use GPS to track each of their vehicles and so dispatch those closest to the scene of an accident. If a vehicle is missing, its GPS locator can help locate it. **Estimated time of arrival (ETA)** is the time of day of an expected arrival at a certain destination and is typically used for navigation applications. **Estimated time enroute (ETE)** is the time remaining before reaching a destination using the present speed and is typically used for navigation applications.

Geographic Information Systems (GIS)

GPS provides the foundation for geographic information systems. A **geographic information system (GIS)** stores, views, and analyzes geographic data creating, multidimensional charts or maps. For example, GIs are monitoring global warming by measuring the speed of glaciers melting in Canada, Greenland, and Antarctica. **Cartography** is the science and art of making an illustrated map or chart. GIS allows users to interpret, analyze, and visualize data in different ways that reveal patterns and trends in the form of reports, charts, and maps.

---

asset tracking
Occurs when a company places active or semi-passive RFID tags on expensive products or assets to gather data on the items' location with little or no manual intervention.

RFID accelerometer
A device that measures the acceleration (the rate of change of velocity) of an item and is used to track truck speeds or taxicab speeds.

chipless RFID tags
Use plastic or conductive polymers instead of silicon-based microchips, allowing them to be washed or exposed to water without damaging the chip.

global positioning system (GPS)
A satellite-based navigation system providing extremely accurate position, time, and speed information.

automatic vehicle location (AVL) Uses GPS tracking to track vehicles.

latitude Represents a north/south measurement of position.

longitude Represents an east/west measurement of position.

geocache A GPS technology adventure game that posts on the Internet the longitude and latitude location of an item for users to find.

geocoin A round coin-sized object that is uniquely numbered and hidden in geocache.

estimated time of arrival (ETA) The time of day of an expected arrival at a certain destination; typically used for navigation applications.

estimated time enroute (ETE) The time remaining before reaching a destination using the present speed; typically used for navigation applications.

geographic information system (GIS) Stores, views, and analyzes geographic data, creating multidimensional charts or maps.

cartography The science and art of making an illustrated map or chart.

edge matching (warping, rubber sheeting) Occurs when paper maps are laid edge to edge, and items that run across maps but do not match are reconfigured to match.

GIS map automation Links business assets to a centralized system where they can be tracked and monitored over time.

Edge matching (warping, rubber sheeting) occurs when paper maps are laid edge to edge and items that run across maps but do not match are reconfigured to match. Edge matching is a critical component of creating a GIS database because map misalignments occur frequently for many reasons, including survey error and cartographic errors. **GIS map automation** links business assets to a centralized system where they can be tracked and monitored over time.

Spatial data (geospatial data or geographic information) identifies the geographic location of features and boundaries on Earth, such as natural or constructed features, oceans, and more. Spatial data can be mapped and is stored as coordinates and topology. A GIS accesses, manipulates, and analyzes spatial data. **Geocoding** in spatial databases is a coding process that assigns a digital map feature to an attribute that serves as a unique ID (tract number, node number) or classification (soil type, zoning category). GIS professionals are certified in geocoding practices to ensure industry standards are met when classifying spatial data.

Companies that deal in transportation combine GISs with database and GPS technology. Airlines and shipping companies can plot routes with up-to-the-second information about the location of all their transport vehicles. Hospitals can locate their medical staff with GIS and sensors that pick up transmissions from ID badges. Automobiles have GPSs linked to GIS maps that display the car's location and driving directions on a dashboard screen. GM offers the OnStar system, which sends a continuous stream of information to the OnStar center about the car's exact location.

Some mobile phone providers combine GPS and GIS capabilities so they can locate users within a geographical area about the size of a tennis court to assist emergency services such as 911. Farmers can use GIS to map and analyze fields, telling them where to apply the proper amounts of seed, fertilizer, and herbicides.

A GIS can find the closest gas station or bank or determine the best way to get to a particular location. But it is also good at finding patterns, such as finding the most feasible location to hold a conference according to where the majority of a company's customers live and work. GIS can present this information in a visually effective way.

Living the
DREAM

Wi-Fi for Fishes

Not too long ago, the Seattle Aquarium decided it needed to take a deep dive into its network infrastructure and deploy wireless across its facilities. Now, a year and half in, the aquarium has found Wi-Fi to be a tool that not only lets it serve visitors in unique ways but also enriches the exchanges possible between staff members and the community, says Pam Lamon, the aquarium's web and social media coordinator. For instance, there are long stretches when Umi, the aquarium's 40-pound giant Pacific octopus, doesn't move at all. Now, staff members armed with tablets can roam around the exhibit showing visitors videos of Umi feeding while they field questions.

Wireless even lets the aquarium interact with people who can't visit in person. For instance, during a recent Google + Hangout on Air, a young boy from an East Coast school asked an aquarium diver how many fish were swimming in the tank with her. The diver, wearing a wetsuit and a facemask with a microphone and speaker, began pointing out fish. "One, two, three, four, five, six, seven," she counted off, before giving up and telling him there were 500, give or take a few. "It's a little bit hard to know for sure because they just don't hold still while we count them," she joked.

The Seattle Aquarium is far from alone among businesses and organizations that are tapping into wireless to expand or improve services. As wireless has morphed from a pleasant perk to a necessity for employees and clients across industries, many businesses are finding they can no longer make do without wireless or with limited Wi-Fi services. Today, not only is there incentive to find better solutions, but companies have access to more sophisticated equipment to help them pinpoint network problems. From next-generation access points to cloud-based management systems, wireless tools can provide expanded capabilities, are easy to manage, and are available in a range of prices.[36]

In a group, choose a business in your area that could benefit from wireless technology, such as the Seattle Aquarium, and create a plan detailing the additional services it could offer its customers.

Some common GIS uses include:

- Finding what is nearby. Given a specific location, the GIS finds sources within a defined radius. These might be entertainment venues, medical facilities, restaurants, or gas stations. Users can also use GIS to locate vendors that sell a specific item they want and get the results as a map of the surrounding area or an address.

- Routing information. Once users have an idea where they want to go, GIS can provide directions to get there using either a map or step-by-step instructions. Routing information can be especially helpful when combined with search services.

- Sending information alerts. Users may want to be notified when information relevant to them becomes available near their location. A commuter might want to know that a section of the highway has traffic congestion, or a shopper might want to be notified when a favorite store is having a sale on a certain item.

- Mapping densities. GIS can map population and event densities based on a standard area unit, such as square miles, making it easy to see distributions and concentrations. Police can map crime incidents to determine where additional patrolling is required, and stores can map customer orders to identify ideal delivery routes.

- Mapping quantities. Users can map quantities to find out where the most or least of a feature may be. For example, someone interested in opening a specialty coffee shop can determine how many others are already in the area, and city planners can determine where to build more parks.[37]

A GIS can provide information and insight to both mobile users and people at fixed locations. Google Earth combines satellite imagery, geographic data, and Google's search capabilities to create a virtual globe that users can download to a computer or mobile device. Not only does this provide useful business benefits, but it also allows for many educational opportunities. Instead of just talking about the Grand Canyon, an instructor can use Google Earth to view that region.

GPS and GIS both utilize **location-based services (LBS)**, applications that use location information to provide a service. LBS is designed to give mobile users instant access to personalized local content and range from 911 applications to buddy finders ("Let me know when my friend is within 1,000 feet") to games (treasure hunts) to location-based advertising ("Visit the Starbucks on the corner and get $1.00 off a latte"). Many LBS applications complement GPS and GIS, such as:

- Emergency services
- Field service management
- Find-it services
- Mapping
- Navigation
- Tracking assets
- Traffic information
- Vehicle location
- Weather information
- Wireless advertising[38]

Just as Facebook and Twitter helped fuel the Web 2.0 revolution, applications such as Foursquare, Gowalla, and Loopt are bringing attention to LBS. Each application is a mobile phone service that helps social media users find their friends' location. Facebook and Twitter have added location-based services to complement their applications. ■

spatial data (geospatial data or geographic information) Identifies the geographic location of features and boundaries on Earth, such as natural or constructed features, oceans, and more.

geocoding A coding process that takes a digital map feature and assigns it an attribute that serves as a unique ID (tract number, node number) or classification (soil type, zoning category).

location-based services (LBS) Applications that use location information to provide a service.

BUSTED Snapping a Theftie

Has your smart phone ever been stolen? If so, you are not alone; more than 3 million Americans' phones were stolen in 2013, which is twice the number in 2012, according to a Consumer Reports survey. Of course, every good entrepreneur can spot an opportunity, and a new antitheft app is one step ahead of criminals who are targeting smart phones.

Lookout is among the latest additions to the growing antitheft industry, and the app features some smart ways of helping you get one step ahead of thieves. A smart phone's front-facing camera is often regarded as merely a portal to endless selfie photographs. But Lookout puts the camera to good use by capturing a photo of you—or of any would-be thief—when someone inputs your phone's password incorrectly three times. That photo, or theftie, is instantly emailed to the phone's owner, along with the device's approximate location. The antitheft app is free to download, but this handy photo feature is not available on iPhones due to Apple restrictions and comes with an annual charge of $30.[39]

Lookout's team has been adding new features to the app's alerts, based on the methods thieves use to steal phones undetected. The app also will send emails to its owner if anyone attempts to remove the phone's SIM card, enables Airplane mode, or turns off the device. From that point, the owner can choose to lock or wipe the phone remotely.

Do you agree that antitheft apps are smart business? Are any ethical issues involved in taking thefties? How would you feel if company security policy required you to install Lookout on your cell phone? If you could add a new feature to Lookout, how would it work and what would it do to deter smart phone theft?