Foundations of

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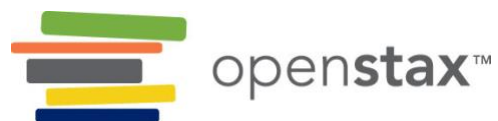
# Sys- tems

# Foundations of Information Systems

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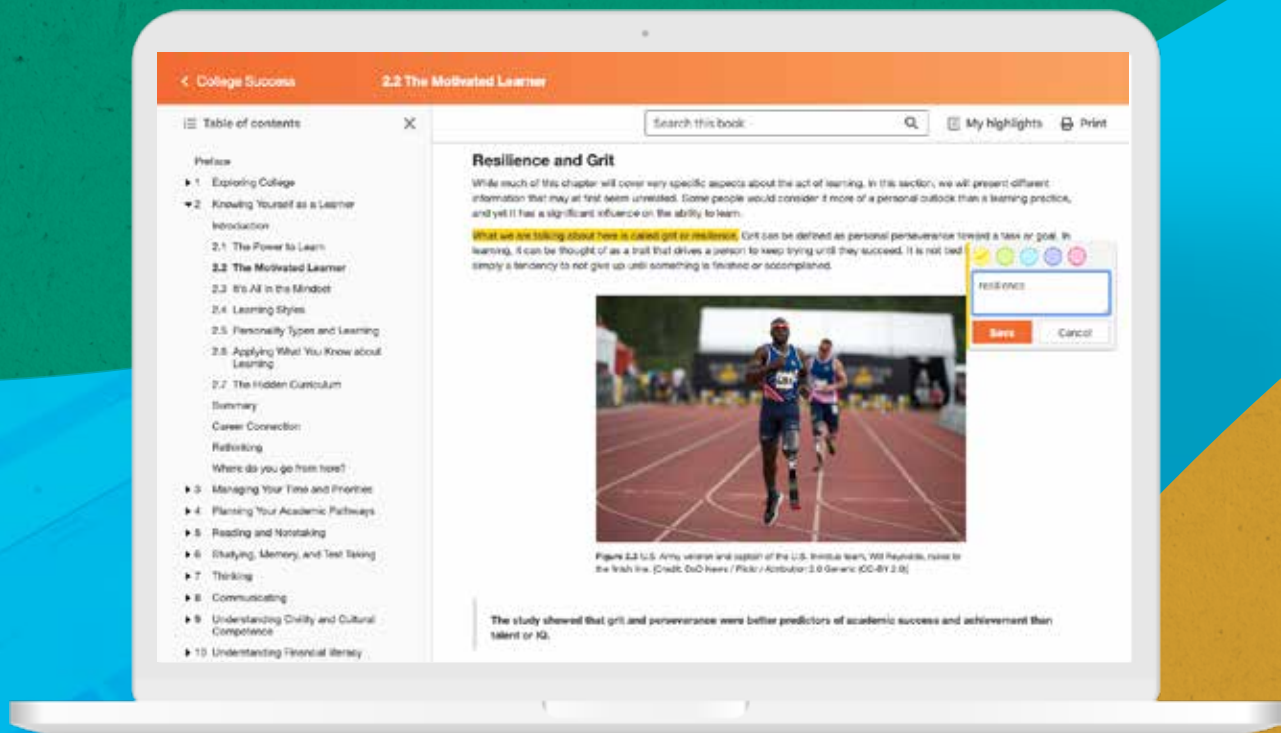| | |
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# Preface

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## About *Foundations of Information Systems*

*Foundations of Information Systems* provides students with the ability to understand the concepts of IS, including hardware, software, database management systems, and data networks. The teaching is based on the ACM/IEEE/AIS curriculum standards for information systems (IS2020) that allow institutions to use the

content for the purposes of accreditation for ABET, AACSB, and ACBSP. The openly licensed resource is grounded in concepts that cross both functional and operational areas to develop student knowledge in transactional, decisional, and collaborative business processes. Specifically, students will be able to understand and apply basic concepts associated with the collection, processing, storage, distribution, and value of information—and how IS professionals provide support to management, customers, and suppliers of the enterprise. Driven by competencies that correlate to knowledge, skills, and dispositions, the book is an asset for 2-year and 4-year information systems programs and to use in general education courses in business and computing.

*Foundations of Information Systems* is intended to be a high-quality, introductory text that provides students with foundational knowledge of global information systems while preparing them to engage with more complex problems and digital technologies. The IS resource appeals to multiple audiences of learners and instructors teaching courses in information technology and those teaching in a comprehensive program in any specialty, including health information systems and business information systems. The book is designed to closely align with international standards and real-life skills needed by employers, while providing a scholarly perspective that encourages students to explore the digital world from a systems design perspective.

## Coverage and Scope

*Foundations of Information Systems* provides a cohesive narrative flow that brings content to life through application, examples, and exercises. The text is based on the recommended Foundations of Information Systems 2020 Curriculum. The topics and format are aligned with the suggested first course in the program of IS2020 and include additional topics organized and recommended by instructors across in 2-year, 4-year, and general education programs around the world. Content is organized under headings and subheadings to allow for structured reading and comprehension, with pedagogical features placed to provide breaks and reinforce concepts. Appropriate visuals complement and illustrate key points in the narrative and draw students into the material.

*Foundations of Information Systems* begins with an overview of hardware, software, and system identification, and ends with ethical considerations in using such technology as machine learning, artificial intelligence, and other newly developed technologies.

## Pedagogical Foundation and Features

*Foundations of Information Systems* is designed to engage students through a combination of practical, real-world applications and thought-provoking scenarios that promote critical thinking and a deeper understanding of core concepts. The pedagogical approach is centered on making information systems relevant and accessible for students from diverse backgrounds. To support this vision, the textbook incorporates several key features:

- **Future Technology** features present newer, emerging, and rapidly changing technologies such as artificial intelligence, machine learning, virtual reality, and augmented reality, and how these technologies fit into the information systems domain.
- **Global Connections** features highlight information systems and technology on a global scale. This feature highlights real IS cases from organizations around the world and describes global technology.
- **Ethics in IS** features highlight ethical issues related to the concepts, skills, and activities being taught in the course. These discuss real-world cases, dig deeper into ethical considerations, and present ethical dilemmas for students to think through.
- **Careers in IS** features introduce students to careers in information systems, including those in high demand, such as health care, data analytics, cybersecurity, cloud computing, business analytics, financial analytics, and more. In addition, this feature offers insight into specialty areas, certifications, and other learning and experience opportunities to enhance career options.
- **Link to Learning** features provide a very brief introduction to online resources—videos, interactives,

articles, and other engaging resources that are pertinent to students' exploration of the topic at hand.

Overall, these features are integrated throughout the textbook to foster active learning, critical thinking, and an appreciation for the practical applications of information systems. By connecting theory to practice and encouraging students to explore real-world issues, *Foundations of Information Systems* provides a meaningful and supportive learning experience that equips students with the knowledge and skills necessary for success in their academic and professional journeys.

**Answers to Questions in the Book**

The end-of-chapter Check Your Understanding and Application Questions are intended for homework assignments or classroom discussion; thus, student-facing answers are not provided in the book. For end-of-chapter Review Questions, the book's Answer Key provides students with answers to about half of the assessments so they can self-check their work as they study. All assessment answers and sample answers are provided in the Instructor Answer Guide, for instructors to share with students at their discretion, as is standard for such resources.

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Dr. Mahesh S. Raisinghani is a professor of Management Information Systems at Texas Woman's University's (TWU's) MAK College of Business and Entrepreneurship, and an Affiliate Professor at TWU's Woodcock Institute for the Advancement of Neurocognitive Research and Applied Practice. He is also a Senior Fellow of the Higher Education Academy in the U.K., and the Director of Strategic Partnerships for the Association of Information Systems' SIG-LEAD. He earned his MBA from the University of Central Oklahoma; M.S. in Information Systems, and Ph.D. in Information Systems and Strategic Management from the University of Texas at Arlington.

Dr. Raisinghani was awarded the Distinguished Research Award by the Association of Business Information Systems in 2022 and 2024; Global Educator Award from X-Culture in 2022, 2023, and 2024; Information Systems Audit and Control Association (ISACA's) Excellence in Education award in 2021; Outstanding Organizational Service award from the Global Information Technology Management Association in 2018; and TWU's 2017 Innovation in Academia award, among other awards. He was also awarded the 2017 National Engaged Leader Award by the National Society of Leadership and Success; and the 2017 Volunteer Award at the Model United Nations Conference for his service to the Youth and Government by the Model United Nations Committee.

Dr. Raisinghani serves as the Editor-in-Chief of the *International Journal of Web-based Learning and Teaching Technologies*. He has published over a hundred manuscripts in peer-reviewed journals in MIS, national and

international conferences, and book series; edited eight books; and consulted for a variety of public and private organizations. He has been involved in many large, medium, and small business technology strategy and innovation projects for companies in several countries across various industries. He has extensive experience with corporate training and has developed and delivered training and mentoring programs for the top corporate education providers.

Dr. Raisinghani has served as a consultant and conducted research as part of a project that received Phase 1, and Phase 2/2B grants from the National Science Foundation. He has also served as a subject matter expert reviewer in technology and commercialization for the National Science Foundation for the last 25 years. Dr. Raisinghani serves as a Board Member for the Global Information Technology Management Association; an Advisory Board Member for Harvard Business Review and X-Culture.org; and an advisor for the National Society of Leadership and Success and World Affairs Council.

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## Additional Resources

### Student and Instructor Resources

We have compiled additional resources for both students and instructors, including Getting Started Guides, an instructor's answer guide, test bank, and image slides. Instructor resources require a verified instructor account, which you can apply for when you log in or create your account on OpenStax.org. Take advantage of these resources to supplement your OpenStax book.

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**PowerPoint lecture slides.** The PowerPoint slides provide learning objectives, images and descriptions, feature focuses, and discussion questions as a starting place for instructors to build their lectures.

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Academic integrity builds trust, understanding, equity, and genuine learning. While students may encounter significant challenges in their courses and their lives, doing their own work and maintaining a high degree of authenticity will result in meaningful outcomes that will extend far beyond their college career. Faculty, administrators, resource providers, and students should work together to maintain a fair and positive experience.

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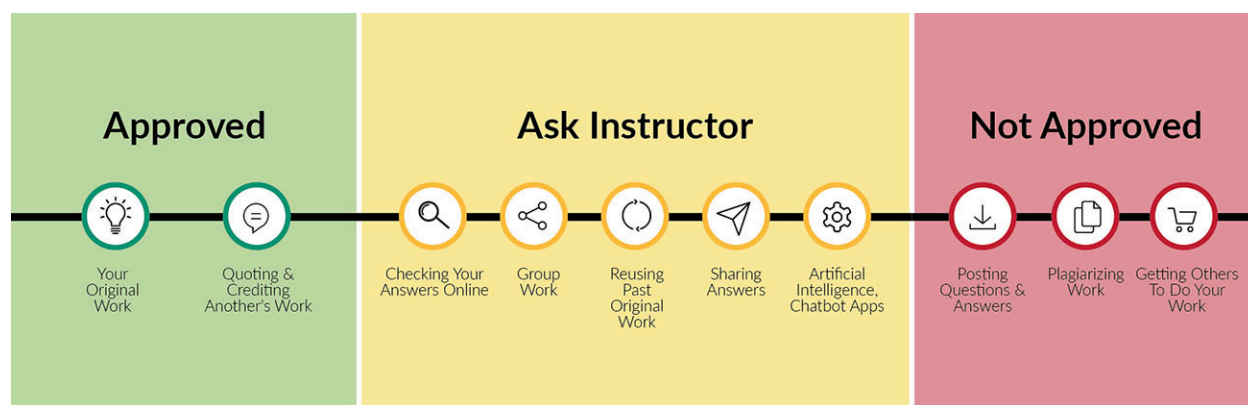


Visit our academic integrity slider (https://view.genial.ly/61e08a7af6db870d591078c1/interactive-image-defining-academic-integrity-interactive-slider). Click and drag icons along the continuum to align these practices with your institution and course policies. You may then include the graphic on your syllabus, present it in your first course meeting, or create a handout for students. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

At OpenStax we are also developing resources supporting authentic learning experiences and assessment. Please visit this book's page for updates. For an in-depth review of academic integrity strategies, we highly recommend visiting the International Center of Academic Integrity (ICAI) website at https://academicintegrity.org/ (https://academicintegrity.org/).

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**1**

# Fundamentals of Information Systems

**Figure 1.1** Information systems are an integral part of our lives. Organizations rely on them to manage data, produce goods and services, and compete successfully in marketplaces big and small. (credit: modification of work "Infoeko2" by "Deeply"/Wikimedia Commons, CC0 1.0)

## Chapter Outline

## Introduction

What comes to mind when you think about information systems? In what ways do you think they affect your life? You might be surprised to find out that information systems have an impact on your life and career whether you realize it or not.

In general, an information system is a set of components that helps gather, analyze, maintain, and distribute data. The components of information systems include people, the system's hardware and software, networks, data, and the procedures used to process the data and maintain the system.

The fields of information systems (IS) and information technology (IT) overlap, and sometimes the terms are used interchangeably. However, the sole focus of the field of IT is technology, meaning the processes necessary to establish and maintain computer systems, networks, and applications. Although the field of IS is concerned with technology, the focus is broader to include the people who are part of system processes. It is a vital tool used by all types of organizations to conduct business and participate in the marketplace, whether local or global.

To put this in perspective, consider the village of Pathanamthitta in Kerala, India. The village has limited resources, and during the COVID-19 pandemic, residents' access to health care was even more limited. To improve the health of the vulnerable geriatric population and protect them from the disease, researchers created a mobile phone app for symptom reporting, telehealth, and assessments. Approximately 60 percent of the geriatric population used the app, and the mobile health project thereby allowed for improved health care for the community.[1]  This is information systems in action, using technology and information to help address concerns from the COVID-19 pandemic.

## 1.1 | Introduction to Information Systems

### Learning Objectives

By the end of this section, you will be able to:
- Define the key concepts in information systems
- Discuss the historical evolution of information systems
- Describe the components, elements, and operations of information systems

It's helpful to understand the relationship between information systems and related fields. Computer science is the discipline that provides foundations for the theories and technology necessary for computing systems. Information technology (IT) implements and maintains those computer systems. Information systems, our area of focus, uses those systems to process and manage information.

### Key Concepts in Information Systems

An **information system** is a set of interconnected components that integrate the collection, processing, storage, and distribution of data, information, and digital products in order to support decision-making, coordination, control, analysis, and visualization in an organization. These systems play an important role in managing and facilitating various business processes and can also be used in individuals' personal lives.

The **field of information systems (IS)** is a dynamic industry, evolving and depending on technological advancements. It intersects with business, computer science, and management, playing a critical role in enhancing organizational efficiency, productivity, and competitiveness. When organizations have robust information systems, they are more capable of planning strategically to gain a competitive edge and achieve success.

### Components of an Information System

As shown in Figure 1.2, an information system typically consists of five key components: hardware, software, data, people, and procedures.

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1   Geethu Mathew, Nooh Bava, Aby Dany Varghese, Abey Sushan, and Anoop Ivan Benjamin, "Project *Vayoraksha*: Implementation of Novel mHealth Technology for Healthcare Delivery during COVID-19 in Geriatric Population of Kerala," *Indian Journal of Medical Research*, 159, 3–4 (July 19, 2024): 289–297, https://doi.org/10.25259/IJMR_62_23
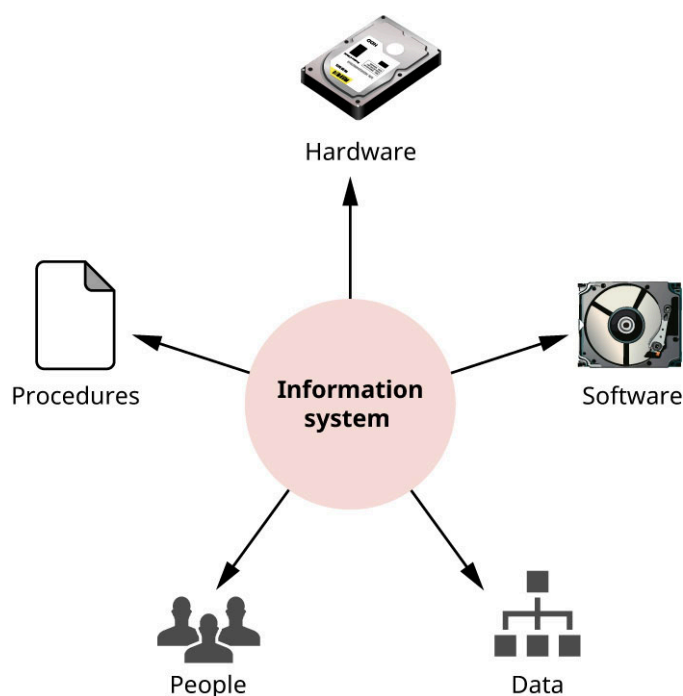
**Figure 1.2** Typically, an information system includes people, as well as hardware, software, data, and procedures. (credit: modification of work from *Introduction to Computer Science*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Before looking closely at each component to understand what it entails and why it is important in IS, let's start with a brief overview of the five components.

- The physical devices, such as computers, servers, networks, and storage devices, that are used to collect, process, and store data are called **hardware**.
- The programs and applications that run on the hardware, enabling users to perform specific tasks, are called **software**. Software can range from operating systems and database management systems to specialized business applications.
- The raw facts and figures that are processed and turned into meaningful information are called **data**. The facts that we use to learn and understand people, places, and things make up **information**. Information is raw data that have been processed and manipulated to give context and meaning. Once data are processed into information, we can use that information personally and professionally. We read or listen to books, watch videos on social media, stream a television show, follow road signs, browse online shopping sites, and interact with information we find on the internet or in the world around us. We use databases to organize and store this data efficiently.
- A Set of instructions and rules that governs the use of the hardware, software, and data components is known as a **procedure**. Standard operating procedures ensure consistency and reliability in the use of information systems.
- Individuals who use the information system, including end users who input and retrieve data in the system, as well as information technology (IT) professionals who design, develop, and maintain the system, are the people who make up an information system.

## LINK TO LEARNING

If you are interested and want to learn more about career opportunities in IS, search "information systems careers" online and explore the dozens of websites with IS career details. This article provides information about career paths and salary (https://openstax.org/r/109ISCareers) and includes links to online higher education institutions that have related degrees. An online search can find other websites that provide

helpful information about IS careers, including the general skills required, types of organizations that hire IS professionals, and what students can expect if they pursue a career in IS.

## Types of Information Systems

As shown in Figure 1.3, information systems can be categorized into different types based on their scope and functionality. Executive information systems are used by an organization's executive staff, decision support systems are used by senior managers, management information systems are used by middle managers, and transaction processing systems are used by frontline workers.
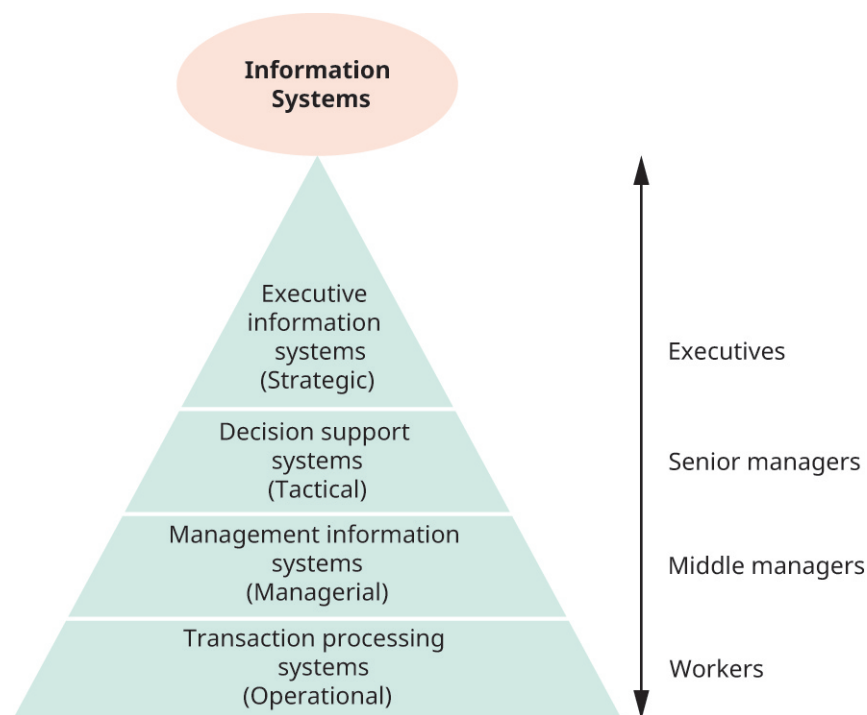


**Figure 1.3** Information systems include several types of systems with distinct purposes. (credit: modification of work from *Introduction to Computer Science*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Let us take a closer look at each type of information system and explore their purposes.

- An **executive information system (EIS)** supports the strategic information needs of top executives, providing the information needed to handle executive functions, such as developing an organization's strategic goals and objectives and plans for achieving them. This includes providing the information needed for managers to understand and manage their organization's supply chain and value chain, which can be helpful to streamline production processes and provide better customer service. Supply chain management is an example of how an EIS can be used as an interorganizational information system, which occurs when two or more organizations use IS to conduct business electronically.
- A **decision support system (DSS)** assists in decision-making by providing interactive tools and access to data analysis. Typically, senior managers use a DSS to obtain tactical information that helps them make routine, short-term decisions about an organization's operations. This helps ensure that organizations stay on track to achieve long-term goals and objectives. Interactive tools available through a DSS enhance these efforts by providing information and technology needed for activities such as project management and employee training.
- A **management information system (MIS)** provides middle managers with reports and summaries to support decision-making and managerial functions. For example, middle managers may use an MIS to generate reports, such as budgeting documents and cash flow statements, to understand an

organization's financial status. In many organizations, this type of system provides the data for an organization's balanced scorecard (BSC), which is a performance metric used by strategic managers to identify an organization's various functions and monitor outcomes. By providing the data necessary for the BSC, an organization's MIS function provides invaluable support.

- A **transaction processing system (TPS)** handles day-to-day transactions, such as order processing and payroll. For frontline staff, a TPS provides information necessary to handle an organization's daily operations, such as inventory reports and customer service records.

In addition to these four types of information systems, an **enterprise resource planning (ERP) system** is a software system that helps an organization manage various types of information systems within the organization, and integrate business processes and functions across the organization. For example, large organizations may rely on an ERP system to handle human resource management throughout the organization. An ERP is also a useful tool for functions such as project management, accounting and financial management including payroll, and tracking customer service.

## Application of Information Systems in Business

Think about a visit to a coffee shop, from ordering to receiving the order, through the lens of IS. First, think about how a barista takes an order at the register. That's the point-of-sale (POS) system at work. The POS system is an information system that streamlines transactions, helping businesses track sales, manage inventory, and even understand customer preferences when tracked with tools such as customer loyalty cards. When a customer switches from their regular black coffee to a caramel macchiato, the system takes note and updates their preferences, contributing to a personalized customer experience.

Now, imagine if the coffee shop had no system to track sales, manage its supplies, and keep track of customer preferences. What do you think might be some of the challenges a business would face if they did not have a way to gather, track, and analyze this data? This is where ERP systems come into play. ERP systems integrate various business processes, ensuring that everything from bean procurement to milk deliveries is synchronized. This not only prevents the coffee shop from running out of their most popular blend, but also helps them manage costs and operate more efficiently.

The POS and ERP systems are not the only information systems in a coffee shop. Most coffee shops have Wi-Fi, which is another information system that includes hardware, software, and the networks that connect them. The coffee shop's Wi-Fi is a small-scale example of how businesses use IS to stay ahead of the competition, whether it be locally, nationally, or globally.

In essence, information systems are about more than simply computers and gadgets. They are the invisible architects that shape our daily experiences, whether we're grabbing a coffee or navigating the complexities of a global market.

### CAREERS IN IS

#### Careers in IS

Students who are interested in the field of IS have a variety of career options. There are technical jobs that require in-depth knowledge of computers, such as software developers who design, create, and test the software applications necessary to develop and maintain an information system. Cloud computing engineers also fall into this category, and they must have the skills to guide and support organizations as they connect their systems to the cloud and use it to conduct business.

But not all IS jobs are technical. Students who find the field intriguing but want a less technical job also have career options. For example, systems analysts explore an organization's operations to identify areas where technology can be used to help an organization be more efficient and cost-effective. Information

systems managers oversee how information systems are planned, implemented, and maintained to ensure that the functionality aligns with their organization's goals and objectives.

# The Historical Evolution of Information Systems

The basic purpose of information systems—processing and sharing information—has been part of our communication practices since the beginning of civilization, evolving from simple cave drawings to the complex technology we have today. Understanding the background and history of IS helps us appreciate the importance of IS, how it has helped shaped civilizations across the ages, and why it continues to be a vital part of our lives, both personally and professionally.

## Evolution of Communication and Information Sharing

The earliest forms of communication evolved from body language, hand signals, and drawings to spoken and written languages. As written language developed around the world, various societies invented ways to print written works that could be shared with others. These earlier means of communication provided essential information without technology components like those we think of today, such as database management systems, data networks, hardware, and software.

For hundreds of years leading up to the twentieth century, early technology laid the foundation for today's complex information systems. The printing press was the dominant invention that promoted communication and information sharing for centuries before the inventions of the telegraph and the telephone. By the end of the 1800s, the basic design of the telephone, which is still the foundation for today's landline handsets and cell phones, was in place. The telephone revolutionized communication, allowing real-time conversations for sharing information for both personal and business purposes.

The telephone took another step forward in 1973 when Martin Cooper, an engineer for Motorola, made the first call on a wireless cellular telephone. This launched a revolution as cell phones progressed to eventually become a vital personal resource for individuals around the world. By January 2024, Pew Research Center found that 97 percent of adults in the U.S. owned a cell phone.[2]

As this information shows, communication has been paramount for humans since the beginning of civilization, and we have strived to find more and better ways to stay connected with one another.

## Development of the Internet

The inventions of the computer and the internet have been instrumental in the development of some of the technology necessary for today's information systems. While societies developed a variety of methods for communication, they also created tools for calculations, establishing the foundation for modern computers. The abacus, which can be traced to at least 1100 BCE, is the oldest known calculating tool. Analog and digital calculators were invented in the 1600s, followed by the Jacquard loom in the early 1800s. The first modern analog computer was developed in 1930, and in the 1940s, IBM produced fully functional computers that evolved over the decades to the laptops and other computers that we have today.

Initially, computers were not linked by data networks and could not be used as communication tools. Rather, their primary purpose was to calculate, process, and store information. For example, the U.S. government used early computers to compile and calculate statistical data gathered from census questionnaires. Businesses first used computers for purposes such as tabulating and storing financial information, and academic institutions relied on these basic computers to organize and analyze research data.

The inventions of the telegraph and telephone laid the foundation for the 1969 introduction of the U.S. Advanced Research Projects Agency Network (ARPANET). This network linked computers to one another and

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2  "Mobile Fact Sheet," Pew Research Center, November 13, 2024, https://www.pewresearch.org/internet/fact-sheet/mobile/

became the forerunner to the internet. Focused on the military and universities, which needed the ability to collaborate and connect project team members in multiple locations, the ARPANET provided a means for professionals in separate locations to share information and computing resources. Using satellite links and packet-switching technology, which transfers data in small pieces as it is routed through a system, computers in the network could communicate with each other. As technology progressed, the ARPANET developed features such as the following:

- telnet, which enables users on one computer to log into other computers using the same network
- FTP protocols, which allow electronic file transfers
- list servers, which send a single message to multiple subscribers
- routers, which handle data packets

Figure 1.4 shows the expanse of the network in 1974.
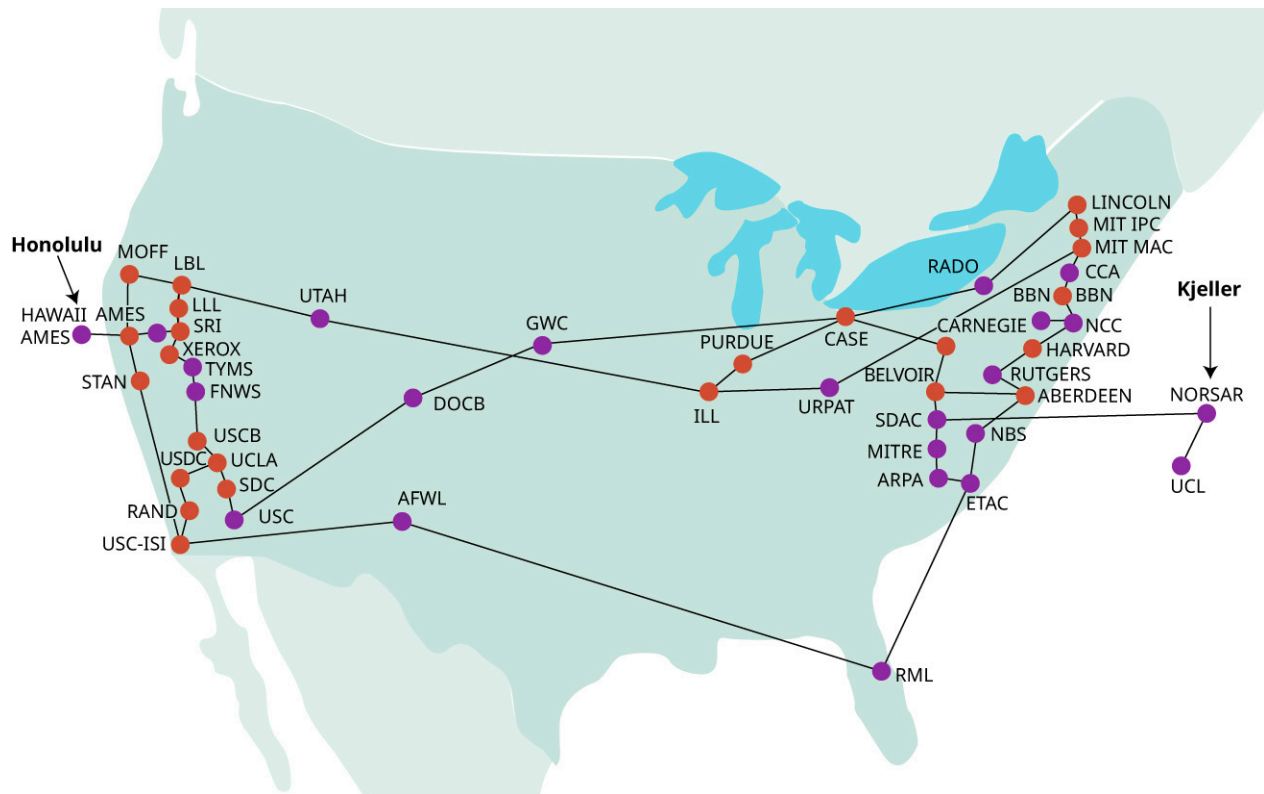


**Figure 1.4** In the 1970s, the Advanced Research Projects Agency's network consisted of a series of nodes (connectors) and lines that stretched across the continental United States. (credit: modification of work "Arpanet 1974" by "Yngvar"/Wikimedia Commons, Public Domain)

During the 1970s, scientists Vinton Cerf and Robert Kahn developed the communications model for Transmission Control Protocol/Internet Protocol (TCP/IP). This established the standards for transmitting data among multiple networks of computers. In 1983, ARPANET adopted TCP/IP, providing the framework for researchers to create the vast network that evolved into today's internet.

In 1990, computer scientist Tim Berners-Lee advanced this technology when he invented the World Wide Web, providing users with the ability to access online information through websites and hyperlinks. The internet has made global communication and information sharing commonplace and convenient for anyone with computer access.

As this history shows, the goal of information technology has been to find ways to do things more efficiently, saving time while increasing productivity. The technological advancements in computer science and information technology have provided the additional technology and frameworks needed to develop today's robust information systems.

## Evolution of Computer Hardware and Software

While technology evolved and the internet was launched, computer hardware and software also evolved. Hardware includes the tangible parts of a computer, such as the motherboard, hard disk drive, and central processing unit, as well as accessories such as electrical cords, keyboards, and monitors. Software refers to the programs and instructions that make computers functional, able to follow commands and carry out tasks. Common examples of software include word processing and spreadsheet programs.

To understand how computers developed, consider the Jacquard loom. This 1801 invention helped artists weave cloth. The loom was used to produce patterned cloth, and by using punched pasteboard cards, Jacquard applied binary code to the weaving process, revolutionizing the way fabric was created. The loom itself was constructed of metal and wood, which functioned as the machine's hardware. The rods in the loom were controlled by pasteboard cards that were stiff and included holes to instruct the rods in the steps needed to weave a specific pattern of cloth (Figure 1.5). The design of the loom helped early computer designers understand the concepts and importance of computer hardware and software by applying binary code.



| (a) | (b) | (c) |
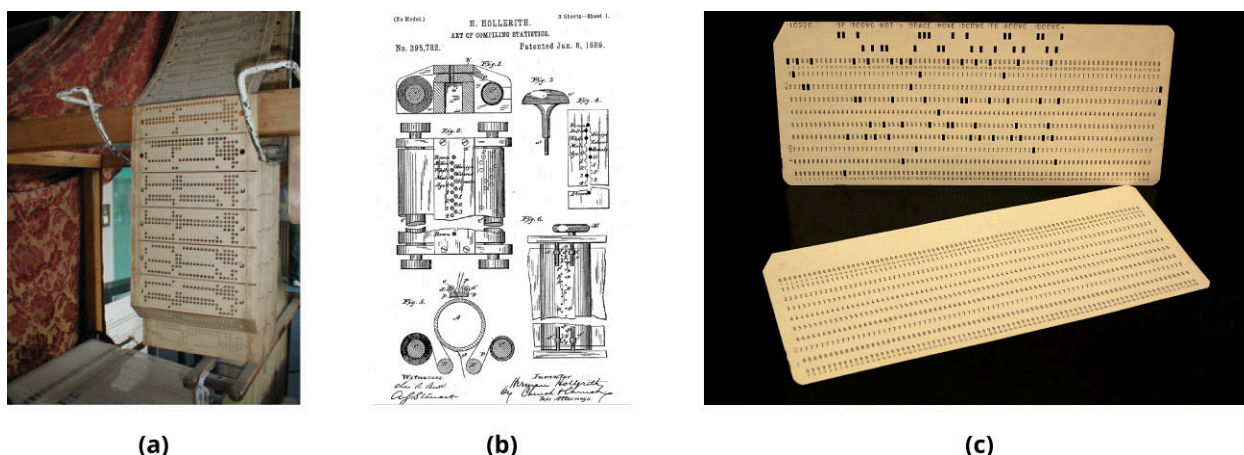
**Figure 1.5** (a) Jacquard's loom, which performed calculations using a punch card system, was an early development in computing, as was (b) Herman Hollerith's punch-card tabulating machine, for which he was awarded a patent in 1889. (c) Each hole in a punch card equals a piece of data (called a "bit" today) that the machines read. (credit a: modification of work "Jacquard.loom.cards" by George H. Williams/Wikimedia Commons, Public Domain; credit b: modification of work "Holerith395782Figures1-6" by Herman Hollerith/ Wikimedia Commons, Public Domain; credit c: modification of work "2punchCards" by José Antonio González Nieto/Wikimedia Commons, CC BY 3.0)

While the cards' pasteboard was hardware, the patterns of holes in the cards were software because they provided instructions and determined which patterns would appear in each piece of cloth produced by the loom. This process demonstrated how hardware and software could be coordinated to achieve specific tasks, providing an important framework as computers were developed.

(https://openstax.org/r/109EarlyComps) and explore the evolution of computer hardware and software.

## Digital Media and Its Impact on Human Communication

As computers have evolved to become more powerful and offer more features, information sharing experienced the next wave of major advancement through digital media. The term **digital media** refers to the content developed, stored, and distributed via mobile devices—such as news stories, blogs, videos, and online games—as well as the hardware—flash drives, DVDs, and digital computers—used to store and share this media. Digital media falls into one of six categories: audio, video, social media, advertising, news, and literature.

The impact of digital media is transformative, as it promotes information sharing, enabling people, businesses, and societies around the world to communicate. With digital media, which has included faster network speed and more robust architecture, students can take classes online; organizations can conduct business worldwide; news outlets can research, write, and distribute stories globally; and people can conduct real-time conversations with coworkers, friends, and families around the world. We use digital media to learn, be entertained, and conduct transactions such as ordering takeout food from a local restaurant or streaming a movie. The evolution of digital computers has caused a major disruption to media and publishing industries that create print newspapers, magazines, and books, now that television programming and advertisements are available online twenty-four hours a day, seven days a week.

As the internet developed, users were able to use computers to share information through resources such as emails and online access to news sites. By the late 1970s, online text-based games became popular, and many organizations began using computers to operate online public bulletin boards. Later, files could be uploaded and shared, and by the late 1990s, it was possible to post and share music and videos online. These technological advancements were important to support the evolution of information systems, giving users more options for communication and information sharing.

## Web 2.0 and Social Media Platforms

The initial version of the internet is known as Web 1.0, and it featured websites that were static, which means that users could read website content but could not interact with it. Shortly before the beginning of the twenty-first century came the next generation of the internet. Known as Web 2.0, the basic functioning of the internet changed to enable, and even encourage, users to be active participants on the internet by contributing content, such as comments, blogs, photographs, and videos.

No technological improvements or advancements were necessary to move from Web 1.0 to Web 2.0. Rather, this transition was simply a change in the way the internet was perceived and used. This led to the launching of applications and websites that led to the growth of social media. Any type of electronic communication tool that enables users to establish online communities where they share content, including personal messages, ideas, photographs, and videos is considered **social media**.

Once technology was available to support social media, many new websites were developed. For example, Wikipedia was launched in 2001, providing users with an online encyclopedia that enables information sharing on any topic. Facebook started in 2004 as a way to connect students at Harvard University and later evolved into the social networking service of today that provides users throughout the world with a means to communicate, connect, and share information. In February 2005, YouTube's online platform to share videos was launched. A few months later, in June 2005, Reddit began, providing users with a means to upload a variety of content—including images, videos, and text posts—that other users could vote up or down. In 2010, Instagram launched, offering a social networking service to share photos and videos. In 2016, China launched TikTok, a social media platform for sharing videos.

The concept of social media, the process of social networking via technology, can be traced back to the telegraph. With the ability to transmit messages electronically over many miles, the telegraph gave people a means to interact socially without being face-to-face. Later, when the ARPANET began, email became a popular form of social media. As the world began to appreciate the convenience and benefits of interacting online, Web 1.0 became Web 2.0. To understand the impact of Web 2.0, consider that by early 2024, 5.04 billion people (62.3 percent of the world's population) were using social media to communicate and share information.[3]

## Future Trends in Information Systems

Our world is complex, and information helps us make sense of the people, places, things, and events that surround us. Through information systems, we can communicate and share information to learn from each other, solve challenging problems, and explore new opportunities to meet our needs, both personally and professionally.

To ensure that people can continue to communicate and manage the complexities of the world, information systems, including processes to share information, continue to evolve. Emerging technologies, such as artificial intelligence (AI), machine learning (ML), and blockchain, have the potential to provide many benefits to much of the world's population, but can also raise or expand ethical concerns. As these systems continue to advance, we will need to balance these ethical concerns with the benefits they bring.

# Features of Information Systems

As you have learned, the components of information systems are people, hardware, software, data, and procedures. These components work with the elements of information systems—input, processing, output, and feedback—and the operations of these systems and the processes to manage data and ultimately to support business operations.

## Components of Information Systems

The components of information systems all interact closely to make the system function. People are a vital part of information systems, both as developers and as system users. An important aspect of systems development is ensuring that a system is user-friendly. To maximize functionality and promote information sharing, systems must be accessible to individuals without a background in technology.

Hardware provides the necessary foundation and tools that make software operational, and software is necessary to process and store data. In addition to enabling software, hardware such as keyboards and mice provides users with the means to access the system for the purposes of inputting and retrieving data. Without software, the hardware does not have the instructions needed to function appropriately and perform specific tasks. Two types of software—operating systems and applications—are necessary for information systems to function. The **operating system (OS)** functions as a computer's manager by operating the computer's memory and other hardware resources such as disk storage. Additionally, the OS provides the interface for users to work with the computer, and it manages the computer's application software programs. Examples of an OS include Linux, which is open source, and Microsoft Windows, for which a license must be purchased.

Programs that enable computers to perform specific tasks are called **application software**. Examples of application software include word processing and spreadsheet programs, as well as web browsers and presentation software. The mobile applications on your mobile phone that enable you to do things like send texts and play games are also examples of application software.

Once hardware and software are in place, the next essential component is data. As noted earlier, the basic concept and purpose of information systems is processing and sharing information, and data are necessary to achieve this objective. This information may include both quantitative and qualitative data. Numerical information is called **quantitative data**. In IS, this may include statistics, financial information, and other data

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3   "Overview of Social Media Use," *Digital 2024: Global Overview Report,* Kepios, January 2024, https://datareportal.com/reports/digital-2024-global-overview-report.

such as marketing trends that are expressed numerically. Nonnumerical information is called **qualitative data**. Depending on the needs of the system, information may include a variety of qualitative data, such as customer names and addresses, photographs, videos, descriptive information, individual opinions, and any other nonnumerical information needed to meet the system objectives.

Once a system has hardware, software, and data, procedures are essential to ensure that it functions appropriately. These procedures should be written in detail to provide instructions and policies for the use of the system. These procedures should include information about security, such as who has authorization to use the system and policies for maintaining and updating passwords.

## Elements of Information Systems

Once the components are in place, several elements are necessary for the information system to function. These elements include environment, input, processing, output, control, and feedback.

- Factors such as physical location and network capabilities that affect a system and help determine how it operates are referred to as its **environment**. This also involves the purpose and context of a system, including whether the majority of users are tech savvy or have limited skills in technology. To ensure that a system is set up appropriately, it must be implemented in an environment that will promote its capabilities and meet the goals and objectives. For example, if an information system contains sensitive information that must be protected from unauthorized users, the physical location of the system must be in a secure building, and the system itself must include cybersecurity features that guard against hacking and other unauthorized use.
- The **input** is the data that are collected and entered into the system by users or automatically when transactions occur, such as when you make a purchase with a debit card and your checking account is automatically charged for the purchase. An information system must include the software needed to handle the types of data required for the system. For example, a system that handles financial data needs spreadsheets, and a system that handles qualitative data such as reports needs word processing capabilities. Typically, an information system needs multiple software applications to handle the diverse types of data required for the system.
- The performance of tasks in order to make data useful in a system is known as **processing**. For example, once financial data are entered into a spreadsheet, that data must be computed in order to yield useful information such as the costs to produce goods and services, the number of sales per month, and the profits earned per quarter. The calculations to derive this data are tasks performed as part of processing.
- The data and information that a system generates and provides to users is called the **output**. Data about a business's costs, sales, and profits are examples of information system outputs. Information system users must be able to retrieve this output in a secure and user-friendly manner whenever data are needed.
- A policy or procedure that ensures a system functions effectively, efficiently, and securely is called a **control**. Controls typically fall into two categories—application and general.
  - An **application control** is built into the system and includes features such as firewalls, encryption, and access control.
  - A **general control** refers to a process that outlines how an information system is to be used and includes requirements such as routine password updates.
- Information that users provide to managers about an information system's functionality is called **feedback**. When users report problems with the system or note a procedure that can be improved, this feedback is used to modify and improve the functionality of the information system.

## Operations of Information Systems

Information systems operations refer to how the system is used. This includes data capture, processing, storage, retrieval, and dissemination.

- The process of gathering data from various sources such as customers and financial records, and

inputting this data into the system is called **data capture**.

- Using calculations, manipulations, and analysis to transform data into useful information is called **data processing**. This includes, for example, the processes of adding the number of products sold during a month and calculating the profits earned from these sales.
- The process of maintaining a system's data and information in a location that is secure, reliable, and accessible to authorized users is called **data storage**. Location refers to the specific computer hardware and software used for an information system. These must include the tools and capability to store and manage data, such as databases. Location also refers to the physical building that houses the computer hardware and software for the system. This location must be secure, protecting the computer hardware and software from unauthorized users, as well as environmental threats such as earthquakes, fires, and floods.
- The process of retrieving data from storage is called data retrieval. For example, users should be able to load and review applications, such as spreadsheets, that store data. Users should be able to download this information and use it for authorized purposes, such as research and preparing reports.
- The process of distributing and sharing information such as reports, videos, photographs, and other system outputs to users is called **data dissemination**.

## Impact on an Organization's Operations

Organizations have come to rely on information systems as a critical resource. A well-developed and maintained system offers important benefits to organizations of all types, including businesses, government agencies, and nonprofit associations. Information systems bring interconnectedness to an organization and provide many benefits, such as improved efficiency, more robust decision-making, enhanced communication processes, increased productivity, and competitive advantages.

Information systems improve efficiency by reducing the time, effort, and costs required to perform tasks and conduct transactional business, which may include processes such as inventory management, filling orders, billing, payment processing, shipping, and returns and refunds. Information systems can make certain tasks easier to perform and can automate others. They can also improve accuracy, making an organization's data more reliable.

To understand how information systems improve an organization's transactional business, consider a food order through a delivery service. The customer places an order online, the restaurant's system processes it, and the app collects the payment. Generally, this process is simple and convenient for the customer and the restaurant. Because the customer entered the order online, the restaurant knows exactly what food they want, which should reduce the chance for errors in the order. Later, the customer can use the system to let the restaurant know about any concerns or to provide a positive review. By using information systems, restaurants and delivery services across the nation have streamlined the process of taking and filling takeout delivery orders, improving customer service while creating a better system of recordkeeping.

Information systems help organizations gather reliable data and make better decisions by providing timely information and the option of developing scenarios, using data in mock situations to examine potential problems or opportunities. The decision-making processes that have been improved by information systems include performance evaluations, risk assessment, budgeting, cost analysis, forecasting, resource allocation, strategic planning, investment analysis, and competitive analysis.

Information systems improve organizational communication by making it easier for colleagues and teams to share information and collaborate. This collaboration is enhanced because these systems enable organizations to work with better and more accurate data. Collaborative business processes positively impacted by information systems include group decision-making, conflict resolution, relationship management, and negotiation.

Consider a team of colleagues who are working together to develop a marketing plan for a new product. By

using information systems, each member of the team can access and share data about the product to understand its purpose, target market, and options for marketing. By accessing data on the organization's previous marketing efforts, they can understand and share information about marketing techniques that have worked well for the organization in the past, as well as those that were not as effective. The information system provides the team with the data and tools they need to fully understand the product and the marketing goals, and gives the team the resources they need to communicate and negotiate to develop a successful marketing plan.

An information system also increases an organization's productivity by enabling users to automate certain tasks and complete others quickly. They streamline workflows, enabling organizations to develop and adhere to workflow processes that are more efficient, thus reducing errors and waste, such as discarded paper.

These improvements generally result in reduced organizational costs and improved quality of an organization's operations, including the goods and services produced. Information systems enable organizations to provide better customer service, which typically leads to more satisfied customers, increasing the likelihood that customers will rely on the organization again when they need its goods or services.

### LINK TO LEARNING

By now, you should understand that information systems are a vital tool for organizational success. To learn more, explore how nineteen companies, including Lego and Sephora, are using information systems (https://openstax.org/r/109ISinWorkplce) in their operations. As you read their stories, consider how the field of IS improved operations, whether these companies could have accomplished their goals without IS, and whether you would recommend these companies use IS in the future.

## 1.2  Frameworks of Knowledge and Industry Standards

### Learning Objectives

By the end of this section, you will be able to:
- Discuss the use of frameworks and industry standards in IS
- Identify the frameworks and standards in IS
- Correlate the frameworks and standards to knowledge as an IS professional
- Discuss characteristics and roles of IS professionals

To promote best practices and help organizations achieve information systems goals and objectives, the field of information systems (IS) is guided by frameworks and industry standards. A **framework** refers to a tangible structured set of guidelines and best practices that is used to guide the process of developing, implementing, managing, or maintaining a business process, policy, system, or procedure --such as an information system. An **industry standard** is a policy, procedure, or requirement widely used and supported in an industry to promote efficiency and quality in goods and services.

Frameworks and industry standards can help IS professionals develop and maintain robust systems that enable organizations to function effectively and competitively. In addition, a framework can enable an information system to function in everyday life. For example, a fitness app can help you set fitness goals, establish an exercise plan, and track food and nutrient intake. It may provide access to free information and suggestions from athletes, fitness trainers, and experts in wellness. Similarly, an organization can use information systems to support decision-making and set goals for any function, including financial management, human resources, and marketing. Once an organization establishes its goals, it can use information systems to develop a plan of action to achieve those goals and then use it to carry out their plans, track progress, and achieve success in the marketplace.

## Use of Frameworks and Industry Standards in Information Systems

When developing an information system, frameworks provide guidance to help IS professionals apply critical thinking as they identify the goals of the system and problems that can be resolved by the system. Frameworks promote proactive communication and help IS professionals organize their ideas and provide a foundation for strategic planning to develop and maintain a system that meets an organization's specific needs. As part of this process, frameworks also provide IS professionals with resources such as continuing education, best practices, and guidelines for systems operations.

Industry standards help IS professionals ensure that the system they develop has the appropriate infrastructure and technological components required to function efficiently. This includes ensuring the system is compatible with information systems used in other organizations. After all, an important objective of IS to enable information sharing internally and externally as organizations interact in the marketplace.

## Specific Frameworks and Standards in Information Systems

Starting with the most commonly used frameworks, those applicable to IS include Agile, Control Objectives for Information and Related Technologies (COBIT), Information Technology Infrastructure Library (ITIL), the Skills Framework for the Information Age (SFIA), Waterfall, and Zachman.

**Agile methodology** is a framework used to guide project management, primarily by dividing projects into phases, or sprints. Typically, these sprints include planning, designing, developing, testing, deploying, and reviewing. After each sprint, the project team examines their progress and adjusts before moving to the next sprint. Agile can be a useful framework as IS professionals plan and develop an information system. Several versions of Agile frameworks are used for project management, including Kanban, Lean, and Scrum.

**Control Objectives for Information and Related Technologies (COBIT)** is a framework that develops and maintains an information system using five processes: Evaluate, Direct, and Monitor (EDM); Align, Plan, and Organize (APO); Build, Acquire, and Implement (BAI); Deliver, Service, and Support (DSS); and Monitor, Evaluate, and Assess (MEA) (Figure 1.6). COBIT is promoted by the Information Systems Audit and Control Association (ISACA), which is a global organization that provides training, research information, news updates, advocacy, and related support for IS professionals and others involved in information technology.
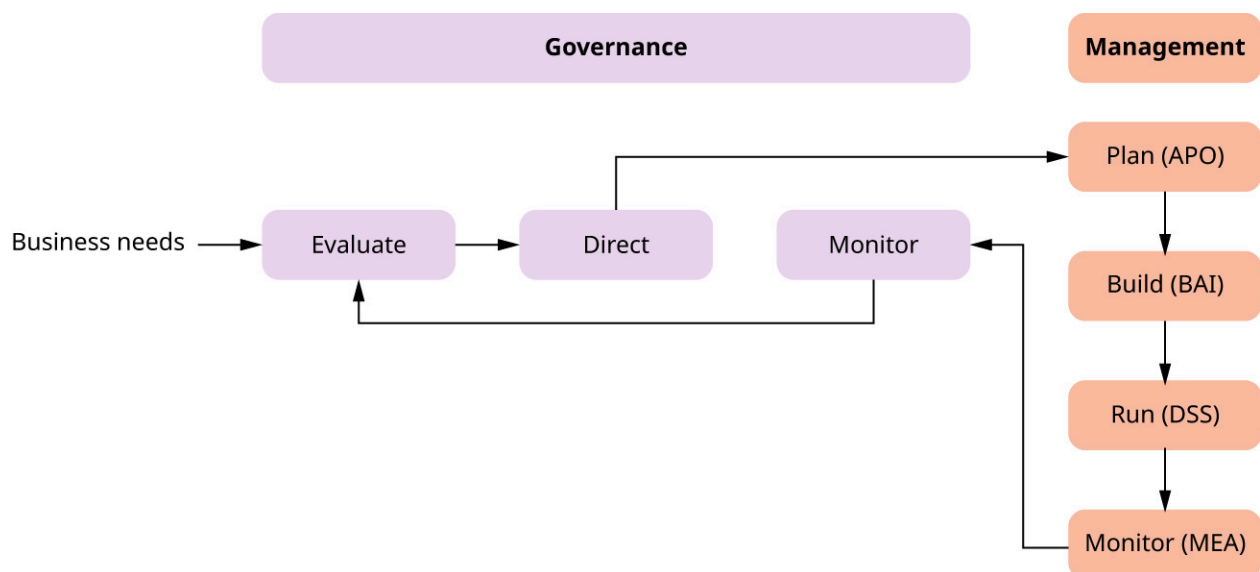


**Figure 1.6** COBIT's framework provides IS professionals with five processes—Evaluate, Direct, and Monitor (EDM); Align, Plan, and Organize (APO); Build, Acquire, and Implement (BAI); Deliver, Service, and Support (DSS); and Monitor, Evaluate, and Assess (MEA)—that can help develop and maintain an information system. (credit: modification of work from *Introduction to Computer Science*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

**Information Technology Infrastructure Library (ITIL)** is a comprehensive framework of documentation that

discusses best practices for managing information technology. ITIL is managed and updated by AXELOS, a company that provides training and certifications to various technology professionals, including those in IS. ITIL offers guidance, as well as professional certification, for carrying out twenty-six processes in the areas of service strategy, design, transition, operation, and improvement.

The **McKinsey 7-S Framework** focuses on how an organization can be efficient and effective with interaction and coordination of its staff, structure, strategy, skills, systems, style, and shared values. The goal of the framework is to determine how an organization can be effective with interaction and coordination of the seven elements:

- Staff: the people who lead and work in an organization, as well as the tools to support the staff, including training and incentive programs
- Structure: how an organization is designed, including its hierarchy and chain of command
- Strategy: the organization's goals/objectives and the plans to achieve these
- Skills: the skills, knowledge, and competencies held by the organization's staff
- Systems: the workflow processes used to achieve the organization's goals and objectives
- Style: the tone at the executive level established by the organization's leaders and managers
- Shared values: the organization's mission and values that motivate its operations

## LINK TO LEARNING

The McKinsey 7-S Framework was introduced in the 1970s to emphasize the importance of coordination within an organization across its structure. Review this interactive presentation about the framework's applicability today (https://openstax.org/r/109McKinsey) from McKinsey and Company.

The McKinsey 7-S Framework can be used by following four steps:

1. Identify the parts of the organization that are not aligned with shared values, including a shared mission, goals, and objectives.
2. Determine the design and structure that will enable the organization to achieve alignment and reach its goals and objectives.
3. Identify areas where changes are needed to update the organizational design.
4. Implement the necessary changes.

This framework can help ensure organizations are in alignment and have an effective design, making it easier to develop and maintain the appropriate information systems to meet the organization's needs.

The **Skills Framework for the Information Age (SFIA)** provides a comprehensive skills and competency framework in a common language for the IT industry. It includes the steps listed in Figure 1.7. It was developed and is overseen by the SFIA Foundation, a global organization committed to helping IS and other technology professionals acquire the skills and competencies needed to successfully develop and manage technology. Organizations around the world in both the public and private sectors use SFIA to map out the knowledge and expertise needed to fill each role in their organizations. This includes entry-level to advanced positions in the areas of technology development, strategy, architecture, and support.
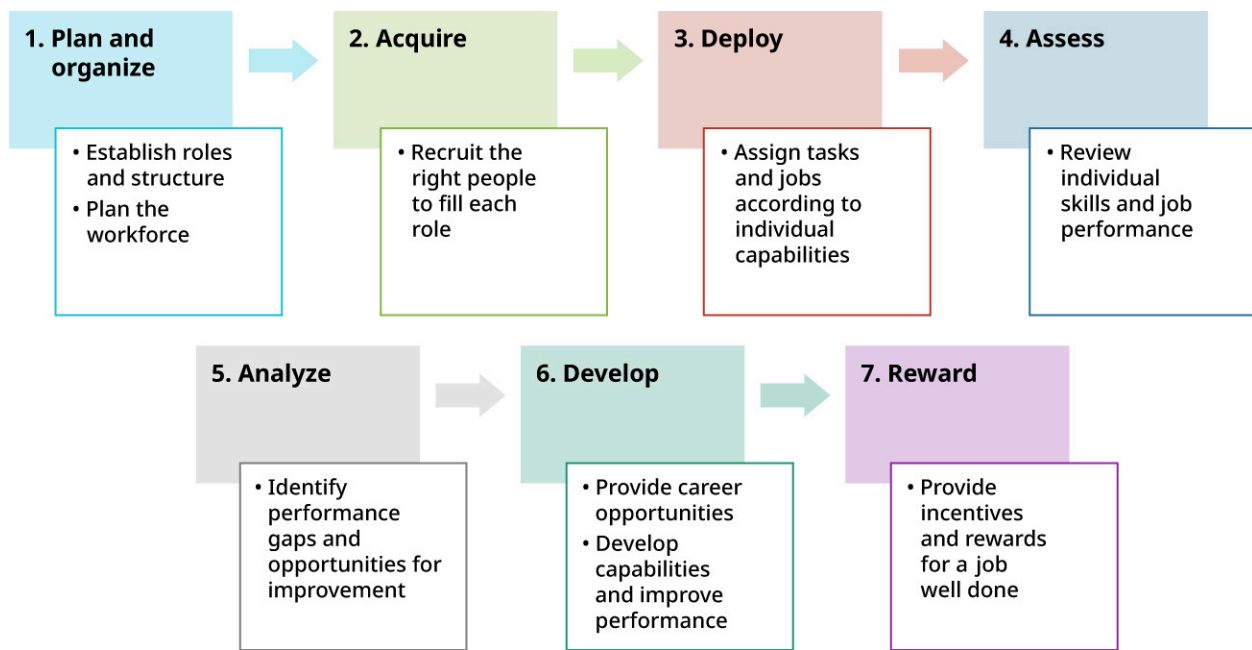
**Figure 1.7** SFIA can be an important framework as organizations develop the skills needed to manage technology. This includes planning and organizing, acquisition, deployment, assessment, analysis, and development. It is also important that organizations reward employees and recognize their success. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Individually, IS professionals use SFIA to identify the skills they personally need to develop to perform their jobs and advance their careers. SFIA is structured to help organizations and individuals achieve success in the following seven levels of responsibility:

- Level 1, Follow: This level applies to entry-level positions that are closely supervised, perform routine tasks, rely on basic tools, and have minimal influence on the work environment, essentially following others as they perform their jobs.
- Level 2, Assist: These employees also work under close supervision, but their work is a bit more complex, and they have more influence with colleagues.
- Level 3, Apply: At this level, employees receive more general supervision, and they have more autonomy. Their work is more complex and may not be routine. They also may be allowed to make some decisions on their own and may oversee other employees.
- Level 4, Enable: Employees at this level have much more complex work in a broader range of contexts. While they receive general direction, they have considerable autonomy, as well as personal responsibility for work outcomes.
- Level 5, Ensure and Advise: At this level, employees receive broad direction, giving them more autonomy, including the ability to self-initiate work that they think should be performed. Their tasks tend to be complex and are an integral part of an organization's strategic plans.
- Level 6, Initiate and Influence: Employees who initiate and influence play a central role in establishing an organization's objectives and assigning responsibilities to subordinates. These employees perform highly complex tasks and make decisions that directly impact an organization's performance and achievement of organizational goals and objectives.
- Level 7, Set Strategy, Inspire, and Mobilize: The final and highest level is filled by an organization's top leaders and managers. These individuals establish an organization's policy objectives and have oversight and accountability for all decisions made and actions taken throughout the organization.

SFIA is an important framework used globally to promote success in the digital world. Its common language helps technology professionals across the globe integrate the processes they must learn to successfully manage technology.

**Waterfall** is a structured, linear framework used to guide project management. Generally, the steps of

Waterfall include compiling documentation of the project requirements, using logical design to brainstorm how to approach the project, developing the physical design, implementing the design plan, verifying and testing the design, and maintaining the design once it is in use. While Waterfall tends to focus on computer programming and coding, the framework can be applied to IS.

The **Zachman Framework** provides a structure for developing and organizing the artifacts of enterprise architecture, including data and documents, which are vital for a robust information system. Using a 6 × 6 matrix, the Zachman Framework asks the following six questions to identify the needs and perspectives of stakeholders in a particular system:

- *What?* seeks to understand the data needed for the system by learning about the organization's data, objects, and information.
- *How?* seeks to understand the organization's processes and functions.
- *Where?* seeks to learn where the organization operates.
- *Who?* seeks to learn who the organizational members are, as well as gather details about the organization's units and hierarchy.
- *When?* seeks to learn the organization's schedule of operations, including when processes are performed.
- *Why?* seeks to learn why the organization has selected certain systems and solutions for its enterprise risk management and information systems. This question also seeks to determine what motivates the organization to perform certain functions.

As shown in Figure 1.8, these questions are posed across the top of Zachman's 6 × 6 matrix. On the left side of the matrix, the rows list the organization's stakeholders. To understand the system needs, the stakeholders' perspectives are entered into the appropriate cells in the matrix. The Zachman Framework can be an important tool to understand what an organization's information systems should entail and develop the appropriate enterprise architecture to support that system.

| | What (Data) | How (Function) | When (Time) | Who (People) | Where (Location) | Why (Motivation) |
|---|---|---|---|---|---|---|
| **Scope (Contextual)** | List of things | List of processes | List of events | List of organizations | List of locations | List of goals |
| **Enterprise Model (Conceptual)** | Semantic model | Business process model | Master schedule | Work flow model | Logistics network | Business plan |
| **System Model (Logical)** | Logical data model | Application architecture | Processing structure | Human interface architecture | Distributed system architecture | Business rule model |
| **Technology Model (Physical)** | Physical data model | System design | Control structure | Presentation architecture | Technology architecture | Rule design |
| **Implementation (Detail)** | Data definition | Programs | Timing definition | Security architecture | Network architecture | Rule specification |
| **Functioning Enterprise** | Usable data | Working function | Usable network | Functioning organization | Implemented schedule | Working strategy |

**Figure 1.8** The Zachman Framework provides a structure for developing and organizing the artifacts of enterprise architecture. By asking *what*, *how*, *where*, *who*, *when*, and *why*, the Zachman Framework can help IS developers understand an organization's needs from the perspective of an organization's various stakeholders, including executives, managers, and technicians. (credit: modification

of work "Zachman Framework (9026775815)" by National Institute of Standards and Technology/Wikimedia Commons, Public Domain)

The industry standards that are applicable in IS include the American Society for Industrial Security (ASIS), the Federal Information Security Modernization Act (FISMA), IS2020, ISO/IEC 27001, and the Open Group Architecture Framework (TOGAF).

The **American Society for Industrial Security (ASIS)** is a global organization that provides training and certification to help professionals in all industries provide security for people, property, and information. ASIS is a global organization that collaborates with public and private organizations throughout the world—such as the Department of Homeland Security and the Federal Bureau of Investigation—to ensure that IS professionals and others involved in security have the resources needed to successfully handle security issues at every stage of their career.

IS professionals who work for government agencies or private businesses that contract with the government should be familiar with the **Federal Information Security Modernization Act (FISMA)**, which sets the guidelines and standards for security that affected organizations are required to meet to minimize the possibility that data will be stolen, lost, or misused. Under FISMA, affected organizations must have a security strategy that addresses issues such as system access control, risk assessment and management, information integrity, audit and accountability, incident response, and staff's continuing education.

**IS2020** is a competency model that provides guidance and standards to higher education institutions to ensure that undergraduate IS programs effectively prepare students for careers in IS. Developed by an international task force of members of the Association for Computing Machinery (ACM) and Association for Information Systems (AIS), IS2020 outlines the curriculum that should be offered to IS students and the competencies that students should develop as they complete the curriculum. This includes the knowledge, skills, and dispositions that students need for successful careers in IS, as well as the tasks that students should learn to perform.

**ISO/IEC 27001** is a worldwide standard established by the International Organization for Standardization that defines the requirements information systems must satisfy to provide adequate security for any system. ISO/IEC 27001 applies to all sizes and types of organizations in both the public and private sectors. The standard focuses on cybercrime but helps organizations guard against any threats to data availability, integrity, and confidentiality.

**The Open Group Architecture Framework (TOGAF)** is a trademarked standard in its tenth edition that promotes best practices for IS and other technology. TOGAF is used by organizations throughout the world in both the public and private sectors to support requirements management for enterprise architecture. The areas covered by TOGAF include architecture vision, business architecture, information systems architectures, technology architecture opportunities and solutions, migration planning, implementation governance, and architecture change management.

## LINK TO LEARNING

The Open Group Architecture Framework (TOGAF) contains vision, requirements, business architecture, information systems architecture, technology, and architecture realization. TOGAF can be an important standard to support organizations as they develop and manage the requirements for enterprise architecture. As their Architecture Development Method (https://openstax.org/r/109ArchDevMethd) shows, TOGAF covers all aspects of enterprise architecture, including information systems. This framework provides an essential structure for managing and aligning strategies with business goals.

## Application of the Frameworks and Standards

IS professionals should rely on the frameworks and standards applicable to their organization and specific role to guide their work. This helps ensure that the work meets the organization's needs, while also following standards important for maintaining IS compatibility with other organizations.

It is also beneficial to join one or more professional organizations such as the Association for Information Systems (https://aisnet.org/), International Association for Computer Information Systems (https://www.iacis.org/), or Information Systems Audit and Control Association (https://www.isaca.org/). Such organizations provide members with important resources, including training, as well as news and updates about events and changes important to IS professionals. Joining such organizations and taking advantage of learning opportunities helps ensure that you obtain the appropriate continuing education to stay abreast of changes and new requirements in the field of IS. In addition, members of such organizations gain access to colleagues around the world who can become an important networking resource for information sharing and collaboration.

### GLOBAL CONNECTIONS

A Symbiotic Relationship: IS and Globalization

Information systems have allowed companies to increase their business operations globally. As more organizations develop an international presence, these systems become a vital tool to promote and sustain organizational successes in the global marketplace. To be effective, IS professionals must understand globalization and how it relates to IS. Organizations such as the Association of Information Systems (AIS), Association of Computing Machinery (ACM), and Information Systems Audit and Control Association (ISACA) can provide information to stay abreast of the developments and opportunities (such as career, networking with IS professionals) related to the theory and practice of IS in the global environment. Establishing and maintaining global connections provides IS professionals with invaluable resources to accomplish IS goals.

## Characteristics and Roles of Information Systems Professionals

People working in IS may be involved with new technologies applicable to information systems, how information systems are used globally, and the ethical requirements necessary to ensure a system is managed securely with integrity. IS professionals hold a variety of important roles and responsibilities in an organization. These include the following:

- A chief information officer (CIO) establishes and maintains an organization's overall information systems. The CIO's responsibilities include ensuring that the systems comply with legal requirements and that others involved in an organization's information systems do their jobs competently.
- Data information systems management manages the people, technology, and procedures needed to convert data into information. This includes cleaning, extracting, integrating, categorizing, labeling, and organizing data.
- Database management develops procedures to organize, manipulate, and retrieve data that are stored on computer databases.
- Systems analysis, design, and development examines an organization's system needs, and designs and develops a system to meet those needs.
- IS security risk management manages the risks that threaten an organization's information system.
- Enterprise security, data privacy, and risk management focuses on threats, such as data breaches, cyberattacks, and risks to data privacy, that can compromise an organization's data and information systems.
- Cloud computing focuses on how an organization uses information systems in the cloud for purposes such as storing and processing data.

- Data analytics and modeling transforms raw data into useful information and analyzes that data to provide information useful in organizational decision-making and other operations.
- IS project management uses the project management steps of initiation, planning, execution, monitoring, control, and closure to handle IS projects.

In addition to the benefit of working in a role aligned with an individual's experience and interest, IS positions tend to pay competitive salaries, and the field's outlook remains promising.

## ETHICS IN IS

### Ethics as Integral to IS

Any IS professional will likely have to manage sensitive data, and mishandling it can negatively impact the operations of organizations, as well as the lives of individuals. Cybersecurity is a priority because, worldwide, hackers are constantly working to find organizations with vulnerable systems that can be exploited for financial gain and other criminal uses. IS professionals must understand IS risks and practice ethical behavior to manage those risks. Keep in mind that every part of IS must be managed with an ethical mindset, understanding its importance and recognizing that IS professionals have an obligation to do everything they can to help safeguard data.

## 1.3 Connections between Information Systems and Information Technology

### Learning Objectives

By the end of this section, you will be able to:
- Explain competencies in IS and IT
- Describe the connections between IS and IT
- Discuss training and education requirements for IS fields

As you have learned, organizations must have robust information systems managed by qualified professionals. To help ensure that IS professionals and organizations have the required expertise, the U.S. Department of Labor has developed the Information Technology Competency Model, a framework that defines the knowledge, skills, and abilities that are essential for IS professionals. It is important for IS professionals to understand the relationship between IS and IT, as these two disciplines work in tandem to support organizational objectives and foster innovation. Further, many of the training and education requirements for professionals in the IS field use the Information Technology Competency Model to prepare individuals to navigate the complexities of this dynamic and rapidly changing industry.

## Competencies in IS

For all occupations, including IS positions, the U.S. Department of Labor (DOL) recommends competency-based approaches for hiring employees and for providing the education and training that employees need to do their jobs well. A **competency** is the ability to apply specific skills, experience, and personal characteristics to do a job in an effective and efficient manner. Someone's personal characteristics are the traits that are appropriate for the job or task being done based on the individual's interests, strengths, background, education, and training. In addition, an individual's talents, motivations, and personal perceptions of their work influence competency.

A **competency model** is a framework that identifies the competencies required for employees to effectively perform their job. Generally, for all industries, the competencies that are important include the following elements:

- Personal effectiveness: competencies such as interpersonal skills, integrity, professionalism, initiative,

dependability, reliability, and willingness to learn
- Academic: competencies such as reading, writing, and mathematics
- Workplace: competencies used in the workplace such as teamwork, creative thinking, problem-solving, and decision-making
- Industry-wide technical: general competencies needed in a specific industry; for example, database management and network administration are competencies necessary to succeed in IS
- Industry-sector technical: competencies directly related to specific positions within an industry; for example, in IS, professionals who focus on cybersecurity must be competent about data security and risk management
- Management: leadership, direction setting, team oversight, conflict resolution, delegation

To be successful in the workplace, IS professionals need personal effectiveness, academic, and workplace competencies. In addition, they need competencies specific to technology and information systems. These include knowledge and skills in the principles of information technology, databases and applications, technological networks, telecom, wireless and mobility, software development and management, user and customer support, digital media and visualization, compliance, risk management, security, and information assurance. IS professionals also need competencies specific to the role they fill in IS. Table 1.1 outlines both general and IS-specific professional competencies.

| Competency | Description | Examples |
|---|---|---|
| Personal effectiveness | Personal characteristics or traits related to working | General:<br>• interpersonal skills<br>• initiative<br>• dependability<br>• reliability<br><br>IS-specific:<br>• integrity<br>• willingness to learn<br>• professionalism |
| Academic | Essential education | General:<br>• reading<br>• writing<br>• mathematics<br><br>IS-specific:<br>• business<br>• technology |

**Table 1.1 Professional Competencies** No matter what field you go into, certain personal, academic, and workplace skills are needed to be successful as you grow in your career.

| Competency | Description | Examples |
|---|---|---|
| Workplace | Competencies used in the workplace | General:<br>• teamwork<br>• creative thinking<br>• decision-making<br><br>IS-specific:<br>• business fundamentals<br>• problem-solving<br>• listening |
| Technical | General competencies needed in a specific industry | IS-specific:<br>• IS principles and concepts<br>• IS standards and IS regulations<br>• databases management<br>• network administration<br>• risk management |
| Occupation-specific | Competencies directly related to specific positions within an industry | IS specific:<br>• cloud computing: networking, programming, machine learning, virtualization, cloud security, business concepts, and project management<br>• systems analysis: system design, data analysis, business analysis, problem-solving, critical thinking, creativity, and systems administration<br>• cybersecurity: threat detection systems, digital forensics, penetration testing, auditing, data security, data privacy |
| Management | Competencies regarding leadership, conflict resolution, delegation, and team dynamics | General:<br>• team management<br>• conflict management<br>• delegation<br>• leadership<br><br>IS-specific:<br>• risk assessment<br>• policy development<br>• regulatory compliance<br>• incident response planning |

**Table 1.1 Professional Competencies** No matter what field you go into, certain personal, academic, and workplace skills are needed to be successful as you grow in your career.

As a student, you can use the Department of Labor's (DOL's) Information Technology Competency Model (https://openstax.org/r/109DoLInfo) to understand the knowledge you should gain and the skills you should develop to have a successful career in IS.

## Connections between Information Systems and Information Technology

As an IS professional, you likely will work closely with professionals in IT. Although the terms *IS* and *IT* are sometimes used interchangeably and the fields are connected, they are not the same. While IS focuses on an organization's goals and developing an information system to meet organizational needs, IT is concerned with the technological operations. IT professionals design and build an organization's technological infrastructure, including the computer hardware, software, and networks required to support the information system. IT professionals also provide user support to maintain technology and ensure that it functions appropriately.

IS and IT professionals typically work together to ensure that an organization's technological needs are met. For example, IT professionals use IS requirements to guide their work as they design and develop an organization's technological infrastructure.

You will likely work with IT professionals at some point during your career, and it will be helpful to understand how IT roles differ from IS roles. This geeksforgeeks.org blog provides more details (https://openstax.org/r/109ITvsIS) about the differences, including a table that compares the two fields.

## Career Focus: Training and Education Requirements for Information Systems Fields

If you are interested in becoming an IS professional, or just want a better understanding of the impact of IS on organizations, you will benefit from learning about a variety of topics important in business and technology. Some of the key topics include the following:

- **business analysis**, which reviews an organization's operations to determine needs and how these can be addressed by IS
- cybersecurity, which identifies an organization's cybersecurity risks and implements measures for risk management
- **enterprise system**, which is a software package that organizations use to automate and coordinate operations, solve an organization's problems, and monitor organizational performance
- information system design, which develops the framework and structure for IS that enables IS to meet an organization's specific needs
- **information technology (IT)**, which reviews how computers and other technology can be used to process, store, retrieve, and share information
- networks, which explores the processes to connect computers and other technology to enable information sharing
- programming, which delves into the processes to develop and write computer code that enables hardware and software to function appropriately

If you want to pursue a degree in IS or learn more about specific topics, you can take additional courses devoted to covering these subjects in depth.

Depending on the role, future IS professionals may qualify for a job by earning a degree or certification(s) in IS,

or both. Even if an IS professional has a degree, earning certifications can provide additional knowledge and training in areas such as security, database management, and data analytics. With certifications, IS professionals are required to complete continuing education credits each year, and holding one or more certifications signals that an IS professional is dedicated to their work. The certifications held by IS professionals include Associate Computing Professional (ACP), Business Data Management Professional (BDMP), Certified Business Intelligence Professional (CBIP), Certified Data Professional (CDP), and Information Systems Analyst (ISA). Typically, IS professionals earn the certification(s) related to the IS role(s) that they perform. To learn more, refer to 5.4 Career Focus: Key Certifications.

## 1.4 | The Global Importance of Information Systems

### Learning Objectives

By the end of this section, you will be able to:
- Describe why information systems should be global
- Discuss global innovation and its importance
- Describe global initiatives in IS

The field of IS is and has been an important component in **globalization**, or the process of businesses and other organizations operating around the world. This includes the international sales of goods and services, as well as the exchange of ideas across international borders.

## Why Information Systems Should Be Global

The global marketplace is an important resource worldwide. Countries trade goods and services, offering businesses around the world opportunities for growth and profit maximization. Organizations of all types in both the private and public sectors use globalization as a means to share information and resources, including technological knowledge.

IS supports globalization by providing the resources that organizations need to achieve success in the global marketplace. This includes enabling global communication and information sharing, as well as supporting the processes to manage data compiled from sources throughout the world. IS also gives organizations the tools to function at any time of day, eliminating the need for different time zones to be an obstacle in global operations. In addition, IS helps organizations develop the frameworks they need for strategic planning and decision-making on a global scale.

You will learn more about globalization and the role of IS in promoting global operations in Chapter 11 Global Information Systems which covers strategic and global information systems. This will include a look at the role of culture in IS, as well as IT, and the risks associated with the use of global data and systems sharing. For now, it is important to recognize IS as a vital tool for globalization.

## Global Innovations

One role of IS is to support and promote **global innovation**, which refers to the processes used to collaborate across international borders in designing and developing new goods and services for the global marketplace. Global innovation also focuses on international collaboration to develop solutions for global problems and challenges, such as climate change. For example, the World Meteorological Organization (WMO) helps governments and other organizations throughout the world track climate change and gather the information needed to make decisions, set policies, and take action to combat the impacts of climate change.

Organizations use processes such as business analysis, problem-solving, and decision-making for global innovation, and these same processes are used for internal and local issues. With global innovation, these organizational processes have a broader scope as they are applied to the global marketplace and this is covered in-depth in Chapter 11 Global Information Systems. In addition, Chapter 10 Emerging Technologies and Frontiers of Information Systems explores topics relevant to global innovation including emerging

technology, the evolving frontiers of IS, and the future of technology and its impacts on IS.

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**FUTURE TECHNOLOGY**

Artificial Intelligence: Theory in Action

Technology changes rapidly, and IS professionals must stay abreast of technological advances, understanding the impact that these have on IS. For example, consider artificial intelligence. AI has many potential benefits for IS, including improvements in efficiency for the processes to gather, store, and manage data. AI also presents a number of serious challenges such as privacy concerns as AI often gathers data without the individual's consent. AI is rapidly evolving and will be an important part of the future of IS. The advent of AI also provides an example of why continuing education is so important. With continuing education, IS professionals can ensure that they are prepared to handle the future, regardless of what technological changes and challenges face them.

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## Global Initiatives in Information Systems

As technology advances throughout the world, IS must continue to evolve. The key topics IS professionals are following include artificial intelligence, machine learning, 5G and the Internet of Things, edge computing, and blockchain.

- The ability of machines and computers to act, reason, and learn, continuing to develop and evolve, is called artificial intelligence. AI has various applications for IS. For example, AI can help process and manage data, making IS more efficient. This includes automating processes and reducing errors, ensuring that organizations have more accurate and reliable data for decision-making and other purposes. AI also can help organizations detect security threats and identify security issues more quickly, making it easier to protect an organization's information.
- The type of AI that allows machines to imitate human thought by improving and learning from experiences without explicit instructions or programming is called machine learning. ML also is evolving and changing the way IS is managed. For example, ML promotes more efficient and accurate processing of the data analytics and documentation needed in IS. As with AI, ML also can help with cybersecurity.
- During the advancement of 5G, the fifth generation of cellular network technology, and the Internet of Things (IoT), the network that connects everyday physical objects to the internet, enabling them to collect and share data with other devices or systems, IS is experiencing changes, such as the faster exchange of information and greater network connectivity. IoT also helps with real-time data collection and automation, which can improve the information available for IS.
- The distributed computing framework that allows data storage closer to the source of data, rather than a centralized cloud or server, is called edge computing. It is continually advancing, giving IS greater options for storing and processing data.
- The shared ledger that records transactions and is maintained through linked computers in a peer-to-peer network is called blockchain. Originally developed in 2008 for Bitcoin, it allows information systems more ways to store and share data with increased efficiency and security.

As technology advances, IS faces more risks, and this creates additional challenges to cybersecurity. Cybercriminals and cyberattacks are on the rise. According to the Federal Bureau of Investigation, 2023 saw a record number of complaints about cybercrimes, with over 880,000 complaints and financial losses exceeding $12.5 billion. This was a 10 percent increase in complaints and a 22 percent increase in financial losses compared to the previous year.[4] Fighting cybercrime and developing better cybersecurity to handle technological advances is an important global initiative for IS professionals throughout the world.

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4   Internet Crime Complaint Center, *Internet Crime Report* (Federal Bureau of Investigation, 2023), https://www.ic3.gov/Media/PDF/AnnualReport/2023_IC3Report.pdf

LINK TO LEARNING

One way to learn more about IS in cybersecurity and understand its importance is to play security awareness games. You can give this a try by exploring the Security Awareness Games (https://openstax.org/r/109SecurtyGames) from the Center for Development of Security Excellence. The website also offers games, word searches, and crossword puzzles that can help you learn more about cybersecurity.

# 🔑 Key Terms

**Agile methodology**   framework used to guide project management, primarily by dividing projects into phases, or sprints

**American Society for Industrial Security (ASIS)**   global organization that provides training and certification to help professionals in IS and other technological industries provide security for people, property, and information

**application control**   control that is built into a system and includes features such as firewalls, encryption, and access control

**application software**   program that enables computers to perform specific tasks

**business analysis**   understanding what a business needs to avoid or solve a problem or to take advantage of an opportunity

**competency**   ability to apply specific skills, experience, and personal skills to do a job in an effective and efficient manner

**competency model**   framework that identifies the competencies required for employees to effectively perform their job

**control**   policy or procedure that ensures an information system functions effectively, efficiently, and securely

**Control Objectives for Information and Related Technologies (COBIT)**   framework that develops and maintains an information system using five processes: Evaluate, Direct, and Monitor (EDM); Align, Plan, and Organize (APO); Build, Acquire, and Implement (BAI); Deliver, Service, and Support (DSS); and Monitor, Evaluate, and Assess (MEA)

**data**   raw facts and figures that are processed and turned into meaningful information

**data capture**   process of gathering data from various sources, such as customers and financial records, and inputting this data into an information system

**data dissemination**   process of distributing and sharing information, such as reports, videos, photographs, and other information system outputs

**data processing**   using calculations, manipulations, and analysis to transform data into useful information

**data storage**   process of maintaining the data and information of a system in a location that is secure, reliable, and accessible to authorized users

**decision support system (DSS)**   system that assists in decision-making by providing interactive tools and access to data analysis

**digital media**   content developed, stored, and distributed via mobile devices—such as news stories, blogs, videos, and online games—as well as the hardware—flash drives, DVDs, and digital computers—used to store and share this media

**enterprise resource planning (ERP) system**   type of information system used by everyone in an organization to integrate various business processes and functions across an organization such as human resource management and inventory control

**enterprise system**   software package an organization uses to automate and coordinate operations, solve the organization's problems, and monitor organizational performance

**environment**   factors such as physical location and network capabilities that affect an information system and help determine how it operates

**executive information system (EIS)**   (also, strategic information system, or SIS) system that supports the strategic information needs of top executives

**Federal Information Security Modernization Act (FISMA)**   sets guidelines and standards for security that organizations are required to meet to minimize the possibility that data will be stolen, lost, or misused

**feedback**   information that users provide to managers about an information system's functionality

**field of information systems (IS)**   dynamic industry, evolving and depending on technological advancements, that intersects with business, computer science, and management, playing a critical role in enhancing organizational efficiency, productivity, and competitiveness

**framework**   structured set of guidelines and best practices that is used to guide the process of developing,

implementing, managing, or maintaining a business process, policy, system, or procedure

**general control**   process that outlines how an information system is to be used and includes requirements such as routine password updates

**global innovation**   processes used to collaborate across international borders in designing and developing new goods and services for the global marketplace

**globalization**   process of businesses and other organizations interacting on a global scale

**hardware**   physical devices such as computers, servers, networks, and storage devices that are used to collect, process, and store data

**industry standard**   policy, procedure, or requirement widely used and supported in an industry to promote efficiency and quality in goods and services

**information**   raw data that have been processed and manipulated to give context and meaning

**information system**   set of interconnected components that integrate the collection, processing, storage, and distribution of data, information, and digital products

**information technology**   field that reviews how computers and other technology can be used to process, store, retrieve, and share information

**Information Technology Infrastructure Library (ITIL)**   comprehensive framework of documentation that discusses best practices for managing information technology

**input**   data that are collected and entered into the system by users or automatically when transactions occur

**IS2020**   competency model that provides guidance and standards that undergraduate IS programs should meet to ensure students are prepared for careers in IS

**ISO/IEC 27001**   worldwide standard established by the International Organization for Standardization that defines the requirements information systems must satisfy to provide adequate security for any system

**management information system (MIS)**   system that provides middle managers with reports and summaries to support decision-making

**McKinsey 7-S Framework**   focuses on how an organization can be efficient and effective with interaction and coordination of its staff, structure, strategy, skills, systems, style, and shared values

**operating system (OS)**   functions as a computer's manager by operating a computer's memory and other hardware resources such as disk storage; provides the interface that users need to work with a computer and manages a computer's application software programs

**output**   data or information that a system generates and provides to users

**procedure**   set of instructions and rules that governs the use of the hardware, software, and data components in information systems

**processing**   performance of tasks in order to make data useful in a system

**qualitative data**   nonnumerical information

**quantitative data**   numerical information

**Skills Framework for the Information Age (SFIA)**   provides a comprehensive skills and competency framework in a common language for the IT industry

**social media**   any type of electronic communication tool that enables users to establish online communities where they share content, including personal messages, ideas, photographs, and videos

**software**   programs and applications that run on computer hardware, enabling users to perform specific tasks

**The Open Group Architecture Framework (TOGAF)**   standard that promotes best practices for information systems and other technology

**transaction processing system (TPS)**   system that handles day-to-day transactions such as order processing and payroll

**Waterfall**   structured, linear framework used to guide project management

**Zachman Framework**   provides a structure for developing and organizing the artifacts of enterprise architecture, including data and documents

# 📄 Summary

## 1.1 Introduction to Information Systems

- An information system refers to a set of interconnected components that integrate the collection, processing, storage, and distribution of data, information, and digital products in order to support decision-making, coordination, control, analysis, and visualization in an organization.
- Information systems can be categorized into different types based on their scope and functionality, including executive information systems used by an organization's executive staff, decision support systems used by senior managers, management information systems used by middle managers, and transaction processing systems used by frontline workers. In addition, everyone in an organization typically uses enterprise resource planning (ERP) systems for functions such as project management, accounting and financial management including payroll, and tracking customer service.
- An information system typically consists of five key components—people, data, procedures, hardware, and software.
- The basic purpose of information systems—processing and sharing information—has been part of our communication practices since the beginning of civilization, evolving from simple cave drawings to the complex technology we have today.
- The printing press, telegraph, and telephone laid the technological foundation for the communication tools used in today's complex information systems.
- While societies developed a variety of methods for communication, they also created tools for calculations, establishing the foundation for modern computers. The abacus from at least 1100 BCE, analog and digital calculators invented in the 1600s, and the Jacquard loom invented in the early 1800s, provided the foundation for the computers used in today's complex information systems.
- Once the components of information systems are in place, the elements of environment, input, processing, output, control, and feedback are necessary for the information system to function.
- Information system operations refer to how the system is used and includes data capture, processing, storage, retrieval, and dissemination.
- Organizations have come to rely on the field of information systems as a critical resource. A well-developed and maintained information system offers many benefits, including improved efficiency, more robust decision-making, enhanced communication processes, increased productivity, and competitive advantages.

## 1.2 Frameworks of Knowledge and Industry Standards

- To promote best practices and help organizations achieve information systems goals and objectives, the field of IS is guided by frameworks and industry standards.
- Frameworks help IS professionals apply critical thinking, promote proactive communication, guide IS professionals as they organize their ideas, provide a foundation for strategic planning, and provide IS professionals with resources such as continuing education, best practices, and guidelines for information systems operations.
- Industry standards help IS professionals ensure that the system they develop has the appropriate infrastructure and technological components required to function efficiently.
- Common frameworks applicable to IS include Agile, COBIT, ITIL, McKinsey 7-S, SFIA, Waterfall, and Zachman.
- Industry standards that are applicable to IS include ASIS, FISMA, IS2020, ISO/IEC 27001, and TOGAF.
- IS professionals perform many roles in organizations, including data information systems management; database management; systems analysis, design, and development; security risk management; enterprise security, data privacy, and risk management; cloud computing; data analytics and modeling; and project management.

## 1.3 Connections between Information Systems and Information Technology

- To help organizations meet IS needs, the U.S. Department of Labor has developed the Information Technology Competency Model, a framework that defines the knowledge, skills, and abilities that are essential for IS and IT professionals.
- Key competencies include personal effectiveness, academics, and workplace behaviors such as teamwork and decision-making.
- DOL also identified technical competencies, which refer to skills and abilities needed in a specific industry. For IS professionals, these include the principles of information technology, databases and applications, technological networks, telecom, wireless and mobility, software development and management, user and customer support, digital media and visualization, compliance, risk management, security, and information assurance.
- While IS and IT are connected and the terms are sometimes used interchangeably, they are not the same. IS focuses on an organization's goals and developing an information system to meet organizational needs. IT is concerned with technological operations and designing and building an organization's technological infrastructure, including the computer hardware, software, and networks required to support the information system.
- To become an IS professional, students should learn about various topics important in business and technology, including business analysis, cybersecurity, enterprise systems, information system design, information technology, networking, and programming.
- In addition to a degree, IS professionals may want to pursue certification. The certifications held by IS professionals include Associate Computing Professional (ACP), Business Data Management Professional (BDMP), Certified Business Intelligence Professional (CBIP), Certified Data Professional (CDP), and Information Systems Analyst (ISA).

## 1.4 The Global Importance of Information Systems

- IS has and continues to be an important component in globalization as IS provides the resources organizations need to achieve success and innovation in the global marketplace.
- As technology advances throughout the world, IS must continue to evolve. The technologies that impact IS include artificial intelligence, machine learning, 5G, the Internet of Things, edge computing, and blockchain.
- As technology advances, IS also faces more risks that create additional challenges to cybersecurity.

## 🗐 Review Questions

1. What type of information system is used by everyone in an organization to integrate various business processes and functions across an organization?
   a. management information system (MIS)
   b. enterprise resource planning (ERP)
   c. transaction processing system (TPS)
   d. decision support system (DSS)

2. What invention is credited with providing ordinary people with access to information and ideas that were previously unavailable?
   a. telegraph
   b. telephone
   c. printing press
   d. internet

3. What invention provided a vital framework for the development of computers?
   a. Jacquard loom

      **b.** printing press

      **c.** digital calculators

      **d.** typewriters

4. What do computers require to manage the computer's memory and other resources such as disk storage while providing the interface for computer users?

      **a.** application software

      **b.** operating system software

      **c.** hardware

      **d.** data processing

5. What element of an information system is concerned with the policies and procedures that ensure an information system functions effectively, efficiently, and securely?

      **a.** processing

      **b.** environment

      **c.** feedback

      **d.** control

6. You are the project manager of a team of IS professionals working together to develop an information system, and you need a suitable structure to guide your team's work. What is this structure called?

      **a.** guideline

      **b.** best practice

      **c.** framework

      **d.** industry standard

7. As your team works to develop an information system, they review the policies, procedures, and requirements that apply to your organization's system. What are they reviewing?

      **a.** guidelines

      **b.** best practices

      **c.** frameworks

      **d.** industry standards

8. As the member of a team developing the information system for your organization, you have been assigned to review best practices and make recommendations to the team on which best practices are most applicable to your organization's system. What resource do you use to access the most comprehensive information on best practices?

      **a.** Agile

      **b.** ITIL

      **c.** SFIA

      **d.** COBIT

9. When IS professionals work for a government agency or a private business that contracts with the government, what must they follow to meet system security requirements?

      **a.** COBIT

      **b.** ITIL

      **c.** FISMA

      **d.** ISO/IEC 27001

10. Your new job in IS requires you to transform raw data into useful information that your organization can use in decision-making and other operations. What is your job?

      **a.** data analytics and modeling

      **b.** cloud computing

      **c.** database management

    **d.** IS project management

11. Imagine you are part of the hiring team tasked with filling your organization's IS jobs. You are concerned about one of the candidates recommended by a coworker because you do not agree that this person has the integrity, initiative, and willingness to learn required for the role. What competency do you think this candidate is lacking?
    **a.** academic
    **b.** workplace
    **c.** technical
    **d.** personal effectiveness

12. Your colleague has excellent skills in teamwork, creative thinking, and problem solving. What competency does your colleague have?
    **a.** academic
    **b.** workplace
    **c.** technical
    **d.** personal effectiveness

13. What is the main focus for an IT professional?
    **a.** organizational goals
    **b.** technological infrastructure
    **c.** organizational competencies
    **d.** business analysis

14. What key topic in IS education refers to the software packages that organizations use to automate and coordinate operations, solve an organization's problems, and monitor organizational performance?
    **a.** enterprise systems
    **b.** information system design
    **c.** programming
    **d.** business analysis

15. What key topic in IS education explores the processes to connect computers and other technology to enable information sharing?
    **a.** enterprise systems
    **b.** information system design
    **c.** networks
    **d.** information technology

16. What is the process of collaborating across international borders to design and develop new goods and services for the global marketplace?
    **a.** globalization
    **b.** global initiative
    **c.** global innovation
    **d.** global computing

17. What is artificial intelligence (AI)?
    **a.** the ability of machines to imitate human behavior
    **b.** a type of advanced calculator
    **c.** a new programming language
    **d.** a method for speeding up computer processors

18. What is an example of a good application for blockchain?
    **a.** recording data that is subject to change
    **b.** health-care records

    **c.** information sharing between companies

    **d.** money transfer

## Check Your Understanding Questions

1. In an information system, what is the difference between hardware and software?

2. How did the telegraph and telephone lay the groundwork for the invention of the internet?

3. Explain the differences between data capture, data processing, and data dissemination.

4. What was the intent behind creating the ARPANET and why was it important?

5. How can frameworks help IS professionals do their work efficiently and effectively?

6. As a student pursuing an undergraduate degree in IS, you want to know whether your school relies on industry standard IS2020 for guidance. Why is this important?

7. You are tasked with maintaining the infrastructure to provide security for your organization's information system. As part of this process, why would you rely on standard ISO/IEC 27001 for guidance?

8. The manager of your organization argues that using DOL's competency models to guide the hiring process is too much work. What do you say to convince your manager that using the competency models can benefit your organization?

9. Why do technological advances pose risks for IS?

## Application Questions

1. A friend asks you to explain the concept of information systems and why it is important for organizations. What do you say?

2. Your business offers more than fifty products for sale. Currently, you have a bookkeeper who uses a laptop with a basic spreadsheet program to track orders and maintain business records. You have five other employees who handle tasks such as inventory management and sales, but your business is small, and the only person who has computer access is the bookkeeper. Explain at least three ways an information system could benefit your business.

3. One of your colleagues does not understand why industry standards are important in IS. What do you say to help this colleague understand industry standards and how they can benefit IS?

4. What is SFIA and how can it help your organization establish and maintain a robust information system?

5. You are explaining your new job in IS to a friend who does not understand how your job differs from an IT job. Explain the difference between IS and IT to your friend.

6. The manager of your organization argues that there is no need for your organization's information system to be concerned about globalization. What do you tell your manager to explain why the information system should be global?