Chapter 3
Information and Communications Technologies:
The Enterprise Architecture

Learning Objectives

1. Describe the four hardware components of a computer, giving examples of each component.

2. Identify and provide examples of the two major types of software, and describe how software is created.

3. Describe the major types of networks and the transmission media they use, and give examples of network protocols.

4. Explain the importance of the enterprise architecture, describing trends in ICT architecture over time.

Solutions to Chapter Review Questions

3-1. What is the function of each of the four components of a computer? Give an example of each component.

Input devices such as keyboards, touch screens, and digital cameras accept input signals, convert them to a digital format, and transmit them to the CPU. Some input devices may also serve as output devices. Processing devices handle control tasks and manipulate data. The computer’s central processing unit (CPU) is a processing device. Output devices transfer data out of a computer in the form of text, images, sound or other media. Flat panel monitors, cell phone screens and e-books are examples of output devices. Storage devices may be temporary or permanent. Random access memory (RAM) is a temporary storage area used by the CPU to execute instructions. Secondary storage devices such as hard drives, flash memory devices, and optical disks preserve information for retrieval.

3-2. What is the meaning and significance of Moore’s Law?
Moore’s Law predicts that the number of transistors fitting on a computer chip will double every one and a half to two years. This prediction about density also captures advances in processing speed, storage capabilities, cost, and other component features. Processing power and speed and storage capabilities have increased exponentially as the cost of computing devices has decreased.
3-3. **What are the two major types of software and how do they differ? Give an example of each.**

Application software supports business processes, personal productivity, and entertainment. An Oracle or Access database is an example of application software. System software controls basic operations such as file management, disk storage, hardware interfaces and integration with application software. Software in this category includes operating system software utilities. Windows 7 is an example of operating system software, and Disk Defragmenter is an example of utility software.

3-4. **What are the different strategies for creating and deploying software?**

There are two strategies for creating and developing software. Commercial off-the-shelf software solutions are ready-made and available for licensing or sale to the general public. Custom software development describes how an organization works with developers to build software tailored specifically to its needs.

3-5. **What are the major types of wired and wireless transmission media? What are the strengths, weaknesses, and potential of each?**

The three major wired media are twisted pair wire, coaxial cable, and optical fiber. Twisted pair wired media that carry ordinary telephone signals are somewhat fragile and susceptible to interference, although they are flexible and relatively easy to install. Coaxial cable wired media that carry television signals are thicker and sturdier than twisted pair. Optical fiber cables that provide high bandwidth capabilities and carry signals over very long distances are proving to be extremely durable.

Wireless media transmit digital information by means of electromagnetic waves. The range of transmission for wireless media varies from a very short distance of several feet for Bluetooth devices, up to 5 miles for cell phone signals and 40 miles for line-of-sight microwave signals.

3-6. **What are two types of networks and how are they used?**

The two types of networks are wired and wireless networks. Wired networks use twisted pair wire, coaxial cable, or optical fiber to connect computers or other devices such as phones, printers or displays. Wireless networks use radio waves to connect computers or other devices.

3-7. **What is a network protocol? What are the roles of ethernet, TCP/IP, and wireless protocols?**

Networking protocols and the tasks they perform ensure connections work smoothly between the sender and the recipient. Network protocols determine how connection issues are resolved between devices. Ethernet is the protocol widely used for local area networks. TCP/IP is the suite of protocols used for Internet communications that connect
ethernet and other networks together. Wireless protocols determine how the electromagnetic spectrum is used to transmit data. The 802.11 family of standards is used for wifi connections. WiMax relies on microwave transmission to blanket large metropolitan areas with wireless connectivity.

3-8. **What is the enterprise architecture and what is its role in an organization?**

The enterprise architecture is the big picture for the organization, the blueprint of hardware, software, and networks that describes the current environment and the target environment the organization hopes to reach to achieve its mission. The enterprise architecture includes information and computer technology (ICT) assets as well as the people, technology, processes, and data that make up the information systems. The enterprise architecture should be strongly driven by business requirements and the organization’s mission.

3-9. **How have ICT architectures changed over time as new technologies have emerged?**

The ICT component of the enterprise architecture changes over time as new technologies emerge and businesses build more effective and efficient processes to achieve their mission. Enterprise architectures have evolved from mainframe environments to client-server architectures. Additional changes include virtualization, integration of voice and data, and cloud computing.

3-10. **What is cloud computing? How does it support business objectives?**

Cloud computing moves IT resources out of the corporation’s own data centers or desktops, and into the “cloud”—a term that describes the Internet. The concept encompasses many different styles and technology and generally involves leasing IT resources from vendors rather than building corporate data centers and installing software locally.

**Solutions to Projects and Discussion Questions**

3-11. **Why did people stand in ridiculously long lines for hours in hopes of buying a $300 iPhone 4?** Despite widespread reports of reception issues, Apple struggled to meet the demand for that smartphone model. Describe the latest iPhone in terms of hardware components (input, processing, storage, and output) and its operating system and application software.

At a minimum, students should be able to list and describe the input components including the touch screen, virtual keyboard, front and rear-facing cameras, and audio input. Output components include the microphone and the touch screen. Answers will vary regarding the processing component of the latest iPhone model. Students are expected to search the Internet for this information.
3-12. When the “StudentNet” wireless Internet signal did not appear on the list of nearby connections (Figure 3-17), Becca Wells used the “garage” network to check her e-mail. What issues should Becca have considered before connecting to that unknown network? For example, is it ethical to connect through someone else’s service without permission, even if they didn’t password protect the access point? What security issues should she be concerned about? Search the web to learn more about “wardriving” and prepare a brief summary of your findings.

As defined on the home page of Wardrive.net (as of September 2013) “Wardriving is driving around a city searching for the existence of Wireless LAN (802.11) Networks. It’s locating and logging wireless access points while in motion. Often, this task is automated using dedicated wardriving software and a GPS Device.” Students should acknowledge that wardriving may involve both ethical issues and security issues, and explain their perspective on these issues. Students may also note that “wardriving” also has implications for the manner in which users should protect their wireless networks from the activities of wardrivers.

3-13. Twenty years ago, analysts predicted the death of mainframe computers. Today, however, many public and private enterprises throughout the world rely on the mainframe as the backbone of large-scale computing. For example, the U.S. Census Bureau uses mainframe computers to process data about the nation’s people and economy. On the other hand, many of today’s data centers run on racks of PC servers or large-scale PC server farms. How are mainframe computers different from PCs? How are they similar? Search the Web or visit Web sites such as openmainframe.org and ibm.com to learn more about how mainframes support an IT infrastructure. List and discuss the major uses of mainframe systems.

Answers will vary, as the object of this question is to prompt students to explore the differences and similarities of mainframes and PCs. They are similar in that both have processors, storage, memory, operating systems, and displays. They are different in the number of users and the volume of transactions they support, and cost.
3-14. Although vendors describe the cloud as a cost-effective solution to increase IT capabilities, critics describe it as marketing hype. The implementation of cloud computing to replace in-house computing generally requires:

a. Leasing IT resources
b. Depending on a third party to store data
c. Depending on a third party to provide services

List the positive and negative results of these factors as they affect organizations that adopt cloud computing. Outline several reasons why a company might decide to use cloud computing. Are there other issues related to cloud computing? In your opinion, what is the strongest argument against cloud computing?

Answers will vary but may be expected to mention scalability, reduced capital expense, and purported cost savings, as well as ownership issues, and privacy and security issues.

3-15. Consider the many types of computer input devices available today. Identify two general categories of input devices and provide several examples of each. List and describe several input devices that also serve as output devices. List several input/output devices that you own. Which are your favorites? Why? Which are your least favorites? Why?

Two general categories of input devices are (1) those that require human input and (2) those that do not. Keyboards and touch screens are examples of devices that require human input, and scanners and sensors are examples of devices that do not. Digital cameras and touch screens function as both input and output devices.

3-16. Why are there different programming languages? What is the fundamental difference between Java and .NET? Search the web to learn the origin of the name “COBOL.” How is COBOL used today? How strong is the case that “COBOL is dead?” Why or why not?

Programming languages are artificial languages that provide the instructions to the computer about accepting information, processing it, and providing output. Different programming languages have evolved to meet the needs of a wide range of data and information processing needs. Microsoft’s .NET is widely used in companies that operate Windows servers and other Microsoft products because it provides a library of “canned code” that solves common problems. On the other hand, it offers developers a way to create software for any platform. COBOL stands for common business oriented language. Billions of lines of COBOL are used today in companies that operate mainframe systems running business applications such as data entry and data processing.

3-17. Jackson Real Estate is relocating to new office space and owner Bella Jackson must decide between a wired or wireless network for 35 on-the-go agents. What are the pros and cons of each type of network for this business environment? Consider the cost, security, and mobility issues of this decision and make a recommendation.
Students will have different answers, but they should understand the differences between wired and wireless networks in terms of security, mobility, and cost.

3-18. Work in a small group with classmates to compare three office productivity applications: Microsoft Office, a commercial off-the-shelf software product; Google Docs, software as a service; and Open Office, a free, open source office suite (available at openoffice.org). What are the benefits, costs, and risks of each application? Discuss why a small business or nonprofit organization may prefer one application over another.

Answers may vary, as the question is designed to require the student to integrate concepts and information introduced throughout this chapter. At a minimum, students should be able to list several features and the functionality for each application. One point that could be discussed is the “total cost of ownership” for office productivity applications that includes technical support and training as well as upgrades and maintenance.

3-19. Work in a small group with classmates to explain the effects of Moore’s Law on information and communications technology. What is the impact of Moore’s Law on your life? Prepare a 5-minute presentation on your findings.

After this discussion, students should have a better understanding of Moore’s Law that describes a historical trend in transistor technology. Moore’s Law explains why the price of everything electronic continues to decline as product capabilities continue to increase; why technology gets more powerful yet smaller. Moore’s Law explains why we have smaller, more powerful information and communication technology for less and less money.

3-20. Work in a small group with classmates to consider the differences between commercial off-the-shelf software (COTS) and custom software. What are the advantages and disadvantages of each type of software? Why would a company decide to develop their own software rather than use COTS? Investigate the student information system used by your college or university to learn whether the software was custom developed or purchased.

After this discussion, students should have a better understanding of software development and deployment strategies. Commercial off-the-shelf (COTS) software is ready made and available for licensing or sale to the general public, whereas custom software is built to meet the organization’s specific needs. The discussion could include information on software as a service and open source software.

Solutions to Application Exercises

Use the historical data of hard drive capacities and prices shown in Figure 3-26 to create an Excel spreadsheet that includes formulas to calculate a common measure of disk size (GB) and the cost per GB for each year. You can also download the Excel file that contains this data, named Ch03Ex01. Recall 1 gigabyte = 1024 megabytes; 1 terabyte = 1024 gigabytes. Create two line charts to present trends in the cost of data storage, using the data for years 1980–1999 for one chart and the data for years 2000–2010 for the second chart. Write a brief summary of the trends you found. What factors have contributed to these trends? What are the implications of these trends?

Students should download the Excel file named Ch03Ex01, convert disk size to a common measure (Size in GB), and use a formula to calculate price (Price per GB). To create the first line chart, plot Price per GB by Year (1980-1999), and add a second axis for Size in GB (Format data series, Plot on secondary axis). To create the second line chart, copy the first chart and reselect data for years 2000–2010. The charts illustrate the increased storage capacity and concurrent decline in price for data storage devices during this time period.
Create an empty database named “Adams.” Download the Excel file Ch03Ex02 and import the two worksheets to tables in your database. Create a Totals query to summarize the current value of equipment for each category. Create a report displaying the names and locations of employees who use laptop computers. Create a report displaying the names and locations of employees who use CAD systems.

Students should produce an Access database with two tables by importing data from the Excel file named Ch03Ex02. Students should create a query to summarize the current value of equipment for each category and two reports to display names and employees using laptop computers and CAD systems.
Solutions to Case Study Questions

Case 1—Google Glass and Wearable Technologies

3-23. Identify the major technical components and capabilities of Google Glass.

The purpose of this question is to develop the student’s abilities to describe technical details of emerging technologies. Google Glass is a head-mounted wearable technology that resembles a pair of eyeglasses. It includes a CPU, camera, and a visual display, and GPS, and it operates on batteries. The device runs the Android operating system, and it offers capabilities such as email, voice phone calls, texting, speech recognition, navigation, and Internet access. To support mobility, the device can access the Internet via a wifi connection to the wearer’s smartphone serving as a hotspot.

3-24. What are some of the advantages to using Google Glass and how will they add value to a customer’s life?

This question and the next prompt students to clarify pros and cons of Google Glass. The device offers wearers “always on” hands-free connectivity to text messages, email, social networks, maps, and the Internet. Users can snap a photo or take a short video without having to take out a camera or smartphone, and they can quickly upload the results to their friends on social networks.

3-25. Why is privacy a concern with Google Glass? How do they increase the threats to a person’s privacy beyond today’s smartphones and digital cameras?

With a smartphone or camera, one must hold up the device and point it to take a picture or video; however, with Glass this isn’t needed. One only looks in the direction they wish and silently snaps a picture. This means people do not know when their photo is being taken, and many people find that uncomfortable, if not intrusive. Additionally, Glass makes it easy and fast to post pictures to social media which exposes people to large audiences without necessarily having their permission to do so. People are concerned that their privacy is being compromised, especially in bathrooms, doctors’ offices, and locker rooms. There is no indication a person is being recorded except that someone with Glass is looking in that direction. Consider how simple it would be to photograph private documents or corporate secrets. Both social etiquette rules and even perhaps legal protections are needed to address these concerns about violating personal and professional privacy.

3-26. Why is Google encouraging developers to create apps for Google Glass rather than building those apps themselves and reaping the potential revenues for Google?

Crowd-sourcing application development opens a large market for Glass. The more apps that are available to users increases the value of the product. With new technologies like Glass, it is critical for its success to get as many uses for the tools as possible, and opening apps development to others is the fastest and least expensive way to achieve this. However
creative and ingenious Google is, the mass of app developers is more so. They add greater creativity and innovation to app development than Google can. The net result is that more apps sell more Glass which drives up Google’s revenues and market share, enabling them to not only sell more Glass but to cross-sell other services and devices.

Case 2—Rolling Out Its “4G” Network, Sprint Nextel Struggles with the Human Element

3-27. What is the relationship between physical infrastructure and services as described in this case study?

The purpose of this question is to help students understand the relationship between physical infrastructure, business strategy, and the services a company is able to provide. In this case, Sprint Nextel must match any agreements or promises the company makes to customers with the capabilities its growing network is able to actually provide. These capabilities are changing quickly, as Sprint Nextel expands its physical infrastructure with more cell towers. The capabilities may also change in ways that are outside the company’s control, as builders construct skyscrapers that block signals, for example.

3-28. What is the relationship between regulatory considerations and wireless services?

The purpose of this question is to help students think through the role of government in commerce. Although students may or may not develop a complete answer in this discussion, it is important for students to consider the issues. In this case, the role of government presents some complicating factors. There is an overlap in jurisdiction among multiple state and local government agencies, which requires additional time and resources for Sprint to navigate. Overall, the telecommunications industry is heavily regulated, and the success of telecommunications firms is related in part to their ability to accommodate the regulation.