## CHAPTER 1: FOUNDATIONS OF INFORMATION SYSTEM IN BUSINESS

## CHAPTER OVERVIEW

This chapter presents an overview of the five basic areas of information systems knowledge needed by business professionals, including the conceptual system components and major types of information systems. In addition, trends in information systems and an overview of the managerial challenges associated with information systems are presented.

By understanding and applying concepts and skills in this chapter we are confident you will tremendously benefit personally and also positively contribute towards your present and future organizations. Learn the skills and apply them and you will be amazed to find how beneficial they are for you and the company you belong to.

## **CHAPTER LEARNING OBJECTIVES**

After studying the chapter and completing the relevant activities and exercises you should be able to:

- Understand the concept of a system and how it relates to information systems.
- Explain why knowledge of information systems is important for business professionals, and identify five areas of information systems knowledge that they need.
- Give examples to illustrate how the business applications of information systems can support a firm's business processes, managerial decision making, and strategies for competitive advantage.
- Provide examples of several major types of information systems from your experiences with business organizations in the real world.
- Identify several challenges that a business manager might face in managing the successful and ethical development and use of information technology in a business.
- Provide examples of the components of real world information systems. Illustrate that in an information system, people use hardware, software, data, and networks as resources to perform input, processing, output, storage, and control activities that transform data resources into information products.
- Demonstrate familiarity with the myriad of career opportunities in information systems.

## CHAPTER SUMMARY

- IS Framework for Business Professionals. The IS knowledge that a business manager or professional needs to know is illustrated in Figure 1.2 and covered in this chapter and text. This knowledge includes (1) foundation concepts: fundamental behavioral, technical, business, and managerial concepts like system components and functions, or competitive strategies; (2) information technologies: concepts, developments, or management issues regarding hardware, software, data management, networks, and other technologies; (3) business applications: major uses of IT for business processes, operations, decision making, and strategic/ competitive advantage; (4) development processes: how end users and IS specialists develop and implement business/IT solutions to problems and opportunities arising in business; and (5) management challenges: how to manage the IS function and IT resources effectively and ethically to achieve top performance and business value in support of the business strategies of the enterprise.
- Business Roles of Information Systems. Information systems perform three vital roles in business firms. Business applications of IS support an organization's business processes and operations, business decision making, and strategic competitive advantage. Major application categories of information systems include operations support systems, such as transaction processing systems, process control systems, and enterprise collaboration systems; and management support systems, such as management information systems, decision support systems, and executive information systems. Other major categories are expert systems, knowledge management systems, strategic information systems, and functional business systems. However, in the real world, most application categories are combined into cross-functional information systems that provide information processing activities. Refer to Figures 1.7, 1.9, and 1.11 for summaries of the major application categories of information systems.
- **System Concepts.** A system is a group of interrelated components, with a clearly defined boundary, working toward the attainment of a common goal by accepting inputs and producing outputs in an organized transformation process. Feedback is data about the performance of a system. Control is the component that monitors and evaluates feedback and makes any necessary adjustments to the input and processing components to ensure that proper output is produced.
- **Information System Model.** An information system uses the resources of people, hardware, software, data, and networks to perform input, processing, output, storage, and control activities that convert data resources into information products. Data are first collected and converted to a form that is suitable for processing (input). Then the data are manipulated and converted into information (processing), stored for future use (storage), or communicated to their ultimate user (output) according to correct processing procedures (control).

• **IS Resources and Products.** Hardware resources include machines and media used in information processing. Software resources include computerized instructions (programs) and instructions for people (procedures). People resources include information systems specialists and users. Data resources include alphanumeric, text, image, video, audio, and other forms of data. Network resources include communications media and network support. Information products produced by an information system can take a variety of forms, including paper reports, visual displays, multimedia documents, e-messages, graphics images, and audio responses.

## **KEY TERMS AND CONCEPTS**

#### 1. Computer-Based Information System (8):

An information system that uses computer hardware and software to perform its information processing activities.

#### 2. Control (29):

The systems component that evaluates feedback to determine whether the system is moving toward the achievement of its goal and then makes any necessary adjustments to the input and processing components of the system to ensure that proper output is produced.

#### 3. Data (34):

Facts or observations about physical phenomena or business transactions. More specifically, data are objective measurements of the *attributes* (characteristics) of *entities*, such as people, places, things, and events.

#### 4. Data or Information Processing (35):

The act of converting data into information. This includes both input and processing activities. Processing includes calculating, comparing, sorting, classifying, and summarizing.

#### 5. Data Resources (33):

Data is now thought of as a valuable raw material that should be used, maintained, and secured as such. Data resources include not only structured information typically found in databases, but also the unstructured information found in e-mail or other collaborative systems, audio, and video.

#### 6. Developing successful information system solutions (18):

Business professionals are responsible for proposing new or improved systems to support their business activities as well as managing their development. Using a systematic development process increases the likelihood of a successful project.

#### 7. E-business (12):

The use of Internet technologies to support business processes, electronic commerce, and collaboration within a company and with its customers, suppliers, and other business stakeholders.

#### 8. E-business applications (12):

Businesses today are using the Internet, corporate intranets, and inter-organizational extranets to support business activities with suppliers, partners, customers, accounting, finance, research and development, manufacturing, marketing, sales, and customer service.

#### **9.** E-commerce (12):

The buying and selling, marketing and servicing, and delivery and payment of products, services, and information over the Internet, intranets, extranets, and other networks, between an inter-networked enterprise and its prospects, customers, suppliers, and other business partners.

#### **10. Enterprise Collaboration Systems (13):**

The use of groupware tools and the Internet, intranets, extranets, and other computer networks to support and enhance communication, coordination, collaboration, and resource sharing among teams and workgroups. These systems allow the creation of "virtual" teams of people who may work together without ever meeting in person.

#### **11. Extranet (12):**

A network that links selected resources of a company with its customers, suppliers, and other business partners using internet technologies.

#### 12. Feedback (29):

Data or information concerning an information system's performance.

#### 13. Hardware Resources (32):

All physical devices and materials used in information processing. This includes not only machines, but storage media such as disks, tape, and paper.

#### a. Machines (32);

Consist of all input, processing, output, networking, and storage devices including computers, keyboards, printers, monitors, and pointing devices.

#### b. Media (33):

Hardware designed to hold data such as paper forms, magnetic disks, optical disks, magnetic tape, magnetic strips, and memory "sticks".

#### **14. Information (34):**

Data that have been converted into a meaningful and useful context for specific end users.

#### a. Information products (35):

The degree to which information is packaged into an easy to use form. Information products include messages, reports, forms, and graphic images.

#### **15. Information System (4):**

The arrangement of all the components and resources necessary to deliver information and functions to the organization. These resources include hardware, software, and people to perform input, processing, output, storage, and control activities that transform data resources into information products.

#### **16. Information system activities (35):**

All information systems (manual or automated) share the same characteristics.

a. Input (35):

Data entry.

#### **b.** Processing (35):

Data transformation including calculating, comparing, sorting, classifying, and tabulating.

#### c. Output (35):

Information made available to end uses. This may take the form of messages, reports, forms, images, sound, and video.

#### **d.** Storage (36):

The retention of information such that it can be later retrieved.

#### e. Control (36):

Control includes feedback regarding input, processing, output, and storage activities as well as actions performed in response to this information.

#### 17. Information System Model (31):

The conceptual view of an information system.

#### **18. Intranet (12):**

Internet-like networks and websites developed for use within an organization.

#### 19. Knowledge Workers (32):

People whose primary work activities include creating, using, and distributing information.

#### 20. Management information systems (15):

These systems provide information to managers and business professionals.

#### 21. Network resources (34)

Network resources include communications media, switches, routers, transmitters, software, and other network infrastructure.

#### 22. People Resources (32):

People are an essential component of an information system. Broadly, this resource includes IS specialists and end users.

#### a. IS specialists (32):

Are people who develop and operate information systems.

#### b. End users (32):

Are people who use an information system or the output it produces.

#### 23. Roles of IS in Business (8):

Information systems perform three vital roles in any type of organization.

#### a. Support of business processes and operations (8):

Examples of supported business processes include activities such as sales transactions, inventory ordering, and payroll processing.

#### **b.** Support of business decision making (8):

Systems can support less structured business activities such as deciding which product lines to add or discontinue. While these types of decisions require human creativity, information systems can support managers in this process by providing them with useful information on demand.

#### c. Support of strategies for competitive advantage (8):

Information systems can make available new types of products and services through which an organization might gain a competitive advantage.

#### 24. Software Resources (33):

Software resources comprise all sets of information processing instructions. This includes not only software but the human procedures associated with managing information systems as well.

#### a. Programs (33):

A set of instructions that cause a computer to perform a particular task. These tasks may include managing the operational components of the information system, or they may directly support business operations.

#### **b.** Procedures (33)

Set of instructions used by people to complete a task.

#### 25. System (26):

A system is a group of interrelated components working together toward a common goal by accepting inputs and producing outputs in an organized transformation process.

#### 26. Types of Information Systems (13):

Information systems are classified in order to spotlight the major roles each plays in the operations and management of a business.

#### a. Cross-functional information systems (15)

Information systems that cross the boundaries of functional business areas and management levels in order to support business processes throughout the organization.

#### b. Management support systems (14):

Information systems that provide information and support for effective decision making by managers. These types of systems include executive information systems, decision support systems, and management information systems.

#### c. Operations support systems (13):

These systems help enable the day to day operations of an organization. They include office automation systems, transaction processing systems, and process control systems.

#### d. Functional business systems (15):

Systems that focus on basic business functions such as accounting, marketing, sales, finance, and human resource management.

#### e. Transaction processing systems (14):

Transaction processing systems (or TPS) are a type of operations support system. A TPS processes routine business transactions such as sales or purchases.

#### f. Process control systems (14):

These systems monitor and control physical processes such as production lines, package routing, and heating and cooling systems.

#### g. Enterprise collaboration systems (14):

Enterprise collaborative systems facilitate team or workgroup communications and productivity. These include e-mail, instant messaging, message boards, digital whiteboards, wikis, and videoconferencing.

### **REVIEW QUESTIONS AND SUGGESTED ANSWERS**

1. How can information technology support a company's business processes and decision making and give it a competitive advantage? Give examples to illustrate your answer.

*Support:* Information technology can automate manual process such as document transmission. Instead of writing memos or letters, employees can compose and send e-mails electronically. Information technology can also facilitate the reengineering of entire business processes. For example, the airlines industry relies heavily on online ticket booking. Not only does this facilitate filling seats, but it also provides them with a valuable information about passengers which they can repackage for sale to business partners in the form of "frequent flier" programs.

*Competitive advantage:* product innovations or cost savings program can provide a product or price advantage over competitors that lasts until competitors catch up. Though the advantage may be fleeting, the boost to an organization's image may be longer lasting.

# 2. How does the use of the Internet, intranets, and extranets by companies today support their business processes and activities?

*Internet:* organization can connect directly with the general public. Opportunities range from giving away basic product information to automatically updating or patching retail software. Many businesses also conduct retail operations online.

*Intranets:* organizations often use internet technologies to facilitate operations within the organization. Such systems might include product support knowledge bases, training systems, and access to the organisation's benefits system.

*Extranet:* organizations may use these same internet technologies to connect with their business partners to facilitate supply chain management, help manage projects, manage accounts, or provide advanced technical support.

Organizations use internet technologies to connect with both customers and suppliers. These technologies allow customers to generate and track their own orders as well as manager their accounts. They also enable significant supply chain automation.

3. Refer to the Real Word Case on eCourier, Cablecom, and Bryan Cave in the chapter. Jay Bregman, CTO and cofounder of eCourier, notes that the company hopes their innovative use of technology will become a differentiator in their competitive market. More generally, to what extent do specific technologies help companies gain an edge over their competitors? How easy or difficult would it be to imitate such advantages?

*Advantage:* at best, most technology innovations provide only a temporary edge over competitors. Even in the unusual case of patented technologies, the patent runs out after 17 years. If the advantage comes from *how* a technology is used, then competitors need only copy these successful implementations. Often, competitors have the opportunity to learn from hard won efforts and improve on them to their advantage.

*Imitation limitations:* economies of scale, proprietary technology, brand image, and high switching costs can all work to make imitations less successful. Xerox brand photocopiers benefited from the first three, and it took competitors decades to catch up. In eCourier's case, competitors need only make the capital investment in off-the-shelf technology in order catch up. eCourier should now focus on increasing switching costs by web-enabling their account management system.

# 4. Why do big companies still fail in their use of information technology? What should they be doing differently?

Top Five Reasons for Success	Top Five Reasons for Failure
User involvement	Lack of user input
Executive management support	Incomplete requirements and specifications
Clear statement of requirements	Changing requirements and specifications
Proper planning	Lack of executive support
Realistic expectations	Technological incompetence

Certainly the reasons listed in the table above could explain some of the major causes of why companies fail in their use of information technology. However, it is important to note that the field of technology is changing at such a rapid pace that many large and successful companies are having difficulty keeping up with it. Other ideas may include such things as a shortage of skilled employees, the major expense involved in managing and developing systems, and a rapidly changing business regulatory environment.

5. How can a manager demonstrate that he or she is a responsible end user of information systems? Give several examples.

There are two sides to this answer. First, managers must make good use of information resources placed at their disposal. Second, managers must not use their information systems irresponsibly. Student's answers may vary depending on how they interpret this question.

Responsible use: Managers should demonstrate that they are using their information systems as intended. In the case of e-mail, calendar, scheduling, and collaborative systems, other users would notice a manager's lack of participation. They would find it difficult to communicate or schedule meetings with non-participating managers. These managers would increasingly find themselves "out of the loop". Instead, managers should incorporate these tools into their To demonstrate appropriate use of other information systems, daily habits. managers should ensure they receive the appropriate training for these various This would include using data and analysis tools in order to make applications. more informed business decisions. High quality decisions based upon the information these systems provide would demonstrate that these assets are not being wasted.

*Inappropriate use:* As a manager or other end user of information, we must insure that we always consider the ethical responsibilities of the use of information. Irresponsible uses:

- accessing and/or selling data for personal gain
- failing to protect data from loss or theft
- violating privacy laws or abusing community privacy expectations
- 6. Refer to the Real World Case on the New York Times and Boston Scientific in the chapter, and think about any technology-enabled innovations that you have read about or come across recently. To what extent is innovation about the technology itself, and to what extent is it about changing the underlying ways that companies do business?

#### Innovations:

- iPad
  iPhone
  Droid
  Solid State Drives (SSD)
  G4 networks
- •IEEE 802.11n
- •HTML 5.0

•Geographically targeted mobile marketing

#### Motivation:

Manufacturers appear to be uncertain about the extent to which an innovative product may change the underlying ways organizations operate. At least initially, they hold back "suggested use" for fear they might accidentally limit their customer's perceptions. Instead, they tend focus on the technical bits: speed, battery life, flexibility, security, and so on.

In short, manufacturers promote solutions in search of a problem. Of course, real world problems exist, and with this sort of promotion, consumers and business consultants are free to find their own ways to apply available solutions. For example, the military developed GPS to solve one set of problems, but marketers now use this technology to provide location-specific advertising to mobile consumers. Rather than guiding a bomb to a target, GPS technology helps guides people looking for a lunch discount to a store with surplus capacity.

# 7. What are some of the toughest management challenges in developing IT solutions to solve business problems and meet new business opportunities?

#### Challenges:

- Increased competitive pressures resulting from a rapidly changing business environment. Developing large systems has been often likened to "hitting a moving target." Projects that take a year or more to implement may well satisfy last year's needs, but may do little to address current challenges.
- Lack of familiarity with information systems development methodologies. As a result, they may make poor decisions that have far-reaching effects.
- Ever increasing customer expectations. Napster set the expectation that music should be easy to find, easy to acquire, and free. FedEx set the expectation that a customer will know what day a package will arrive. Wikipedia set the expectation that users can add to or correct information in articles themselves. People with Internet access now get many services free: e-mail, calendaring, scheduling, instant messaging, news, information, software, entertainment, and even free web space. All these experiences play into users' expectations.
- Managers must overcome resistance to change within their own organization. Employees quickly become comfortable with their work, and they find changing processes stressful. Managers need to foster a work environment where employees see change as a routine part of their job.

# 8. Why are there so many conceptual classifications of information systems? Why are they typically integrated in the information systems found in the real world?

Conceptual classifications of information systems are designed to emphasize the many different roles of information systems. This can be done from various points of view, such as the level of management that the information systems serve, or the business functions they support. In practice, these roles are not always clearly divided, and in any case, information produced by one business activity may serve as input data to another activity. Thus it makes sense to integrate various roles into one information system.

# 9. In what major ways have information systems in business changed during the last 40 years? What is one major change you think will happen in the next 10 years? Refer to Figure 1.4 to help you answer.

#### History:

- Tabulation (pre 1950s)
- Data processing (1950s-1960s)
- Management reporting (1960s-1970s)
- Decision support (1970s-1980s)
- Strategic end user support (1980s-1990s)
- Enterprise and global internetworking (1990s-2000s)
- eBusiness (2000s-2010s)
- Social networking (2010s-current)

#### Future:

- User authentication
- Virtual machines
- Cloud computing
- Solid state drives
- Overhaul of computing legislation
- Integration of video, audio, images, GPS, networks into entirely new products and services.
- Biometric computing
- Monitoring and control systems embedded into the human body (for example, insulin injectors, ID chips)

## CHAPTER 2: COMPETING WITH INFORMATION TECHNOLOGY

### **CHAPTER OVERVIEW**

This chapter introduces fundamental concepts of competitive advantage through information technology and illustrates major strategic applications of information systems.

By understanding and applying concepts and skills in this chapter we are confident you will tremendously benefit personally and also positively contribute towards your present and future organizations. Learn the skills and apply them and you will be amazed to find how beneficial they are for you and the company you belong to.

## **CHAPTER LEARNING OBJECTIVES**

After studying the chapter and completing the relevant activities and exercises you should be able to:

- Identify several basic competitive strategies and explain how they use information technologies to confront the competitive forces faced by a business.
- Identify several strategic uses of Internet technologies and give examples of how they can help a business gain competitive advantages.
- Give examples of how business process reengineering frequently involves the strategic use of Internet technologies.
- Identify the business value of using Internet technologies to become an agile competitor or form a virtual company.
- Explain how knowledge management systems can help a business gain strategic advantages.

## CHAPTER SUMMARY

• Strategic Uses of Information Technology. Information technologies can support many competitive strategies. They can help a business cut costs, differentiate and innovate in its products and services, promote growth, develop alliances, lock in customers and suppliers, create switching costs, raise barriers to entry, and leverage its investment in IT resources. Thus, information technology can help a business gain a competitive advantage in its relationships with customers, suppliers, competitors, new entrants, and producers of substitute products. Refer to Figures 2.3 and 2.5 for summaries of the uses of information technology for strategic advantage.

- **Building a Customer-Focused Business.** A key strategic use of Internet technologies is to build a company that develops its business value by making customer value its strategic focus. Customer-focused companies use Internet, intranet, and extranet e-commerce Web sites and services to keep track of their customers' preferences; to supply products, services, and information anytime or anywhere; and to provide services tailored to the individual needs of the customers.
- **Reengineering Business Processes.** Information technology is a key ingredient in reengineering business operations because it enables radical changes to business processes that dramatically improve their efficiency and effectiveness. Internet technologies can play a major role in supporting innovative changes in the design of workflows, job requirements, and organizational structures in a company.
- **Becoming an Agile Company.** A business can use information technology to help it become an agile company. Then it can prosper in rapidly changing markets with broad product ranges and short model lifetimes in which it must process orders in arbitrary lot sizes; it can also offer its customers customized products while it maintains high volumes of production. An agile company depends heavily on Internet technologies to help it respond to its customers with customized solutions, and to cooperate with its customers, suppliers, and other businesses to bring products to market as rapidly and cost effectively as possible.
- **Creating a Virtual Company.** Forming virtual companies has become an important competitive strategy in today's dynamic global markets. Internet and other information technologies play a key role in providing computing and telecommunications resources to support the communications, coordination, and information flows needed. Managers of a virtual company depend on IT to help them manage a network of people, knowledge, financial, and physical resources provided by many business partners to take advantage of rapidly changing market opportunities.
- **Building a Knowledge-Creating Company.** Lasting competitive advantage today can only come from the innovative use and management of organizational knowledge by knowledge-creating companies and learning organizations. Internet technologies are widely used in knowledge management systems to support the creation and dissemination of business knowledge and its integration into new products, services, and business process.

### **KEY TERMS AND CONCEPTS:**

#### 1. Agile Company (62):

An organization with the ability to profitably operate in a competitive environment of continual and unpredictable changes by adapting quickly to emerging customer preferences and producing high-quality, high-performance, customer-configured products and services.

#### 2. Business Process Reengineering (58):

The fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in cost, quality, speed, and service.

#### **3.** Competitive Forces (46):

A business must confront:

- 1) rivalry of competitors within its industry
- 2) threat of new entrants
- 3) threat of substitutes
- 4) the bargaining power of customers
- 5) the bargaining power of suppliers.

#### 4. Competitive Strategies (49):

A business can develop:

- 1) cost leadership
- 2) product differentiation
- 3) innovation
- 4) growth
- 5) alliance

or other strategies to confront its competitive forces.

#### 5. Create switching costs (52):

A strategy designed to increase the cost in time, money, effort, and inconvenience that it would take a customer or supplier to switch its business to a firm's competitors.

#### 6. Customer value (54):

The customer perceives the value or benefit associated with a given transaction or business relationship. Vendors can provide this by recognizing that quality rather than price has become the primary determinant. Vendors must focus on anticipating future needs, responding to customer concerns, and providing top-quality service.

#### 7. Interenterprise information systems (64):

These systems consist of extranets linking suppliers, customers, subcontractors, and competitors together.

#### 8. Knowledge-Creating Company (66):

Also known as "learning organizations", are companies that consistently create new business knowledge, disseminate it widely throughout the company, and quickly build the new knowledge into their products, services, and business processes.

#### 9. Knowledge Management System (66):

An information system that helps manage organizational learning and business know-how. These systems help knowledge workers create, organize, and make available important business knowledge wherever and whenever it's needed.

#### **10.** Leverage investment in IT (52):

Developing new products, services, and business processes through the use of new information made possible by investments in information technology.

#### 11. Lock in Customers and Suppliers (50):

A business may lock in customers and suppliers by building valuable relationships with customers or by intimidating managers into accepting a less profitable relationship.

#### 12. Raise Barriers to Entry (52):

An organization may raise barriers to entry by creating technological, financial, or legal requirements that deter competitors from offering similar products or services.

#### **13. Strategic Information System (46):**

Strategic information systems are information systems that support or shape an organization's competitive position and strategies.

#### **14. Value Chain (56):**

A series of activities with each activity adding value to an organization's products and services.

#### **15. Virtual Company (64):**

Also called a virtual corporation or virtual organization, is an organization that uses information technology to link independent people, assets, and ideas.

#### **REVIEW QUESTIONS AND SUGGESTED ANSWERS**

1. Suppose you are a manager being asked to develop computer-based applications to gain a competitive advantage in an important market for your company. What reservations might you have about doing so? Why?

Unless the individual is familiar with the tools and processes involved in developing information technology applications, they will have a high level of apprehension. Reservations would include the fear of being out of one's depth and feelings of helplessness, insecurity, and dependence on others.

The individual may also wonder whether or not an appropriate application might be obtained off the shelf. Off the shelf software, though not easily customizable, generally costs less than custom software development.

Lastly, he or she might also feel concerned about how the software may affect their position within the organization. Change isn't easy, and if it isn't supported at the very top management levels, it may fail due to lack of organizational will, and this failure would look bad on their performance review.

2. How could a business use information technology to increase switching costs and lock in its customers and suppliers? Use business examples to support your answers.

#### Switching Costs

A business might undertake projects to integrate some of its information systems with its customers' systems in order to provide them with more timely, accurate, and useful information. The business might even provide applications for its customer's use at low or no cost. Customers later considering changing suppliers would lose these benefits. Indeed, the very process of developing these tools will help managers increase their familiarity with their customers and allow them to tune their information resources to their customer's needs. This relationship will further serve to lock in customers.

#### Examples

For example, Fed Ex provides its customers with package tracking information. Medical supply companies provide hospitals with inventory management and re-ordering systems. Wal-Mart will soon provide small medical practices with reduced cost patient management systems.

# **3.** How could a business leverage its investment in information technology to build strategic IT capabilities that serve as a barrier to new entrants into its markets?

Businesses may leverage its IT platforms by connecting them with their customers and suppliers to provide better communications. Initially, both the company and the customer benefit from the new system. However, as time goes by the customers will tend to integrate these systems into their own core processes thereby becoming dependent on the platform. In the long run, the company's investment in IT results in locking in their customers and suppliers and creating switching costs. The high costs associated with developing these systems serve as barriers to entry for competitors.

4. Refer to the Real World Case on quantifying IT risks and value in the chapter. Why do you think that the "IT as a cost" mindset is so prevalent among organizations? Relate your answer to the discussion about technology as a competitive advantage or a competitive necessity in the chapter.

#### Mindset

Some elements of IT are much like a utility. In those cases, estimating IT's value is about as difficult as estimating the value of electricity. For example, if an executive uses a computer only to send e-mails, how would you calculate its value? The value would literally depend on the content of the e-mails and the necessity of sending them nearly instantly as opposed to sending a letter via inter-office mail, overnight delivery, or through the post office.

In many ways, it's simply easier to tell a manager what his or her e-mail enabled device will cost his business unit on an annual basis and trust the manager to make the appropriate decision.

#### 5. What strategic role can information play in business process reengineering?

Information plays a critical role in BPR initiatives. First, information about existing operations serves as a baseline for future comparison. Second, as new processes take shape, information in the form of feedback allows managers to evaluate and control these new processes. Lastly, the organization may find ways to repackage this information for its customers' use.

# 6. How can Internet technologies help a business form strategic alliances with its customers, suppliers, and others?

Information technology can help a business form strategic alliances with its customers, suppliers, and others by enabling communications, collaboration, and

information sharing in ways that were never before possible. By virtue of working together online, managers can monitor and automatically capture process metrics, identify bottlenecks, and recommend process improvements within and between organizations.

# 7. How could a business use Internet technologies to form a virtual company or become an agile competitor?

#### Virtual company:

Example: a person or company could use the Internet to acquire customers and then farm out the work to suppliers. A simple example of this can be found managing contractors. A company solicits customers for contract work (customers) and then solicits reliable contractors who can do this work (suppliers). In exchange for a share in the contractor's earnings, the virtual company handles the billing and customer relations. It manages its reputation by monitoring the quality of the contractor's work. High performing contractors are not invited to work on future contracts. Some software vendors now lease (or provide for free) web enabled business software to manage accounting, customer relations management, and office automation tasks (word processing, spreadsheets, calendaring, and e-mail). As a result, a truly virtual company need only a computer connected to the Internet and a web browser. Visit <u>rent-acoder.com</u> for a reverse auction site version of this enterprise.

#### Agile competitor:

In addition to monitoring the marketing for business intelligence, an agile competitor might implement an Internet based system that allows its customers to configure their own products. For example, Dell allows its customers to configure computers to their own specifications to include type of CPU, motherboard, I/O devices, memory, monitor, and more. T-shirt and bumper sticker companies might allow customers to upload their own custom designs or work interactively with their own graphic designers to create a suitable product.

8. Refer to the Real World Case on companies using smartphones in the chapter. Do you think smaller companies like Lloyd's Construction are ready for large-scale implementations of technology in their business? What could they do to prepare for those implementations? Use examples to illustrate your answer.

*Small organization benefits* – smart phones are simply advanced communications devices with the ability to run simple applications and share information. Small organizations can benefit.

*Example:* a small law firm consisting of two attorneys, a paralegal, and an assistant could take advantage of smartphone technology. The assistant could use the smartphone to keep the attorney's schedule up to date. The paralegal working out of the office can respond to information requests and send documents, research, and other information to attorneys in court or at a client site.

If a small organization's customers or critical vendors work remotely, then the small organization can still benefit by providing a higher level of connectivity then allowed by ordinary cell phones.

**Preparation:** any organization large or small planning to implement this (or any) new technology should have one or more clear, short-term objectives in mind. The organization can add additional objectives once the technology is in place and operating correctly. The organization should also plan on thorough user training (if required), and potentially include technology literacy as a hiring requirement. Lastly, but most importantly, top management must fully appreciate the new technology's value and support its implementation. This support may include removing obstacles to implementation such as recalcitrant managers.

9. Information technology can't really give a company a strategic advantage because most competitive advantages don't last more than a few years and soon become strategic necessities that just raise the stakes of the game. Discuss.

Information technology for early innovators can give a company a temporary competitive advantage. Although technology changes at a rapid pace, the first company to gain acceptance stands to capture a substantial market share before its competitors can catch up. Apple's iPod serves as a good example. By the time that other organizations caught up, the Apple had realized a large market share and captured substantial customer loyalty.

On the other hand, competitors can learn from the leader's mistakes at very little cost other than running the risk that their competitor will succeed brilliantly. With these cheaply acquired insights, competitors can introduce their own products into an already primed marketplace and take it over with a superior product and/or a lower price.

10. MIS author and consultant Peter Keen says: "We have learned that it is not technology that creates a competitive edge, but the management process that exploits technology." What does he mean? Do you agree or disagree?

#### Why?

*What does it mean?* Keen recognizes that buying and installing a new application simply because a competitor has it does little to guarantee its successful application.

*Agreed*: It takes leadership to foster the organizational changes enabled by new technologies.

# **CHAPTER 3: COMPUTER HARDWARE**

### **CHAPTER OVERVIEW**

This chapter reviews history, trends, and developments in microcomputer, midrange, and mainframe computer systems; basic computer system concepts; and the major types of technologies used in peripheral devices for computer input, output, and storage.

By understanding and applying concepts and skills in this chapter we are confident you will tremendously benefit personally and also positively contribute towards your present and future organizations. Learn the skills and apply them and you will be amazed to find how beneficial they are for you and the company you belong to.

## **CHAPTER LEARNING OBJECTIVES**

After studying the chapter and completing the relevant activities and exercises you should be able to:

- Understand the history and evolution of computer hardware.
- Identify the major types and uses of microcomputer, midrange, and mainframe computer systems.
- Outline the major technologies and uses of computer peripherals for input, output, and storage.
- Identify and give examples of the components and functions of a computer system.
- Identify the computer systems and peripherals you would acquire or recommend for a business of your choice, and explain the reasons for your selections.

## CHAPTER SUMMARY

• **Computer Systems.** Major types of computer systems are summarized in Figure 3.3. Microcomputers are used as personal computers, network computers, personal digital assistants, technical workstations, and information appliances. Midrange systems are increasingly used as powerful network servers and for many multiuser business data processing and scientific applications. Mainframe computers are larger and more powerful than most midsize systems. They are usually faster, have more memory capacity, and can support more network users and peripheral devices. They are designed to handle the information processing needs of large organizations with high volumes of transaction processing or with complex computational problems. Supercomputers are a special category of extremely powerful mainframe computer systems designed for massive computational assignments.

- The Computer Systems Concept. A computer is a system of information processing components that perform input, processing, output, storage, and control functions. Its hardware components include input and output devices, a central processing unit (CPU), and primary and secondary storage devices. The major functions and hardware in a computer system are summarized in Figure 3.10.
- **Peripheral Devices.** Refer to Figures 3.14 and 3.22 to review the capabilities of peripheral devices for input, output, and storage discussed in this chapter.

### **KEY TERMS AND CONCEPTS**

#### 1. Binary representation (108):

The presence or absence of electronic, magnetic, or optic "signals" in the computer's circuitry or in the media it uses. There are only two possible states or conditions - presence or absence. These may also be interpreted as on/off, or 0/1.

#### 2. Central processing unit (93):

The component of a computer system that includes the circuits controlling the interpretation and execution of instructions. The CPU includes the arithmetic-logic unit and the control unit.

#### 3. Computer system (92):

A computer system consists of input and output devices, primary and secondary storage devices, the central processing unit, and other peripheral devices.

#### 4. Computer terminal (85):

A terminal is any device that enables both input and output between a user and a computer via telecommunications link.

#### 5. Cycles per second (94):

Denoted as Hz, cycles per second is a measure of the speed of the computer's timing circuits or internal clock. The higher the number, the faster the CPU. Cycles in the millions per second range are called *megahertz* (MHz), in the billions per second range are called gigahertz (GHz), and in the trillions per second range are called terahertz (THz).

#### 6. Direct access (109):

A method of storage where each storage cluster has a unique address and can be individually accessed in approximately the same period of time as any other cluster without having to first search through preceding sectors. *Instructor's note:* 

these storage positions are not necessarily individual bits of memory. On disk-based media, an individual memory location is called a "cluster". Clusters may vary in size between disk partitions but will remain uniform in capacity within a partition. Cluster size can only be set during partition formatting.

#### 7. Graphical user interface (97):

A design approach that enables users to interact with a computer by manipulating images or "icons" that represent objects or actions.

#### 8. Information appliance (86):

Hand-held microcomputer devices. Most of these devices now include wireless connectivity to the Internet and innovative I/O methods such as touch screens, pen-based handwriting recognition, and detachable keypads.

#### 9. Magnetic disks (112):

Data storage technology that uses magnetised spots on metal or plastic disks.

#### a. Floppy disk (112):

Small, flexible, plastic disk enclosed in a protective envelope and hard plastic shell. It holds data in the form of magnetised spots. These were once widely used to provide a removable direct access storage capability for microcomputer systems.

#### **b. Hard disk (113):**

A secondary storage medium consisting of metal disks covered with a magnetic recording surface. It holds data in the form of magnetised spots. Microcomputers typically have at least one built in hard drive. They may also have the capacity to add additional internal and/or external drives. Single drive storage capacity ranges up to 1.5 TB and continues to increase.

#### c. RAID (Redundant array of independent disks ) (113):

A RAID array comprises two or more interconnected microcomputer hard disk drives and their controllers. They provide, fault tolerant storage capacities. RAID arrays are characterized by their ability to continue running without data loss even if one drive should fail.

#### 10. Magnetic stripe (105):

A strip of magnetic tape embedded in a plastic card and widely used for credit/debit cards and identification cards. These stripes hold up to 200 bytes of information.

#### **11. Magnetic tape (113):**

A plastic tape with a magnetic surface on which data can be stored by selective magnetisation of portions of the surface. Tapes can only be read sequentially from beginning to end. As a result, magnetic tapes are primarily used for data archiving and data backups.

#### 12. Mainframe system (89):

This category comprises large, fast, and powerful computer systems. Processing speeds range up to billions of instructions per second. Primary memory may consist of hundreds or thousands of gigabytes. Usage considerations include cost, space, air-conditioning, and uninterrupted power supplies. They are used for computationally tense applications such as managing airline reservation systems or financial transactions in banking institutions.

#### 13. Microcomputer (83):

Also called a "Personal Computer" or "PC", these are small computers, ranging in size from a "computer on a chip" to a small typewriter-size unit. These networked workstations are critical to individuals and business professionals.

#### 14. Midrange system (87):

Larger, more powerful, and more expensive than most microcomputers but are smaller, less powerful, and less expensive than most large mainframe computer systems, these computers are used to handle large-scale processing for integrated enterprise wide manufacturing, distribution, and financial applications, large websites, or data warehouse management and related data mining and online analytical processing (OLAP) applications.

#### 15. Minicomputer (88):

This category comprises mid-range computer that might be used as a high-end workstation for computationally intense applications. They are often found in industrial process control systems such as computer aided manufacturing (CAM) applications. These computers may also serve as front-end servers to relieve mainframe computers of telecommunications and network management tasks. While microcomputers would fit on, under, or next to a desk, minicomputers are larger and are generally not co-located with its users.

#### 16. MIPS (94):

An acronym standing for Millions of *Instructions* per Second. This is a way of measuring relative CPU speed (see also cycles per second – measured in MHz)

#### 17. Moore's law (94):

Moore predicted that the number of transistors per integrated circuit will double every 18 to 24 months.

#### **18. Network computer (86):**

A category of low-cost microcomputer designed mainly for use with the Internet and intranets on tasks requiring limited or specialised applications and no or minimal disk storage.

#### **19. Network server (83):**

This is a powerful microcomputer used to co-ordinate telecommunications and resource sharing across local area networks (LAN), manage large websites, Intranets, and extranets.

#### 20. Network terminal (85):

A terminal that depends on network servers for its software and processing power.

#### 21. Off-line (97):

Off-line pertains to devices not under control of the central processing unit or to a computer not connected to a network. A connected device powered down is also considered off-line (not available).

#### 22. Online (97):

Pertains to equipment or devices under control of the central processing unit or that are connected to a network.

#### **23. Optical disks (114):**

A storage device using a laser to read tiny spots on a plastic disk. The disks are currently capable of storing billions of characters of information.

#### 24. Optical scanning (103):

Using a device (scanner) that reads characters or images and generates their digitally coded representations.

#### 25. Peripherals (97):

In a computer system, any unit of equipment, distinct from the central processing unit, that provides the system with input, output, or storage capabilities.

#### 26. Pointing devices (97):

Devices which enables end users to move a cursor on the display screen.

#### 27. Primary storage unit (93):

The main (or internal) memory of a computer. Usually in the form of volatile semiconductor storage.

#### **28.** Processing speed (94):

see also "cycles per second" and "MIPS".

- a. Millisecond (94): One thousandth of a second  $(10^{-3})$
- **b.** Microsecond (94): One millionth of a second  $(10^{-6})$
- c. Nanosecond (94): One billionth of a second.  $(10^{-9})$
- **d.** Picosecond (94): One trillionth of a second  $(10^{-12})$

#### 29. RFID (115):

Radio Frequency Identification Device. A class of small active or passive transmitters that can be embedded in or affixed to objects to facilitate identification and tracking.

#### **30. Secondary storage (93):**

External or auxiliary storage device that supplements the primary storage of a computer. Examples include magnetic disks, magnetic tape, optical disks, and solid state devices. Devices that contain a mechanical component have slower read/write times than solid state devices. However, all secondary devices maintain data even without power.

#### **31. Semiconductor memory (110):**

Microelectronic storage circuitry etched on tiny chips of silicon or other semiconducting material.

#### a. Semiconductor memory – RAM (110):

Also known as main memory or primary storage; type of memory that temporarily holds data and instructions needed shortly by the CPU. RAM is a volatile type of storage.

#### b. Semiconductor Memory – ROM (110):

Also known as firmware; a memory chip that permanently stores instructions and data that are programmed during the chip's manufacture. Three variations on the ROM chip which that are re-writable. These are PROM, EPROM, and EEPROM. All forms of ROM are non-volatile.

#### **32. Sequential access (109):**

Sequential access describes a sequential method of storing and retrieving data from a file. Access times for any one piece of information will vary depending on its location. This method is typical for tape drives and is typically used for archiving and backups.

#### **33. Speech recognition (101):**

Direct conversion of spoken data into digital characters. As this technology develops, it promises to be the most natural way to communicate with computers. Current accuracy rates range up to 95%.

#### **34. Storage capacity (109):**

Units used for storage capacity and data: bits (b), bytes (B), kilobytes (KB), megabytes (MB), gigabytes (GB), terabytes (TB), Petabyte (PB).

#### a. Bit – "b" (108):

A contraction of "binary digit". It can have the value of either 0 or 1.

#### b. Byte - "B" (108):

A sequence of adjacent binary digits operated on as a unit and usually shorter than a computer word. In many computer systems, a byte is a grouping of eight bits. In the ASCII coding scheme, this would represent a single character, number, or symbol. Fun fact: a "nibble" is equal to four bits or half a byte.

#### c. Kilobyte - "K" or "KB" (109):

When referring to computer storage capacity it is equivalent to 2 to the 10th power, or 1,024 in decimal notation.

#### d. Megabyte - "MB" (109):

One million bytes. More accurately, 2 to the 20th power, 1,048,576 in decimal notation.

#### e. Gigabyte - "GB" (109):

One billion bytes. More accurately, 2 to the 30th power, or 1,073,741,824 in decimal notation.

#### f. Terabyte - "TB" (109):

One trillion bytes. More accurately, 2 to the 40th power, or 1,009,511,627,776 in decimal notation.

#### g. Petabyte (109):

A unit of computer, or binary storage, equal to one quadrillion bytes.

#### **35. Supercomputer (90):**

This category comprises the most powerful computer systems. They are designed to solve massive computational problems such as creating complex models for long-term planetary weather forecasting, exploring the origins of the universe, and simulating nuclear reactions at the atomic level.

#### **36. Volatility (110):**

Memory (RAM) that loses its contents when electrical power is interrupted.

#### **37.** Workstation computer (83):

These computers are high-end microcomputers which support processor intense applications such as mathematical computing, graphics rendering, computer aided design (CAD), and powerful analytical software.

## **REVIEW QUESTIONS AND ANSWER**

# **1.** What trends are occurring in the development and use of the major types of computer systems?

Computers are becoming physically smaller, faster, with more memory, cheaper, more reliable, and user friendly. They are increasingly being connected via telecommunications links throughout organizations. Multiple processors, once the realm of supercomputers are now finding their way into personal computers. Software maintenance and upgrades are managed online automatically with little or no user action required. Each major type of computer system is increasingly able to take on tasks previously undertaken by the next higher computer classification. Computers are increasingly referred to by their size and portability rather than their computing power and applications i.e.

• handheld – a computer held in one hand and operated with the other

- netbook a computer the size of a clipboard which may be operated with one or two hands
- laptop a portable computer operated with two hands
- desktop a non-portable computer which easily fits on, under, or next to a desk
- server a computer mounted on a rack serving multiple concurrent users
- mainframe a powerful computer requiring its own room and serving entire business units
- supercomputer a special purpose mainframe designed for applications requiring massive computational power such as modeling nuclear reactions or global weather patterns.

# 2. Will the convergence of PDAs, subnotebook PCs, and cell phones produce an information appliance that will make all of those categories obsolete? Why or why not?

There is no doubt that the convergence of PDAs, sub-notebook PCs, and cell phones will produce an information appliance that will make all of those categories obsolete. As more powerful appliances capable of completing multiple tasks are developed, there will be a trend toward converging of these technologies into a single appliance. Users do not want to carry around 4 or 5 different devices when one would do the job. However, users will want flexibility in their selection of software as well as network and data service providers.

# **3.** Refer to the Real World Case IT asset management in the chapter. What advice would you provide to a growing company to avoid facing the issues discussed in the case?

Full blown asset management systems are expensive to buy and implement – especially for a small to mid-sized organization. IT departments in growing companies should establish procedures for purchasing and tracking their IT assets (hardware and software). This will create an immediately useful database they can use for reporting and planning purposes. This light-weight approach also helps ingrain tracking and reporting habits across the organization.

By starting with this low-cost approach, the IT organization will have a current and accurate inventory database, and they'll have managers throughout the organization already accustomed to reporting and coordinating their IT activities with the IT department. These two factors will help ensure a low cost and accepted full-scale implementation at a later, appropriate date.

# 4. Do you think that information appliances like PDAs will replace personal computers (PCs) in business applications? Explain.

If PDAs continue to grow in power, storage capacity, and in ability to connect with peripheral devices (via Bluetooth, for example), then there is no reason they can't replace personal computers.

Assuming a powerful enough PDA, we can envision a worker using the PDA's (relatively) small screen and data entry devices to check e-mails, schedules, tasks, take orders, and so on while mobile. At home, in the office, or at a kiosk, hotel room, or other temporary workspace, the PDA might wirelessly connect to a standard monitor, keyboard, mouse, scanner, and printer to provide a more comfortable user interface. Users might also purchase data storage devices for home use or rent "cloud" based storage space.

The increasing prevalence of cloud-based applications (e-mail, calendaring, scheduling, CRM, and office automation) will slow the demand for PDA processing power and storage capacity.

# 5. Are networks of PCs and servers making mainframe computers obsolete? Explain.

Mainframe sales continue to trend upward. Reasons given include increased global demand for computing power and the trend toward consolidation and virtualization. They consume power more efficiently, take up less space, and use fewer human resources.

On the other hand, Google, the search engine industry leader and a computing powerhouse, uses "clusters of more than 15,000 commodity class PCs" to serve its users. This approach may provide an early signal that mainframes simply lack the flexibility to meet future business demands.

6. Refer to the Real World Case on speech recognition in health care in the chapter. Although these and other technologies are becoming more prevalent in health care, doctors have traditionally been reluctant to adopt them. Why do you think this is the case? How would these technologies change the way doctors perform their job?

#### Reasons for doctors' resistance

- •too busy to learn
- doubts over accuracy
- •not trained to think in business terms
- •not comfortable with technology
- •negative prior experiences with technology

#### Impact if adopted

The case study describes several impacts:

- •cost savings
- •user time savings/increased productivity
- •increased level of detail in patient files
- faster updates to patient files (shorter processing times)

#### 7. What are several trends that are occurring in computer peripheral devices? How do these trends affect business uses of computers?

#### Trends

- "plug and play" capability
- standardized connectivity (USB, Firewire, Bluetooth, WiFi)
- increasingly dense removable solid state storage devices
- networking capabilities (Wi-Fi, cellular)

#### Business use effects

Businesses are pushing their computing tasks further into the field. This includes communications and data capture. This allows for improved decision making, faster response times, and higher data quality.

# 8. What are several important computer hardware developments that you expect to happen in the next 10 years? How will these affect the business use of computers?

#### Developments:

- Hardware devices will increase in speed and capacity.
- Hardware devices will decrease in size and cost.
- A growth in the type and usage of smart gadgets and information appliances for input and output purposes.
- Wireless devices will become the standard for many businesses.
- A reduction in the dependency on keyboards and mouse-type pointing devices.
- The replacement of hard drives (especially external drives) with solid state drives.
- Mobile devices will continue to combine hardware functionality while allowing users to select their choice of applications.
- The introduction of new power supply technologies including miniature fuel cells and induced current technologies.
- The international merger of telecommunications standards.

#### Effects on Business:

- Real-time data acquisition
- Automated data acquisition
- Increased workforce mobility
- Increased security risks
- Increased flex-time and work-at-home options

- Increased co-location of employees with both customers and suppliers
- Increased focus on employee productivity rather than hours worked
- Increased ability to manage more employees per manager
- Increased demand for technology-literate workers
- Increased demand for managers familiar with information analysis techniques and tools

# 9. What processor, memory, magnetic disk storage, and video display capabilities would you require for a personal computer that you would use for business purposes? Explain your choices.

*Note:* all business computing requirements lists should include data backup and recovery hardware and software when network backups are not available daily. All home computing requirement lists should also include full system backup and recovery hardware and software.

The requirements below satisfy this author's need for processing very large amounts of image, video, and text files.

#### Requirements:

- 1. Dual core processor or greater
- 2. Monitor resolution 1680 x 1050 or greater
- 3. External speakers
- 4. Intel<sup>®</sup> Core<sup>™</sup> i7, 32-bit processor
- 5. 4GB RAM (more is wasted without a 64 bit processor)
- 6. 1500 GB onboard application drive
- 7. 3 x 1500 GB storage drives
- 8. 3 x 1500 GB backup drives

#### Explanation:

- 1. Multi-core processes allow the operating system to free up more CPU cycles for computationally intensive applications. Examples include analytical software, video rendering applications, and data processing software. This means that while the computer churns away at a large, critical problem, the user can still access other applications without lag.
- 2. The monitor is the desktop today. A large monitor enables multi-tasking without placing undo demands on the user's own memory. The user can simply see all the various tasks at hand and return to them easily. Monitors have increased in size but have decreased in price, desktop footprint, and heat production, so they are simple to incorporate into an existing physical workspace. For this reason, multiple monitors have become increasingly common.
- 3. Desktop machines still using a 16-bit processor are now museum pieces, but 64-bit machines are now available. A 64-bit machine running applications

designed to take advantage of this architecture will run faster, but hardware and software vendors have been slow to adapt. A 32-bit machine will suffice for the next few years.

- 4. 32-bit processors are limited by their 32-bit word size to a maximum of 4 billion unique address locations. As a result, they can not take advantage of more than 4 GB of memory (actually, just a little less). Video processing, image processing, and data processing software, and multi-tasking all require significant amounts of memory. While modern operating systems can take advantage of "virtual memory", this reliance will negatively affect a computers' performance.
- 5. A reliable, internal 1.5 TB SATA drive costs less than \$150. As of this writing, this is the lowest cost per GB available. Video, image, and scientific data storage could easily require a drive this large. Without looking too far into the future, 500 GB would satisfy all the common business applications.
- 6. All drives fail. All business computer systems should use some form of backup. A stand-alone system could use an external drive or an on-line backup service. A networked PC could backup to the network or use network storage and rely on network backups.

# 10. What other peripheral devices and capabilities would you want to have for your business PC? Explain your choices.

#### Uninterrupted Power Supply (UPS)

All computers should connect to a UPS. This helps prevent damage due to variances in power supply, preserves data, and decreases user frustration which invariable results from lost work.

#### USB Hub

Numerous peripheral devices (printers, hard drives, PDA's, keyboards, pointers, etc.) now connect via USB. An easily accessible hub would enable quick connect/disconnect capabilities for portable devices.

#### Dual DVD/CD R/W drives

The DVD format enables up to approximately 4.4 GB of data storage. The write capability enables both backups and small-scale multi-media publication.

#### Ergonomic I/O devices

An ergonomic mouse, keyboard, desk, and chair all contribute to comfort, productivity, and safety.

#### Auto-feed Digital Scanner

Even paper can become paperless with an auto-feed scanner. These devices are great for sharing access to paper records, document archiving, and saving valuable office space taken up by filing cabinets.

#### High speed color printers

Allows a business to skip the bottleneck associated with employing 3<sup>rd</sup> party printers for large print jobs. Enable rapid customization of print material.

#### ADA (Americans with Disabilities Act) compliant I/O devices

Employees, customers, and business partners may require additional assistance, and the appropriate tools should be readily available.

#### Touch screen workspaces

Touch screens can replace keyboards and mouse-type pointers for many input operations as well as serve a fully functional output device. For example, file management activities lend themselves more to icons and spatial representation than characters.

#### Video camera

Video is to word processing what word processing was to typewriters thirty years ago. Video has numerous applications including instruction, entertainment, personal communications, feedback, and security.

#### Noise cancellation headphones

Cube farms are already distracting places to work. Headphones enable audio output without disturbing others, and sound cancellation technology helps remove distracting background noise.

#### Noise cancellation microphones

Noise cancelling microphones allow clearer speech recording. This greatly improves the quality of audio communications (phone, voice mail, and digital voice recording). It also significantly improves the interpretation accuracy of speech recognition systems.

#### Large, multiple monitors

The computer monitor has become the new workplace desktop. With larger monitors and multiple monitors, workers can actively track more applications (e-mail, telephony, digital dashboards, workflow applications), without the need for pop-ups, audio feedback, or incessant toggling between windows.

#### Wireless peripheral devices

Wireless technologies enable both data and power connections. Wireless devices are easier to set up and take down. They also reduce desktop and floor clutter.

#### Wireless router

A wireless router allows a business or home to instantly expand its network without added cabling. It also allows users to connect Wi-Fi enabled peripheral devices such as printers and data storage units. If configured correctly, routers can also provide an extra layer of security between the computer and the Internet.

# **CHAPTER 4: COMPUTER SOFTWARE**

### **CHAPTER OVERVIEW**

This chapter reviews the basic features and trends in the major types of application software and system software used to support enterprise and end-user computing.

By understanding and applying concepts and skills in this chapter we are confident you will tremendously benefit personally and also positively contribute towards your present and future organizations. Learn the skills and apply them and you will be amazed to find how beneficial they are for you and the company you belong to.

## **CHAPTER LEARNING OBJECTIVES**

After studying the chapter and completing the relevant activities and exercises you should be able to:

- Describe several important trends occurring in computer software.
- Give examples of several major types of application and system software.
- Explain the purpose of several popular software packages for end-user productivity and collaborative computing.
- Define and describe the functions of an operating system.
- Describe the main uses of computer programming software, tools, and languages.
- Describe the issues associated with open-source software.

## CHAPTER SUMMARY

- **Software.** Computer software consists of two major types of programs: (1) application software that directs the performance of a particular use, or application, of computers to meet the information processing needs of users and (2) system software that controls and supports the operations of a computer system as it performs various information processing tasks. Refer to Figure 4.2 for an overview of the major types of software.
- **Application Software.** Application software includes a variety of programs that can be segregated into general purpose and application-specific categories. General purpose application programs perform common information processing jobs for end users. Examples are word processing, electronic spreadsheet, and presentation graphics programs. Application-specific programs accomplish information processing tasks that support specific business functions or processes, scientific or engineering applications, and other computer applications in society.

- System Software. System software can be subdivided into system management ٠ programs and system development programs. System management programs manage the hardware, software, network, and data resources of a computer system during its execution of information processing jobs. Examples of system management programs are operating systems, network management programs, database management systems, system utilities, application servers, and performance and security monitors. Network management programs support and telecommunications activities and network manage performance telecommunications networks. Database management systems control the development, integration, and maintenance of databases. Utilities are programs that perform routine computing functions, such as backing up data or copying files, as part of an operating system or as a separate package. System development programs like language translators and programming editors help IS specialists develop computer programs to support business processes.
- **Operating Systems.** An operating system is an integrated system of programs that supervises the operation of the CPU, controls the input/output storage functions of the computer system, and provides various support services. An operating system performs five basic functions: (1) a user interface for system and network communications with users, (2) resource management for managing the hardware resources of a computer system, (3) file management for managing files of data and programs, (4) task management for managing the tasks a computer must accomplish, and (5) utilities and other functions that provide miscellaneous support services.
- **Programming Languages.** Programming languages are a major category of system software. They require the use of a variety of programming packages to help programmers develop computer programs and language translator programs to convert programming language instructions into machine language instruction codes. The five major levels of programming languages are machine languages, assembler languages, high-level languages, fourth-generation languages, and object- oriented languages. Object-oriented languages like Java and special-purpose languages like HTML and XML are being widely used for Web-based business applications and services.

## **KEY TERMS AND CONCEPTS**

#### **1.** Application service provider (143):

An application service provider owns, operates, and maintains application software for access by others via the Internet.

#### 2. Application software (130):

Application software provides tools to help users complete general information processing tasks (such as word processing or spreadsheet calculations) *or* structured tasks (such as payroll or time tracking).

#### 3. Assembler language (158):

Assembler is a second generation language that uses a few letters and numbers to directly represent machine code or memory locations.

#### 4. CASE tools (168):

Computer-Aided Software Engineering tools support and standardize the activities associated with systems analysis, design, programming, testing, and maintenance.

#### 5. Cloud computing (145)

Cloud computing provides hardware and software as a service over the Internet.

#### 6. COTS software (130):

Commercial off the shelf software can be purchased or licensed and does not require (or allow) customization beyond its own configuration settings.

#### 7. Custom software (130):

Individuals and organizations can develop their own software using any number of programming tools in order to create specialized applications.

#### 8. Desktop publishing - DTP (139):

Desktop publishing uses computers, laser printers, and page layout software to produce a variety of printed materials at a level formerly done only by professional printers.

#### 9. E-mail (137):

E-mail transmits, storages, and distributes electronic messages to specific addresses over communications networks.

#### **10. Fourth-generation language (159):**

4GLs are programming languages that are easier to use than high-level languages. They are also known as nonprocedural, natural, or very high-level languages.

#### **11. Function-specific application software (134):**

Function-specific software is designed to perform task-specific work or work only within a specific functional area of a business.

#### 12. General-purpose application programs (130):

General-purpose application programs can perform *only* common information processing jobs such as word processing, electronic spreadsheets, and graphics programs.

#### **13. Groupware (141):**

Groupware is a type of general purpose software that supports collaboration between members of a work group with networked computers.

#### 14. High-level language (158):

A high-level programming language uses statements that closely resemble human language or mathematical notation to describe a procedure. Compilers or interpreters translate these instructions into machine code prior to execution.

#### 15. HTML (161):

Hypertext Mark-up Language is a language that creates formatted hypertext or hypermedia documents.

#### 16. Instant messaging (IM) (137):

Instant messaging enables users to communicate textually in real time with other online users.

#### **17. Integrated package (136):**

Integrated packages consist of two or more software applications designed to seamlessly share functions and data. These includes less functionality, but at a lower cost, than a software suite.

#### 18. Java (164):

Sun Microsystems created Java as an object-oriented programming language with a syntax similar to the "C" programming language. It is widely available on multiple hardware platforms, easy to learn, and powerful. Therefore, Java is widely used as a software development platform.

#### **19. Language translator (167):**

Language translators convert programming language instructions stored in a computer program into machine language code. Major types include assemblers, compilers, and interpreters.

#### **20. Machine language (157):**

Machine language is a first generation language where instructions are expressed in the binary code immediately recognizable for execution by a computer's CPU.

#### **21. Middleware (157):**

Middleware helps diverse software applications and networked computer systems exchange data and work together more efficiently.

#### 22. Multitasking (151):

Multitasking is a computing approach that uses the same computer to accomplish more than one information processing task concurrently.

#### 23. Natural language (159):

Natural languages, also called fifth-generation languages, are programming languages that resemble human language.

#### 24. Object-oriented language (160):

Object-oriented languages are a type of  $5^{th}$  generation language. An object consists of data variables and the actions that can be performed on the data within these variables.

#### 25. Operating system (147):

An operating system is an integrated system of programs that manages the operations of the CPU, controls the input, output, storage resources, and security, of the computer system, and provides various other support services as the computer executes the application programs of users.

#### 26. Personal information manager (PIM) (141):

Personal information managers help end users store, organize, and retrieve text and numerical data in the form of notes, lists, memos, tasks, calendars, schedules, and contact lists.

#### **27. Presentation graphics software (140):**

Presentation graphics software displays graphics such as charts, illustrations, animations, audio, and/or video to illustrate the information in presentations.

#### **28. Programming language (157):**

Programming languages allow a programmer to develop the instructions that a language translator or interpreter will turn into machine executable instructions.

#### **29. Software suites (135):**

Software suites are powerful, integrated software packages that combine several individual applications with a common graphical interface in a manner that allows them to share data directly between them.

#### **30. Spreadsheet package (139):**

Spreadsheet applications allow users to develop sophisticated calculators and mathematical models using an intuitive spreadsheet interface, formulas, and custom programs (macros).

#### 31. System software (147):

System software are programs that control and support the operation of a computer system, including operating systems, file management applications, communications control programs, service and utility programs, and programming language translator programs.

#### 32. User interface (147):

The user interface sends and receives information between the computer and the person using it. It includes keyboard, monitor, pointing device, and related software.

#### **33. Utilities (156):**

Utilities are a set of programs that assist in the operation of a computer system. They perform tasks such as file type conversion, data backup, data recovery, virus protection, firewalls, data compression, disk partitioning, user authentication, and file defragmentation.

#### 34. Virtual memory (150):

Virtual memory allows an operating system to use a secondary storage device as an extension of primary storage. Thus it gives the computer the appearance of having a larger main memory than actually exists. Overreliance on virtual memory will cause applications to run considerably slower when using hard disk drives for secondary storage (as is common practice). However, solid state drives will significantly mitigate this problem.

#### **35. Web browser (136):**

A web browser provides the user interface for accessing Internet, intranet, and extranet web sites.

#### **36. Web services (165):**

Web services are software components that are based on a framework of Web and object-oriented standards and technologies for using the Web that electronically link the applications of different users and different computing platforms. This allows various business applications to exchange information in real-time.

#### **37. Word processing software (138):**

Word processing software enables the creation, editing, revision, and printing of documents.

#### 38. XML (162):

eXtensible Markup Language provides data and its meta-data (contextual labels) to web browsers and other applications.

## **REVIEW QUESTIONS AND SUGGESTED ANSWERS**

**1.** What major trends are occurring in software? What capabilities do you expect to see in future software packages?

#### Trends

- Americans with Disabilities Act (ADA) compliance
- Applications updates and error reporting
- Applications interoperability via open source standards
- Open source applications
- Web based applications
- Web based application APIs
- Biometrics for user authentication
- Speech recognition integration
- Location (GPS) aware software

#### Future capabilities

- Ad-hoc workflow design and collaboration tools supporting instant teams and team management.
- At home medical diagnostics and monitoring with various input devices for vital signs and at home tests
- Audio, video indexing, searching
- Virtual desktops
- Virtual presence
- 2. How do the different roles of system software and application software affect you as a business end user? How do you see this changing in the future?

#### System software end-user effects

O/S choice affects a machine's look and feel, but these differences are relatively minor. Therefore an organization's operating system choice should have little effect on the end user. The O/S choice impacts which applications can run on a computer, but even that limitation is fading with the increasing popularity of virtual machines and web based applications.

#### Application software end-user effects

Computer users spend most of their time *using* a computer's applications. Because applications vary significantly by functionality and usability, application choice has a significant effect on an end user.

#### Future

Employees' interactions with their operating systems will continue to decline as document management and workflow applications provide a superior file management interface. IT administrators will continue to "lock down" operating systems thereby limiting end-user's O/S-related activities to those that can not

interfere with the system's operations and security. IT administrators will increasingly manage systems support remotely.

When an organization can not control or predict what operating system an end user might have installed, the organization will need to consider adopting standards which have been implemented across many platforms. In short, organizations can count on most end users being able to support web based applications, and so we will see many more web based applications. Many of these applications will require Java, Flash, or an open source equivalent.

#### 3. Refer to the Real World Case on Software-as-a-Service (SaaS) in the chapter. Do you think GE would have been better off developing a system specifically customized to their needs, given that GE's supply chain is like nothing else in the world?

*No:* the case makes it clear that Avaro had both the necessary expertise and a product GE's experts could examine for themselves. This expertise gave GE a jumpstart on implementation – critical to meeting GE's cost-savings goals. GE beat the problems associated with inflexible vendors by choosing one small enough that GE could dictate its requirements. GE beat the problem associated with small vendors vanishing overnight because it could provide Avaro with enough financial resources to prevent financial failure.

# 4. Why is an operating system necessary? That is, why can't an end user just load an application program into a computer and start computing?

In theory, it is possible to program applications that do not require an operating system. However, such a program would also need to know how to accomplish I/O tasks for each machine configuration on which users expect it to run. It's far easier to install an operating system to manage these tasks on the program's behalf so the application programmer can focus on creating the application's more unique features. This makes applications smaller, easier to understand, easier to use, and allows multiple applications to run concurrently.

# 5. Should a Web browser be integrated into an operating system? Why or why not?

#### Pro

If the operating system isn't fully "open", then a bundled web browser can take advantage of the OS's secret features. Microsoft took this approach in the 1990's. Web browsers are currently free and easy to install. Users can easily ignore a pre-installed and integrated web browser.

Con

Courts have ruled that bundling a web browser with the operating system is anti-competitive when it is difficult or impossible to uninstall. Others would argue that it is anti-competitive even when it is not difficult to uninstall due to the "halo effect".

6. Refer to the Real World Case about the U.S. Department of Defense and its adoption of open-source software in the chapter. Would such an approach work for a commercial organization, or is it limited to government entities? What would be the most important differences in each case, if any?

#### Commercial organizations

OSS primarily supports commercial organizations, so yes, this approach would work. Organizations with a decentralized structure could benefit in the same way as the government: business units could share applications and application development between them at their individual discretion and benefit accordingly.

#### Significant differences

Commercial organizations tend to be more volatile than the government. The government is also not as likely to sell off a business unit to a competitor.

# 7. Are software suites, Web browsers, and groupware merging together? What are the implications for a business and its end users?

Yes.

#### Implication for business

- Increased ability to partner with customers/suppliers
- Increased cloud computing (decreased desktop computing)
- Increased data security risks
- New tools to measure employee productivity
- Increased opportunities for business process reengineering

#### Implications for end users

- Increased mobility
- Increased collaboration
- Smaller computing devices
- Greater intrusion into an employee's home life
- Increased ability to connect to the internet

#### 8. How are HTML, XML, and Java affecting business applications on the Web?

Effects

- •These standards enable more sophisticated applications with larger user bases.
- •These are vital tools for building multimedia web pages, web sites, and web-based applications.
- •Business can use HTML to create hypertext and hypermedia documents and create hyperlinks to other parts of documents anywhere on the Web.
- •Java is a simple and secure programming language. It is specifically designed for real-time, interactive, web-based network applications. It uses small programs which can reside on web sites or on a network server until needed by client systems. They are easy to distribute online; the casual user will be able to automatically download and run applets on an as-needed basis by using browser software. These capabilities result in web-based applications that have become increasingly more sophisticated, useful, and available.
- •IT managers may feel more inclined to implement web applications rather than take the more traditional buy-and-install approach. Zimbra sells an interesting example of such a system.

# 9. Do you think Linux will surpass, in adoption and use, other operating systems for network and Web servers? Why or why not?

Organizations are increasingly purchasing commercial versions of Linux such as Red Hat Enterprise Linux for several reasons.

- Stability (very high mean-time between failures)
- Processing efficiency
- Bundled features
- Ongoing upgrades, maintenance, and support are available

Will Linux (in general) surpass other network operating systems? Probably, with a virtually unlimited and free developer base from which commercial organizations like Red Hat can borrow, Linux can stay competitive even against R&D powerhouses.

# **10.** Which application software packages are the most important for a business end user to know how to use? Explain the reasons for your choices.

#### Important applications

*Groupware* (and messaging) – enables basic collaboration activities such as e-mail, calendar, schedule, task, and discussion (or "chat") capabilities. This allows people to work together more efficiently.

*Word processing* – allows users to express themselves effectively in formatted text. However, we're seeing these applications integrated into other applications such as e-mail and instant messaging.

*Web browser* – provides users with a tremendous amount of information via access to the Internet, extranet, and intranets.

*Spreadsheets* – allows users to perform calculations and analysis on business data thereby enabling better decision making.

*Presentation graphics* – software to create professional-quality graphics presentations that can incorporate charts, sound, animation, photos, and video clips. In short, it simplifies preparing visual aids for live presentations.

*Desktop publishing software* – this is software that provides control over the placement of text, graphics, and photos in the layout of a page and enables a range of print format options.

*Databases management systems* – allows users to quickly sort, filter, tabulate, and maintain large quantities of information on order to gain useful insights that might have otherwise remained hidden by the sheer volume of data.

*Video editing* – enables true multi-media communications and presentations.