INTRODUCTION TO END-USER COMPUTING

In this chapter you will learn:
- How historical changes in computer technology have affected computer use
- Ways to classify end users
- Computing resources that end users need
- The major categories of end-user applications software
- Common problems end users may encounter

Computer use has become much more widespread during the past decade than ever before. Almost everyone who works in business offices, manufacturing facilities, educational institutions, and government agencies has a computer on their desk, near their work site, in their car, or at home. Furthermore, people interact with computers much differently than they did several decades ago. As the computer industry has grown and changed, so has the way people use computers.

This chapter provides an overview of end-user computing. You will examine some of the important trends that have influenced computer use over the last 50 years. Then, you will learn about the types of end users and the main categories of computer applications. Finally, you will look at the problems that accompany the growth of end-user computing. These problems often threaten the increases in worker productivity promised by end-user computing.
End-user computing refers to the everyday use of computers for both business and personal use. At every level, many workers interact with personal computers (PCs) to accomplish their work. Many people also have computers in their homes. However, when computers were first used in business, most people did not have computers on their desks, nor did they use computers themselves—at least not directly.

**The 1950s and 1960s: Early Mainframe Computers**

In the 1950s and 1960s, computer systems in business and government were highly centralized. Mainframe computers are large, powerful computer systems that process high volumes of transactions, store databases with millions or billions of records, and often serve as the hub of a corporate network. Mainframe systems are installed in a secure central location and are operated by computer professionals. During the early days of business computer use, the professional computer staff that worked with a mainframe computer was organized into a Data Processing (DP) department, the division that programs and operates the organization’s mainframe computer system. Only the professional DP staff had direct access to these computers and had the ability and access to write programs, enter information, perform calculations, and produce reports. Employees in other departments who wanted to process information with a computer had to request services from the DP department and then wait for the results.

1950s and 1960s vignette: Mainframe payroll processing

Juanita Hawkes, a payroll clerk, prepares a monthly payroll. At the end of each month, Juanita handwrites the hours-worked information from each employee’s approved timesheet into columns on a large sheet of ledger paper. Juanita then sends the ledger sheets to the Data Processing department, where a data entry clerk keys the data into punched cards. To avoid errors, a different data entry clerk independently verifies that the correct entries were punched into the cards. When the verified punched cards are returned to Juanita, she adds some program control cards to the payroll transaction cards. These program control cards instruct the mainframe computer to run the payroll application program with the attached transaction cards. Then she walks downstairs to the DP department window and turns in the punched cards to be run on the mainframe computer.

If the mainframe software detects errors, Juanita receives the punched cards back along with a printout that lists the errors. If no errors are detected, Juanita receives a detailed payroll report and the employee paychecks that were printed on the mainframe’s printer. Juanita contacts a programmer in the DP department if the payroll program terminates abnormally with an error message. Although Juanita has been a payroll clerk for several years, she once remarked that she had never actually seen the mainframe computer she relies on in her work.

Between 1950 and 1960, mainframe computers were used primarily for transaction processing and management reports. **Transaction processing** is the use of computers to input
large volumes of business events or activities, process the data, and prepare printed reports. Banking computer systems that process deposits and withdrawals from customer accounts are a familiar example of transaction processing. Unlike most transaction processing today, which usually occurs as soon as a transaction occurs (sometimes called real-time processing), transactions in the 1950s and 1960s were often collected and stored for a day, a week, a month, or sometimes for an entire year. The collected transactions were then processed as a group, a procedure known as batch processing.

One goal of transaction processing using mainframe computers was to automate as much manual processing of business data as possible. Organizations commonly used transaction processing to calculate employee payroll, control inventories of raw materials and finished goods, enter product orders and shipments to customers, and perform other high-volume record keeping required to operate a business or government agency. Contrast the difference between a large organization that uses its clerical staff to record, calculate, and file payroll information manually with an organization that invests in a mainframe computer system to automate many of the manual payroll processing steps. The payroll application (software program) can input, sort, match, calculate, print, and store payroll records with little or no manual processing by clerical employees. Mainframe computers could process payroll transactions much more rapidly and with fewer errors than clerical workers. Because of their speed and accuracy, mainframe computer systems were often justified as a cost-effective productivity tool for businesses.

Another common use of mainframe systems during the 1950s and 1960s was management reporting. Management information systems (MIS) are computer software that automates the preparation of reports for managers and employees. Detailed data that has been previously stored on a computer disk or magnetic tape by a transaction processing system is input, summarized, and printed as reports. Management information and reporting systems dramatically reduced the manual staff hours required to summarize data and type lengthy reports. For example, a supervisor of a maintenance shop could request a weekly report that shows the number of hours worked on each repair project, which projects are over budget, or which projects require substantial employee overtime. An MIS programmer could access payroll data from the transaction processing system to prepare the necessary management reports. A computer operator would then schedule the reports to print at regular intervals to meet the supervisor’s need for management information.

To learn more about the current use of mainframe computers in large organizations, visit the IBM Web site for zSeries systems at www-1.ibm.com/servers/solutions/zseries. Articles on the Web site describe how IBM mainframe computers are used by organizations to gather, manage, and analyze information; provide communication tools for workers who collaborate on projects; and manage relationships with customers.

Because mainframe computers in the 1950s and 1960s were centralized, and because the technologies for computer input were very limited, data for input to a mainframe had to be delivered physically (in the form of punched cards, paper tape, or magnetic tape) to the
central system location. Output (in the form of payroll checks, for example, or printed reports) had to be delivered back to the department where it was used or distributed. Figure 1-1 summarizes how mainframe computers were used in the 1950s and 1960s.

![Figure 1-1 Characteristics of early mainframe computer use](image)

As you can see from this brief overview, computer use in the 1950s and 1960s was very different from computer use today. Although mainframe computers may seem cumbersome by today’s standards, they met many of the objectives of that era. Early mainframes provided a substantial increase in employee productivity over manual processing methods. Although some organizations today still rely on computer processing that is similar to that of the 1950s and 1960s, other organizations took the first steps toward a different mode of computer processing and end-user computing in the 1970s.

### The 1970s: The First Steps Toward Decentralized Computing

During the 1970s, computer use in many organizations gradually became decentralized as terminals became common. A **terminal** is a keyboard and a display screen that are connected to a mainframe computer by a pair of wires and used by employees to enter and access information in a mainframe system. A 1970s vintage terminal had no processor or storage capability like today’s PCs. And they displayed only text output instead of the graphic output common today. They were sometimes called “dumb” terminals. However, terminals enabled clerical employees to interact directly with the mainframe computer from their own desks. Although the data was still stored and processed centrally in the mainframe computer, employees who were computer users could run programs and input and retrieve data themselves, without leaving their desks.
1970s vignette: Terminal payroll processing

Mohammed Hakkim is a clerk responsible for payroll processing for a local school district. At the end of each month, Mohammed keys the payroll information for each district employee he receives from school principals using the terminal on his desk. When the data have been entered, Mohammed enters a command at his keyboard to run the payroll processing program on the mainframe computer. If the program encounters a problem, an error message is displayed on Mohammed’s terminal screen. Some problems require that Mohammed make changes to correct the data; other problems require the assistance of a programmer in the Data Processing department.

When the payroll program has completed its calculations, detailed and summary payroll reports and employee paychecks are printed on a remote printer located in the Accounting department where Mohammed works. Mohammed says that use of a terminal and remote printer to enter and correct payroll data and run the payroll program directly from his desk has significantly reduced the time it takes him to process the district payroll.

However, not every employee had access to a terminal during the 1970s. One reason was cost: the first terminals were too expensive for most organizations to provide one to each employee. In addition, some of the mainframe professionals in the DP department disliked terminals. Computer access by clerical workers and the ability to run programs whenever they want meant that the central computer staff had lost some control over the mainframe system and the information stored in it. The DP department staff often expressed the concern that errors and mistakes made by clerical workers in other departments could offset any productivity gains from terminal access to the mainframe. Furthermore, the DP department staff expressed concerns about the cost, and what they perceived as a waste of time, to provide assistance to clerical users in departments outside the DP department whenever they encountered problems.

In addition to terminals, another step toward decentralized computing was the introduction of minicomputers during the 1970s. In comparison to a mainframe, which could easily occupy much of the space in a large room, a minicomputer is a smaller computer, closer in size to a refrigerator or file cabinet. A minicomputer is less powerful than a mainframe, but also much less expensive. Because 1970s-era mainframe systems often cost $1 million or more, they were affordable only by large corporations and government agencies. Minicomputers, on the other hand, could be purchased for $100,000 to $500,000 and were therefore affordable by small businesses and individual departments in large organizations.

A few companies still make minicomputers. One system available for small businesses is the Sun Microsystems SunFire series. To learn more about Sun’s minicomputer systems and the applications software they can run, see Sun’s Web site at [www.sun.com/solutions](http://www.sun.com/solutions). IBM’s current minicomputer product line is called iSeries. To learn more about the iSeries, visit [www-1.ibm.com/servers/eserver/iseries/about/why.html](http://www-1.ibm.com/servers/eserver/iseries/about/why.html).
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Although minicomputers reduced the cost of computers during the 1970s for many small businesses and moved the power of computers closer to the employees who needed them, organizations that owned minicomputers often had to hire specialists (programmers and computer operators) to run them.

The 1980s and 1990s: The Growth of Decentralized Computing

It was not until the 1980s and 1990s that large numbers of employees in many companies began to use computers directly, ushering in the era of end-user computing. Several trends converged in the 1980s to make the widespread transition to decentralized, end-user computing possible. These trends are summarized in Figure 1-2.

- The backlog in requests for new mainframe applications
- An increase in the number of knowledge workers
- The availability of inexpensive microcomputers
- The availability of inexpensive productivity software
- The development of user-friendly graphical user interfaces

Figure 1-2  Major reasons for the growth of decentralized computing

Applications Backlog. It became increasingly clear to organizations in the 1970s and 1980s that the programmers and analysts who created programs for central mainframes or minicomputers could not keep up with the demand for their services. With transaction processing systems to handle common manual processing tasks (such as payroll, inventory control, billing, and payments to suppliers), managers began to think of new ways to use computer technology. They wanted analysts and programmers to design and write computer programs that could solve a wide variety of specific business problems to make employees even more productive. For example, a marketing and sales manager might want computer analysts to create a customer contact and tracking system to help sales reps organize the large amount of customer and product information they work with every day. However, professional computer staffs could not grow fast enough to meet the increasing demands on their time. The term applications development backlog refers to the excess demand for new computer applications that outstripped the supply of computer professionals available to develop them. The backlog problem—widespread and well known during this period—was a source of frustration for both the professional data processing staffs and the business departments that demanded new applications. An inventory manager, for example, might develop an idea for a computer application that could potentially reduce inventory costs and staff payroll costs, only to be told that the analysts and programmers in the DP department couldn’t start on any new projects for two years.
More Knowledge Workers. A second trend that contributed to the growth of end-user computing was a dramatic increase in the number of knowledge workers, or employees whose primary job is to collect, prepare, process, and distribute information. The growth in the number of knowledge workers has corresponded with shifts in the U.S. economy from mechanical to electronic ways of working. Whereas factory workers need industrial equipment to do their jobs, knowledge workers need information. The most efficient way to obtain information is through computer technology, so knowledge workers need to interact directly with computers to do their jobs.

The demand for more knowledge workers continues today. An examination of the number and kinds of jobs advertised in the Help Wanted classified ads in a Sunday newspaper attests to the unmet demand for knowledge workers in many industries. To learn more about knowledge workers, read the article “The Age of Social Transformation” by Peter Drucker (who invented the term in 1959) in the Atlantic Monthly Website at www.theatlantic.com/issues/95dec/chilearn/drucker.htm.

Declining Microcomputer Cost. Another reason for the growth of end-user computing during the 1980s and 1990s was a dramatic drop in the cost to provide computer power to employees. As the computer costs decreased, technology capabilities (especially semiconductor power and capacity) increased exponentially. Mainframe systems were expensive to purchase and operate, even when these substantial costs were spread over a large number of employees. However, desktop microcomputers with price tags of around $2000 made computing more affordable, especially for small and mid-sized organizations and even for individual employees. A microcomputer is a complete computer (sometimes called a personal computer, or PC) built on a smaller scale than a mainframe or a minicomputer, with a microprocessor as the processing unit (CPU). The first microcomputers appeared in some organizations during the early 1980s. Individual employees occasionally made unauthorized purchases, despite warnings by the Data Processing department that money should not be wasted on these “toy” computers.

The cost of computer hardware is somewhat deceiving. A basic personal computer system configuration cost $2000 to $2500 in the early 1980s. Many systems still sell in that price range. If the price for a high-end system today is about the same as 25 years ago, what has changed? The amount of computing power has changed dramatically. A typical 1980s-vintage personal computer had a 1 MHz speed processor, 64 KB of RAM (that’s kilobytes, not megabytes—a difference factor of 1000), a 5 MB hard drive (that’s megabytes, not gigabytes—again a difference factor of over 1000 compared to today’s hard drives), a monochrome (one-color) display screen, and a 300-baud modem. Today, a PC with a 2 GHz processor, 512 MB of RAM memory, an 80 GB hard drive, a color display, a 56 KB modem, and a readable/writeable CD drive can be purchased for about $2000. Many basic models sell for substantially less than $2000. It is not unusual for computer professionals to comment that their
Moore's Law is a popular rule-of-thumb in the computer industry. Gordon Moore says that the capabilities of the technology (CPU speed, for example) double every 18 to 24 months. To learn more about Moore's Law, visit the Intel Web site at www.intel.com/research/silicon/mooreslaw.htm.

Inexpensive Productivity Software. The development of inexpensive applications software contributed to the rapid expansion of desktop computers in many organizations. Although mainframe computer hardware was expensive, programming applications software to run on a mainframe was even more costly. Many organizations reported that they spent more on software development than on hardware. Pre-programmed, off-the-shelf software for mainframes was relatively rare and very expensive; most software was custom developed. The availability in the early 1980s of inexpensive software packages such as Visi-Calc (spreadsheet), WordStar (word processor), Lotus 1-2-3 (spreadsheet), and dBASE (database) meant that many organizations, and sometimes even individual employees, could afford not only microcomputer hardware but also the software that would make them more productive computer users. End users were no longer dependent on the schedules and backlog of in-house program developers in the DP department. Software development vendors that specialized in mass-market productivity software for microcomputers were able to supply general-purpose programs that met user needs at a reasonable cost. In addition to inexpensive productivity software, industry-standard operating systems, such as MS-DOS, MacOS, and Windows, also contributed to the rise in end-user computing.

User-friendly Graphical User Interfaces. Early computer systems executed commands that a user typed at a terminal to communicate with the computer’s operating system. The MS-DOS operating system is an example of a text command interface. During the 1980s and 1990s, many of the programs written for personal computers incorporated menus and graphical user interfaces (GUIs), or screen images that enable users to access the program features and functions intuitively, making the programs much easier to use than command-oriented mainframe software. Users no longer had to remember the correct command, and they found computers less intimidating to operate with a point-and-click mouse as a pointing device.

For more information about the development of the graphical user interface, including a timeline of development highlights, see toastytech.com/guis/index.html.
1980s and 1990s vignette: Payroll processing on a PC

Junior LeBeau is an accounting clerk for a small business of about 25 employees. At the end of each month, Junior collects payroll data from every employee and asks their supervisor to approve the timesheet information. Junior then keys the data into a payroll program on his desktop PC that is designed specifically for small businesses. The software can detect certain kinds of errors, such as an entry of 88 hours in a day that should have been 8.

When payroll transactions are entered and errors corrected, Junior selects a menu option on the PC payroll software to process the payroll transactions. Junior prints the detailed and summary payroll reports for distribution on the printer attached to his PC. However, for security reasons, Junior writes a file on a floppy disk with paycheck information, which he then sends to a payroll service bureau across town where the paychecks are actually printed.

The Late 1990s and 2000s: The Era of Distributed and Network Computing

Both centralized mainframe computing and decentralized end-user computing share a common goal: to help employees be more productive. However, the way people interact with computers, as well as the size and cost of the computers, has certainly changed. Other innovations in the way computers are used are still under way. Widespread use of computer networks (both local area and wide area networks) in small and large organizations and the phenomenal growth in the use of the Internet as a communication tool, information resource, and electronic business platform will continue to have a significant impact on business and home computer users. Figure 1-3 illustrates the transition from centralized to decentralized computing.

Although end-user computing has changed the way many people work with and obtain information, mainframe computing still plays a significant role in most large corporations and government agencies. Many enterprises own modern mainframe systems that still process transactions and management information. Corporate (or enterprise) need for centralized mainframe and minicomputer applications has not diminished and often cannot be met with desktop systems. For example, operating a large database system, such as an online airline reservation system or a transaction processing system for a multi-branch bank, would require the processing power of hundreds of the fastest microcomputers working together as a single synchronized system.
Therefore, mainframe computing has not been replaced by end-user computing; rather, the two have been joined through the technology of computer networks. The term **distributed computing** describes an environment in which the needs of the organization determine the location of its computer resources. Organizations frequently require centralized mainframes, minicomputers, or network servers to perform enterprise-wide recordkeeping and transaction processing, as well as desktop tools to increase personal productivity at each employee’s workspace. Distributed computing relies on network technology to link central systems and personal computers, so as to meet both corporate and individual employee needs.

2000s vignette: Payroll processing on a networked PC

Trisha Toledo is an accounting clerk for a small business of about 50 employees. During the month, employees enter payroll information into their personal desktop PC, from where it is automatically transferred into a payroll database on the company’s network server. At the end of each month, Trisha sends an e-mail to remind each department supervisor to verify and authorize the data entered by employees in each department. As an additional check, Trisha runs software on her desktop to verify and validate that each piece of payroll data as submitted is within an expected range. The software alerts Trisha about any potential problems so she can correct them immediately.

When payroll transactions have been approved and verified, Trisha runs a program on the company’s network server that computes the payroll, e-mails a pay stub to each employee, and then directly deposits the net pay amount into each employee account at a local credit union using electronic funds transfer over the Internet.

Yesterday’s Data Processing department has been renamed Information Systems, Information Services (IS), or Information Technology (IT). The change reflects a shift in its mission and an attempt to improve the tarnished image it earned earlier due to its inability to meet the demands of the applications development backlog. The IS or IT department now operates mainframe and minicomputer systems that frequently act as hubs of corporate computer networks. Corporate networks often include mainframe, midsize, desktop, portable, and wireless systems.

Table 1-1 summarizes the main events that occurred in computer technology in the decades between the 1940s and the present.

Table 1-1 Milestones in the adoption of computer technology

<table>
<thead>
<tr>
<th>Decade</th>
<th>Primary Types and Uses of Computer Systems</th>
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<tbody>
<tr>
<td>1940s</td>
<td>• Invention of computer processing units and mainframe peripherals</td>
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<td>1950s</td>
<td>• Early use of mainframe computers in large corporations</td>
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<td>1960s</td>
<td>• Widespread use of mainframes</td>
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<td>• Early use of workgroup minicomputers</td>
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<td>1970s</td>
<td>• Widespread use of minicomputers in workgroups</td>
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<td></td>
<td>• Terminal access to mainframes and minicomputers</td>
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<td></td>
<td>• Early use of microcomputers</td>
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<td>1980s</td>
<td>• Widespread use of home and business microcomputers</td>
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<td></td>
<td>• Availability of mass-market applications software and personal computer operating systems</td>
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<td></td>
<td>• Early use of data communications and networks to connect micro-to-micro and micro-to-mainframe</td>
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<tr>
<td>1990s</td>
<td>• Widespread use of data communications, local area and wide area computer networks</td>
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<td></td>
<td>• Distributed computing</td>
</tr>
<tr>
<td></td>
<td>• Rapid growth of the Internet as a global network</td>
</tr>
<tr>
<td>2000s</td>
<td>• Increased use of the Internet for electronic business and business-to-business transactions</td>
</tr>
<tr>
<td></td>
<td>• Availability of very low-cost PCs</td>
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</tbody>
</table>
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A detailed timeline of events in the history of computers (with pictures) is available on the Web at www.computer.org/computer/timeline/timeline.pdf (requires Adobe Reader to view). Another timeline that focuses on personal computers is www.islandnet.com/~kpolsson/comphist. To view a slide show on the history of the Internet, go to www.isoc.org/internet/history/2002_0918_Internet_History_and_Growth.ppt.

END-USER CLASSIFICATIONS

To understand the variety of environments and situations in which organizations provide user support, it is helpful to recognize the different types of end users. Who are end users? Where are they located? How do they use computers in a business or home environment? There are many useful ways to classify end users. Figure 1-4 lists some common end-user classifications.

- **Environment**: home or personal user, corporate or organizational user
- **Skill level**: novice, unskilled, semiskilled, expert
- **Principal applications**: word processing, e-mail, accounting, and others (see “End-User Applications” in this chapter)
- **Frequency of use**: occasional, frequent, constant
- **Features used**: basic, intermediate, advanced
- **Location**: internal user, external user

Figure 1-4  Common categories of end users

Environment

For some purposes, it is helpful to distinguish between people whose primary use of computers occurs at home with non-business-related applications and those whose primary use occurs at work with business-related applications. Of course, many users fall into both groups at different times.

Skill Level

End users span the range from novice and unskilled users (who have little or no computer experience, difficulty with basic computer vocabulary, and many questions) to highly skilled users who are largely self-sufficient. Users who are highly skilled in one application program may be novices, however, in another application program or operating system.
Software Used

Users can be classified by which applications they use. For example, some home users primarily work with word-processing and e-mail programs and play computer games for entertainment. Business users often work with spreadsheet and database applications or software designed for specific business use, such as a specialized medical accounting system.

Frequency of Use

Some people use computers only occasionally; they may not use a computer every day, or even every week. Other users make frequent, possibly daily, use of a computer. A user who makes extensive use of a computer for several hours each day in an organization or home business could be classified as a constant user.

Features Used

Some users may use only basic software features. They may know only how to perform a routine set of simple tasks using common features of a program. Other users may use more features, including several that are intermediate in their power and complexity. Users who employ advanced software features have learned to use the full power of the software in order to be very productive, and are sometimes called power users.

Location

Another way to classify end users is by location, as viewed from an organization’s perspective: are the users internal (in-house employees) or external (clients or customers)? Whether its users are internal or external often determines the characteristics of the support an organization offers.

Internal Users. In-house employees at any level within an organization who use computers to do their work are called **internal users**. It is difficult to think of a department that does not use computer technology in some way. Clerical and administrative employees, whose manual tasks were the first targets of automation on early mainframe computers, continue to be a significant category of end users. Managers, professional workers, engineers, marketing representatives, and factory workers also make extensive use of computer systems to complete their work. Internal users need technical support as they use their computers to perform their daily tasks.

Even computer professionals, such as programmers and analysts, can be considered internal users. Computer professionals often use the same kinds of personal computers and software as other employees. The fact that an employee is a computer professional does not mean that he or she never requires support services. A highly skilled software programmer, for example, may know little about how to diagnose and repair a hardware or network problem. Because computer technology professionals are end users who work within a company, they are classified as internal users.
External Users. **External users** are end users who are outside an organization, usually because they are customers or home users. Customers of hardware and software vendors are external users from the viewpoint of the vendor. Home computer users who have purchased personal computer hardware and software from a retail outlet or through the mail are external users. When external users encounter problems, they often contact the hardware or software company (the vendor) where they made their purchase.

With today’s mobility, the distinction between internal and external users is sometimes blurred. A worker who telecommutes (works at home) is an internal user who shares many of the characteristics of an external user. Internal and external users both require technical support services, but the environments in which they work may affect the support services they need and the way those support services are delivered. Despite the differences among the computer users that these classifications describe, all end users need some common resources to make effective that use of computer technology.

**Resources End Users Need**

People who want to use computers at home, on the job, or in school often buy their first computer on the basis of media advertising. Computer ads sometimes tout complete systems for less than $500. These are usable, but fairly basic hardware systems that may or may not include a monitor or a printer. New users often are surprised that the full cost of owning a personal computer system is more than the purchase price of the initial hardware. What kinds of costs are end users likely to encounter?

**Basic Hardware**

Hardware refers to the electrical and mechanical components that are part of a computer system. In addition to the system unit with a central processing unit (CPU), users need memory and storage space, a keyboard and a mouse or other pointing device, a display screen (monitor), and a printer for even a basic task such as word processing. The original cost of the hardware is only a starting point in the cost of a complete system.

**Add-on Peripherals**

In addition to basic hardware, end users frequently need peripheral devices, or hardware add-ons that plug into the computer’s system unit, either externally or internally. For example, anyone who wants to connect to the Internet needs some type of dial-up or broadband modem or a connection to a local area network. Office users who want to connect to a local area network need a network interface card (NIC), an adapter card located within a computer’s system unit that connects their PCs to the network. The network cable plugs into the NIC, which sends and receives signals to and from a network server. Users who work with graphics and images usually purchase an image scanner or a digital camera. Anyone who wants to make convenient media backups might invest in a
removable disk drive. The list of available peripheral devices is long and can add considerable expense to a basic system.

**Hardware Maintenance and Upgrades**

Most PCs are sold with a basic warranty and perhaps some technical assistance to cover initial installation or other operational problems. Warranties of 90 days to three years are common, during which hardware problems are repaired without charge. A few vendors also offer next-day on-site repair services. Other companies offer a warranty that specifies that the user must pay shipping to return a defective device to the manufacturer or to a repair depot. Some companies offer extended warranties on hardware components. Most extended warranties add to the expense of the hardware and are usually very expensive relative to their value, because most computer components that fail do so early, during the standard warranty period. Extended warranties may be a worthwhile expense for new users who want the assurance that help will be available during installation if it is needed, or who want to cover potential hardware problems during a fixed time period at a fixed cost. However, most computer purchasers do not purchase additional warranty provisions. In any case, all computer purchasers should know the features of the warranty that come with a new PC and whether technical assistance is available locally or via a long-distance call.

Even after the initial purchase of a system and peripherals, additional costs may arise. During the two- to four-year life of a typical computer system, users might need to upgrade the amount of memory, the CPU speed, the size of the hard disk drive, the speed of a peripheral (such as a modem or a printer), or other system components. Some users upgrade their basic system at the time of their initial purchase, especially if they plan to run a software package that requires more than the minimum amount of memory. For example, although software vendors sometimes advertise that their products operate on a system with a minimum of 128 MB of RAM, they may perform better with 256 MB or more. As technological improvements are introduced, users may want to take advantage of new devices such as an improved sound system, a digital video disc (DVD) player, or a CD or DVD burner (to read/write CDs and DVDs). Hardware upgrades help keep systems fully functional as more complex software packages with higher memory and disk space requirements become available, and as hardware devices with more capabilities are developed.

Although the hardware components in most PCs are generally reliable over time, hardware service organizations keep busy diagnosing and repairing a multitude of malfunctions. Most organizations with a sizable investment in computer equipment need to budget for occasional hardware repairs. Although individual home users may beat the odds and never need hardware repairs, the probability is that a few users out of every one hundred will experience a burned-out power supply or a crashed hard drive, and have to pay the cost of a replacement.
Software and Software Upgrades

Most hardware packages are bundled (sold) with preconfigured operating systems. However, some users want to run one of the several alternatives to industry standard operating systems, such as Linux, instead of, or in addition to, Windows. For these users, the alternate operating system often represents an added cost.

In addition to operating system software, users can expect to spend a considerable part of their computer system budget for applications software, especially if they purchase one or more special-purpose packages. Some users require specialized packages, such as a computer aided design (CAD) program, or a software package tailored to a specific business, such as a legal billing system. Although mass-market software is often fairly inexpensive, specialized software can add thousands of dollars to the cost of a system. In the next section, you will review some common software applications.

Besides the initial purchase of the operating system and applications software, users need to budget for software upgrades. Although some software upgrades are free when downloaded from the Internet, many new software versions and upgrades must be purchased. The price can vary, depending on the extent of the upgrade and the type of software. For example, a virus protection package may have frequent, inexpensive upgrades, whereas a tax preparation program may require replacement of the product each year.

Supplies

When estimating the total cost of a computer system, end users should be sure to include consumables, such as printer paper, mailing labels, ink-jet or laser printer cartridges, cleaning supplies, media (floppy disks, removable cartridges, recordable CDs, or tape cartridges), cables, and other supplies they will need to operate their system. Laser printer cartridges and high-capacity removable disk media can be very expensive.

Data and Information

As end users communicate more with other users and get information from outside sources, they can incur costs for information services. The monthly cost of an Internet access service falls into this category, as do the costs of downloading stock market, financial, or economic data from a service such as America Online. Although many information vendors and brokers initially offer free access to their data to attract customers, over time more information providers will charge for specialized information access. Proprietary information and expert opinion, in particular, will cost more as awareness grows that information has a value to consumers.
Technical Support

As end users buy and learn new programs and discover new uses for programs they already own, they often need technical support. Support can include installation assistance, training courses, training materials, books, and magazines. Frequently, users must contact a hardware or software help desk to solve a problem. When they do, they often pay for long-distance telephone charges in addition to the cost of the support call itself. Some computer vendors sell support packages for a fixed fee. In a large organization, personal computer support is a major budget item.

Training is a good example of a technical support service that can add substantially to the cost of a computer system. Training for end users is available in a variety of formats, as described in Chapter 11. Some users try to avoid the cost of training by using a trial-and-error learning method, which would appear to be free. However, when you factor in the cost of reduced productivity and the errors made by a poorly trained user, the hidden costs of this approach to training are significant. While the purchase of a $40 tutorial, book, or online course on a software product may seem inexpensive, an employee’s time must be added as a hidden cost. Commercial training courses are expensive, especially when you add in the cost of travel, lodging, and meals.

Facilities, Administration, and Overhead

Both home users and businesses should budget for the cost of facilities they will need to house and operate a computer system. Facilities include furniture, ergonomic devices (such as keyboard wrist rests and antiglare screens), electricity, air conditioning, power conditioners, space, and other workplace components that are necessary to operate a computer system.

In many organizations, overhead and supervisory costs are related to the management of end-user computing systems. These costs include acquisition assistance, purchase order processing, shipping, inventory control, insurance, security, and related costs of doing business. The cost of end-user computing must include a proportional share of overhead costs.

The list of cost categories for an end-user computing system is long. Of course, not all costs apply to each user or to every system. But what does it all cost, bottom line? The total cost of ownership (TCO), or the total expenditures necessary to purchase, upgrade, and support an end user’s personal computer system over its expected useful lifetime, provides this figure. The Gartner Group, a company that researches trends in the computer industry, estimates that the total cost of ownership to an organization for a personal computer system over a five-year period is about $40,000, or approximately $8000 per year. Hardware costs account for only about 20% of the total cost of ownership, whereas software and support make up a substantial portion.

As you can see from this overview, end users need many types of resources to make their computers true productivity tools. End users who are attracted to $500 computer systems should be aware that other ownership costs must be included in the total package.
END-USER APPLICATIONS SOFTWARE

Among the computer resources end users need, applications software is one that has a significant impact on user productivity. Tasks that formerly required considerable manual effort, such as preparing a budget report or managing a mailing list, can be done faster and more accurately with a well-designed applications software program. End users run a variety of software applications, which are grouped below into 10 primary categories—electronic mail and instant messaging, Web browser, word processing, spreadsheets, database management, graphics, planning and scheduling, desktop publishing, Web site development, and educational and entertainment software.

Figure 10-4 in Chapter 10 lists some of the popular packages in each category.

Electronic Mail and Instant Messaging

Electronic mail (e-mail) enables users to communicate privately with others. It is the most common business and personal use of computers today. E-mail is closely related to word processing because the goal is to enter, modify, format, transmit, and receive text messages and attachments (an attachment is a separate file transmitted with the e-mail message that contains a document, worksheet, graphic image, or other output from an application program). To send and receive e-mail, a computer must be connected to a network, either directly or via a modem. An e-mail client program is also required to send and receive e-mail messages from a PC.

Instant messaging is communication between two or more users who are online (connected to the Internet) at the same time. As with e-mail, it is a private communication, open only to those invited. Instant messaging software notifies a user when one or more other users from a predefined “buddy” list are online so that a “chat” session can begin. Selection of an instant messaging software package is not trivial, because there are no industry standards and competing packages cannot automatically communicate.

Web Browser

A Web browser is a primary application tool that enables end users to find and display information on the Internet. Pages of information are stored and transmitted on Internet computers in a format called Hypertext Markup Language (HTML). When an Internet user inputs the name or address of a page of interest, the Web browser retrieves the page and
displays it on the user’s PC. During the last 10 years, owing to the enormous popularity of
the World Wide Web as an information storage and retrieval reservoir for both home and
business users, Web browsers have become one of the most popular application packages.

Word Processing

Word-processing software enables users to enter, edit, format, store, and print text information
as a document. Many word processors also permit users to integrate graphics, numbers,
and footnotes easily into a document. Because most clerical, administrative, and managerial
employees produce letters, memos, papers, reports, and other printed documents, word
processors are one of the most frequently used software applications among end users. Word
processors are usually part of an office “suite” of software tools, so users sometimes don’t put
much thought into the selection of a word processor.

Spreadsheets

Because clerical, administrative, and managerial employees frequently work with numeric
information in addition to text, electronic spreadsheets are close to the top of many users’
software shopping lists. Spreadsheets are used to prepare budgets, sales reports and forecasts,
financial statements, and other reports in which numeric information is organized into a
worksheet of rows and columns, and in which repeated calculations are necessary to produce
meaningful results. Spreadsheet software is also commonly a part of an office “suite” of
software tools.

Database Management

End users frequently need to track information that relates to business activities and projects.
A database management program allows end users to enter, update, store, format, and print
reports containing information that is stored as a series of records that share a common
format in a database. Client lists, mailing lists, personnel records, office supply inventories,
and class rosters are examples of common databases. Home users also use database manage-
ment programs for managing personal directories, such as a club roster, or lists, such as an
inventory of antique collectibles. Database software runs the gamut from easy-to-use
packages that are often included in office “suites” of programs to sophisticated enterprise-
wide database packages. Some sophisticated database software includes a data mart, which is
a user-friendly front-end that allows employees to extract and analyze data from a database
without programming skills.

Graphics

Users often need to organize and summarize information in the form of pictures, charts, or
drawings. Graphics software lets a user create illustrations and charts that analyze trends,
show relationships, and summarize large amounts of data. Presentation graphics software
is used to create attractive electronic slide shows with text, pictures, charts, and diagrams for
training, sales presentations, lectures, and other events where the appearance of visual information is important. Other graphics software packages are used to organize and edit digital pictures and scanned images. Although specialized graphics software packages are specifically designed to prepare graphical images on a computer, many word-processor, spreadsheet, and database packages sold today also include some graphics capabilities.

Planning and Scheduling
Office employees spend considerable time planning and scheduling their individual work as well as team projects. Software packages for planning and scheduling include personal information managers, which help business or home users maintain an electronic calendar, a to-do list, and an address book. For collaborative projects, some scheduling and calendar software can arrange meetings at a convenient time for all members in a group. In addition, project management programs allow managers to plan, schedule, and monitor the status of tasks in a group project, as you will see in Chapter 7.

Desktop Publishing
Desktop publishing software combines the features of a word processor and a graphics program. Desktop publishing software enables end users to design, lay out, and prepare—at a relatively low cost—high-quality brochures, newsletters, posters, computer manuals, and other printed material that would otherwise need to be designed and typeset by a printing professional. As word processing software becomes more feature-rich and powerful, the distinction between the two categories narrows. However, in general, desktop publishing packages give the user considerably more control over typographical features and have superior WYSIWYG (what-you-see-is-what-you-get) features to preview on the screen what will be printed.

Web Site Development
Web site development software is popular with employees and home users who design, develop, and maintain an organizational or personal Web site. Web site development software packages enable users to create, maintain, and update Web pages that include a mixture of text and graphics and incorporate features such as e-mail links, chat rooms, File Transfer Protocol (FTP), and restricted access for security. Software for Web site development ranges from features incorporated in some word processors to sophisticated packages designed for professional Web programmers.

Educational and Entertainment Software
Educational software provides learners with hands-on experience to supplement an instructor’s lectures or distributed materials. Educational software can also test and provide feedback on learners’ understanding of concepts or on their ability to solve problems. Tutorial software
is also available to help computer users learn new software packages. Computer games are, of course, a significant portion of the entertainment industry.

**Mainframe Applications**

Corporations and business enterprises continue to run many of the same applications on their mainframe systems as they did decades ago: payroll, accounting, inventory and asset management, human resources, and manufacturing. Newer categories of mainframe applications software include customer relationship management (CRM) and enterprise resource planning (ERP). Although some organizations have converted their legacy (old) mainframe applications to more modern hardware platforms and applications software, some continue to run the same programs today as they did in the 1960s and 1970s. The cost to upgrade to more recent software and the cost to convert a large database of information from older mainframe systems to newer ones are often cited as reasons organizations continue to use legacy systems.

Many employees also use their personal computers as terminals to connect to company mainframes. Once connected, they can use terminal emulation software to run programs on the mainframe much as they did 25 years ago, or to download information from the mainframe to their personal computer. Transaction processing and management reports are tasks end users can now run on their personal computer systems with data extracted from a corporate mainframe. Because personal computers are much more powerful than the terminals of the 1970s, users can process some information locally on their PC’s processing unit. **Client/server computing** is a form of distributed computing whereby processing tasks are shared between a mainframe system or powerful microcomputer (the server) and a local personal computer (the client). In a client/server system, some data is stored and processed on a central system; other data storage and processing occurs on a local system, such as a personal computer.

The preceding categories encompass the most common personal computer applications and include many of the primary applications employees use in business, government, education, and other organizations. New categories of applications emerge when a need develops. Whether for home or business use, almost all software applications are designed to increase users’ productivity. In fact, most organizations justify their computer purchases on the basis that they help make employees more efficient. To accomplish this objective, computers should either increase the amount of output (product or service) an employee can produce based on a given amount of input (effort), or reduce the amount of input required to produce a given amount of output. In general, end-user computing has accomplished this ambitious goal, but not without problems along the way.

To learn more about how productivity among knowledge workers is measured, read a white paper on how to measure and improve productivity at the Business Authority Web site, [www.business-authority.com/management/time_management/productivity_management.htm](http://www.business-authority.com/management/time_management/productivity_management.htm).
Many employers believe that employees who use technology are more productive. But productivity for an individual worker is often difficult to measure. Is there evidence that investments in technology actually increase worker productivity?

The U.S. Department of Labor measures the productivity of all non-farm workers in the U.S. economy. First, it calculates the total dollar value of all goods and services produced each year. Then, it divides that figure by the number of hours employees worked to produce those goods and services. The result is the dollar value of worker productivity per hour worked.

According to figures released by the Department of Labor, the value of worker productivity increased by an average of 2.5% per year between 1996 and 2002. Compare that increase with the average annual increase of 1.4% during 1973 to 1995. Economists and financial analysts think the increase in productivity is due to investments in computers, cellular phones, facsimile machines, copiers, and other technology products. Alan Greenspan, Chairman of the U.S. Federal Reserve Board, says the notable pickup in productivity is due to U.S. business investments in technology that are now paying off. Why hasn’t the increase in worker productivity been more obvious?
until the mid-1990s? Greenspan thinks the delay occurred because it takes time for investments in technology and worker training to use new technology to result in increased productivity.

One example of increased worker productivity is occurring in the banking industry. Some banks have doubled the number of ATM machines available to customers in the last few years. The result is an increase in the number and speed of transactions for both the customer and the bank. However, automated transactions take fewer bank employees to process. The banking industry is currently working on the next big productivity gains in banking: first, banks are working to convince customers of the advantages of personal computer use and the Internet to process bank transactions, such as online bill paying; second, although its use is not yet widespread, some financial institutions are planning for the day digital money will replace paper and coin currency.

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PROBLEMS WITH END-USER COMPUTING

The benefits of end-user computing are often accompanied by a new set of problems that organizations must address. Although not necessarily unique to end-user computing, the problems listed in Figure 1-5 can result from an environment in which powerful hardware and software tools are used (and can be easily misused) by a large number of employees.

Figure 1-5  Common problems with computer technology

There is a good chance that end users will encounter one or more of these problems in the course of their work or home computing experience.

Waste

Waste refers to the use of money, time, or other resources that do not contribute directly to increased user productivity, or may even result in lower productivity. End users who do not have the same training as computer professionals may lack the expertise and experience to make cost-effective purchase decisions about hardware, peripherals, software, and networks. For example, end users who are not knowledgeable about the relationship between hardware and software capabilities may purchase software that does not operate (or operate efficiently) on their hardware configurations. If the software an end user purchases operates
inefficiently or causes the user’s system to crash frequently, the result is often frustration and lower user productivity. Waste also occurs when end users purchase software that does not meet their needs as well as a competing program, or they purchase software that costs more than a similar package. Another form of waste is employee time spent viewing information on the Internet or reading and sending e-mail messages that are not directly job-related.

Mistakes

End users who are careless or not properly trained can easily make mistakes as they use sophisticated software. For example, an end user who prepares a spreadsheet to estimate a project’s cost may inadvertently enter the wrong formula or data for critical calculations. The user may not understand the importance of testing even simple spreadsheet formulas for correctness, and may fall victim to a common assumption: “If the results are prepared on a computer, they must be correct.” However, if a formula or number is entered incorrectly, then the results will be incorrect.

A well-publicized example of a computer mistake occurred in the early days of spreadsheets when a bidder failed to get a job contract because of a spreadsheet miscalculation. The user didn’t realize that adding a row to a spreadsheet in that particular program meant that he had to revise the formula to include the added row. As a consequence of one simple error, the total amount bid was unrealistically overstated. A lawsuit followed, but the spreadsheet software company won. The court ruled that the spreadsheet user was responsible for mastering documented features.

Another common mistake is a user’s failure to make backups of important information. Computer mistakes can be extremely costly, especially in high-stakes business situations. All computer users need to build in safeguards and double-checks to ensure that computer errors are detected before they do significant damage.

Computer Crime

Although waste and mistakes are usually unintentional, computers are also used to commit intentional crimes. For example, an employee may have access to company information that would be potentially valuable to a competitor, and may try to profit from the sale of the information. Information theft, identity theft, fraud, sabotage, and embezzlement can be committed with the aid of a computer. These crimes are not unique to end-user computing; they emerged very early in the use of mainframe computers. However, the number of personal computer users, the lack of security measures, and the easy access to information multiply the potential for computer crimes among end users.
Piracy

Another form of computer crime is piracy, which is software theft that involves illegal copying, distribution, or use of computer programs or information. Because floppy disks and CDs are simple to copy, software theft is frequent. For example, employees might copy the installation disks for a software package purchased by their company, take the disks home, and install the program on a home computer. Legal or illegal? The answer depends on the software vendor’s license agreement and on the employer’s policies. Some organizations either do not have a specific policy about software piracy by their employees or look the other way when this kind of theft occurs. Sharing software among home users is a similar problem, and also illegal. In fact, software piracy costs software companies billions of dollars in lost sales, which in effect raises the price that software vendors must charge to cover their development and distribution costs. Because pirated software is also a source of computer viruses, the costs in lost productivity are substantially higher than the loss of sales revenue among vendors.

Invasion of Privacy

Another form of computer crime is invasion of privacy, whereby unauthorized parties exploit personal information. This problem occurs because vast amounts of information about employees, clients, patients, and students (both current and former) are stored in computer systems. Without adequate company policies and security safeguards to define who has authorized access to which pieces of information, the potential for invasion of individual privacy and identity theft is substantial.

Loss of Data

Many (perhaps most) end users do not make frequent or effective backups of important information stored on their workplace or home personal computers. Consequently, when hardware, software, or a network fails, they risk losing data. Loss of critical data can be expensive because lost data is sometimes impossible to replace. Manual reentry of destroyed data is expensive and time-consuming, and may contribute to a business failure. In contrast, restoring lost data from a backup disk or tape is an almost trivial operation.

Computer Viruses

A computer virus is a program created with malicious intent that can destroy information, erase or corrupt other software and data, or adversely affect the operation of a computer that is infected by the virus program. Viruses are transmitted from computer to computer via networks (including the Internet) or through exchange of media between computers (including floppy disks, CDs, DVDs, removable hard disks, and cartridge tapes). In a networked environment, such as an instructional computer lab at a school or a training department in an organization, the spread of computer viruses is a frequent problem for computer facilities managers. Virus protection software can be costly because it must be
updated frequently to defend against new versions of viruses. However, the cost to an individual or an organization of virus attacks, removal, and data restoration can be many times the cost of an antivirus utility program.

Health Problems

Every tool that can be used can be misused. A common source of misuse that may not even be apparent to end users is the physical environment where a computer is operated. Without proper lighting, space, furniture, and environmental safeguards, physical injury to end users can result. Without proper operating procedures and techniques, an appropriate work environment, periodic breaks, and corrective eyewear, employees may subject themselves to a variety of physical ailments. Common ailments include headaches, nausea, eyestrain, hand or wrist pain (often the result of carpal tunnel syndrome, which is severe hand or wrist pain due to an inflammation of the tendons in a user's hand and wrist), and back and neck aches. In addition, stress due to the frustrations of working with technology, and possibly other longer-term health impacts due to extensive computer use, are consequences the medical profession doesn’t yet fully understand or know how to treat. Ergonomics is a field that studies how to design a workspace that promotes employee health, safety, and productivity. Many common ailments can be avoided by paying attention to ergonomics.

Chapter 10 discusses ergonomic concerns and workspace design in more detail.

Employees who provide technical support to end users often confront these problems. Similarly, a technical support job may include providing end users with solutions to many of these same problems.

Chapter Summary

- Early business computer systems were primarily large, centralized corporate mainframes. They were used primarily to automate transaction processing and management reports. The first steps toward decentralized computing were the use of terminals to connect employees directly to a mainframe system, and the availability of less powerful, but less expensive minicomputers.

- The development of end-user computing was due to several industry trends during the 1970s and 1980s: (1) the backlog of requests for new mainframe applications, (2) an increase in the number of knowledge workers who work primarily with information, (3) the availability of inexpensive microcomputers, (4) the availability of inexpensive productivity software, and (5) the development of user-friendly graphical user interfaces.
End users can be categorized according to skill level (novice, unskilled, semiskilled, or expert), environment (home or business), software used, frequency of use (occasional, frequent, or constant), features used (basic, intermediate, or advanced), or location (internal employee or external client).

Resources that end users need to use a computer system include hardware, peripherals, hardware upgrades and maintenance, operating system and applications software, software upgrades, supplies, data and information, facilities, and technical support. These resources significantly affect the total cost of end-user computing to an individual or a company.

End users run a variety of software packages on their personal computers, including electronic mail and messaging, Web browsers, word processing, spreadsheets, database management, graphics, planning and scheduling, desktop publishing, Web page development, educational and entertainment software, as well as traditional mainframe applications.

A primary goal of end-user computing is to make employees more productive in their jobs. However, productivity is not without costs, because end users can misuse their personal computers. Common problems include waste, mistakes, computer crime, piracy, invasion of privacy, loss of data, computer viruses, and health problems.

**Key Terms**

applications development backlog — The excess demand for new computer applications that outstripped the supply of computer professionals available to develop them; the backlog of requests for software development was often measured in years of staff effort.

batch processing — The processing of a group of transactions that has been collected over a day, a week, a month, or a year.

carpal tunnel syndrome — Severe hand or wrist pain due to an inflammation of the tendons in a user’s hand and wrist; often a result of overuse in combination with an improper and/or nonergonomic physical environment.

client/server computing — A form of distributed computing whereby processing tasks are shared between a mainframe system or powerful desktop system (the server) and a local personal computer (the client).

computer virus — A computer program created with malicious intent that can destroy information, erase or corrupt other software or data, or adversely affect the operation of a computer that is infected by the virus program.

Data Processing (DP) department — A division in an organization that programs and operates the organization’s mainframe computer system; Information Technology (IT) is a more modern name for the DP department.

desktop publishing software — Software that enables end users to design, lay out, and prepare—at a relatively low cost—high-quality brochures, newsletters, posters, computer manuals, and other printed material; combines the features of a word processor and a graphics program.
distributed computing — A computing environment in which the needs of the organization determine the location of its computer resources; often includes a centralized system, such as a mainframe computer or network server, and decentralized systems, such as individual PCs on employee desks.

end-user computing — The everyday use of computer technology for both business and personal use; increases the productivity of employees, managers, students, and home users of computers.

ergonomics — The study of how to design a workspace that promotes employee health, safety, and productivity.

external user — An end user who is outside an organization, such as customers of hardware and software vendors, home workers, or personal users.

graphical user interface (GUI) — Screen images that enable users to access program features and functions intuitively, using a mouse or other input device.

Information Systems, Information Services (IS), Information Technology (IT) — The modern names of the Data Processing department; also may be responsible for network and distributed systems, such as employee PCs and user support services.

internal user — An in-house employee at any level within an organization who uses computers to do his or her work; compare with external user.

knowledge worker — An employee whose primary job function is to collect, prepare, process, and distribute information.

mainframe computer — A large, powerful computer system used by an organization to process high volumes of transactions, store databases with millions of records, and serve as the hub of a corporate network.

management information systems (MIS) — Computer software that automates the preparation of summary reports for managers and employees from detailed data.

microcomputer — A complete computer (often called a personal computer, or PC) built on a smaller scale than a mainframe or a minicomputer, with a microprocessor as the CPU.

minicomputer — A computer system that is smaller and less powerful than a mainframe, but more powerful than a microcomputer; minicomputers were used in small businesses, departments, and work groups during the 1970s and 1980s, and continue to provide a midsize option today.

network interface card (NIC) — An adapter card located within a computer's system unit that connects a PC to a computer network.

peripheral device — A hardware add-on that plugs into a computer's system unit, either externally or internally; includes input devices (keyboard, scanner), output devices (display screen, printer), input and output (modem, network interface card, touch screen display), and storage (magnetic media—tapes and disks, and optical media—CDs and DVDs).

personal information manager — A computer program that helps business or home users to maintain an electronic calendar, a to-do list, and an address book.

piracy — Software theft that involves illegal copying, distribution, or use of computer programs or information.
presentation graphics software — A computer program used to create attractive electronic slide shows with text, pictures, charts, and diagrams for training, sales presentations, lectures, and other events where the appearance of visual information is important.

project management program — A computer program that helps managers to plan, schedule, and monitor the status of tasks in a group project.

real-time processing — A form of computer processing in which each transaction or event is handled or processed as it occurs; compare to batch processing.

terminal — A keyboard and a display screen that are connected to a mainframe computer by a pair of wires; employees use terminals to enter and access information in a central system.

total cost of ownership (TCO) — The total expenditures necessary to purchase, maintain, upgrade, and support an end user's personal computer system over its expected useful lifetime; includes hardware, software, network, information, training, and technical support costs.

transaction processing — The use of computers to input large volumes of business events or activities, process the data, and prepare printed reports, usually at the time the event or activity occurs.

Web site development software — Applications software that enables users to create, maintain, and update Web pages that include a mixture of text and graphics and incorporate features such as e-mail links, chat rooms, File Transfer Protocol (FTP), and restricted access for security.

Check Your Understanding

Answers to the Check Your Understanding questions are in Appendix 2.

NOTE

1. True or False? The goal of transaction processing on mainframe computers was to automate as much manual processing of business information as possible.

2. Large computers that process high volumes of business transactions, access organizational data, and serve as corporate network hubs are called ____________ .
   a. mainframe computers
   b. minicomputers
   c. mid-range computers
   d. microcomputers

3. True or False? During the 1970s, a dumb terminal included many of the capabilities of today's personal computers.

4. A modern name for the Data Processing (DP) department is ____________ .
5. Client/server computing is a form of ____________.
   a. personal computing
   b. mainframe computing
   c. centralized computing
   d. distributed computing

6. Widespread use of the Internet among business and home computer users first occurred during the ____________.
   a. 1960s
   b. 1970s
   c. 1980s
   d. 1990s

7. True or False? Economists and financial experts think the increased productivity of U.S. workers is due to low interest rates.

8. An internal user is a(n) ____________.
   a. end user
   b. employee of an organization
   c. customer of a vendor
   d. client who buys over the Internet

9. True or False? Technical support costs are generally included in the purchase price of a computer product, and are therefore free to users.

10. ____________ is a field that studies how to design a work environment that promotes employee health, safety, and productivity.

11. Use of a computer for unauthorized access to information about a customer, student, or patient is ____________.
   a. waste
   b. an ergonomic problem
   c. an invasion of privacy
   d. piracy

12. A(n) ____________ uses pull-down menus and screen images that are easier to use than systems that require users to memorize and type lengthy commands.

**Discussion Questions**

1. Why do you think so much of the software that ran on mainframe computers was custom-written by programmers, whereas today most personal computer software is purchased off-the-shelf?
2. Do you think the changes in the way computers are used since the 1950s is due primarily to advances in computer technology over the past 50 years or due primarily to demand for improvements among end users?

3. Based on your knowledge and studies of the computer industry, what other information would you add to Table 1-1 that would help someone understand important changes in computer technology? What do you think the significant new developments for the decade of the 2000s will be by the year 2010?

4. Are the end-user problems described at the end of this chapter inevitable or can they be resolved?

H ANDS-ON P R O JECTS

Many of the interviews suggested as projects below could be organized as activities for an entire class or training session.

NOTE

Project 1-1

Interview an IS employee. Talk to an employee in an Information Systems department at your organization or school, or interview a family member, friend, or acquaintance who works in an IS department. Find out the following information:

1. What is the employee’s job title and responsibilities?
2. With what kind of computer equipment does the person work?
3. What purpose does the computer system(s) serve in the organization? What tasks does it perform? Who uses the output from the system(s)?
4. How has computing changed since his or her organization first used computers?

Write a one-page summary of the information you obtain.

Project 1-2

Interview an early computer user. Find a coworker, instructor, acquaintance, friend, or neighbor who worked with computers in the 1960s, 1970s, or 1980s. Interview the person to learn the following:

1. In what type of business did the person work?
2. With what type of computer equipment did the person work?
3. What were the principal tasks the computer performed? Who used the results?
4. What was the relationship between the computer professionals and the end users of the information?
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5. Were terminals used?
6. Was the person involved with application programming? If so, did he or she experience any of the difficulties mentioned in this chapter?
7. What changes in computer use did the person experience, and over what time period?
In a one-page report, summarize the results of your interview and compare this person’s experience with the information in this chapter.

Project 1-3
Predict future computing trends. Based on your knowledge of current trends in the computer industry, add more information to the decade milestones shown in Table 1-1 for the 2000s decade. What do you think the significant events and trends in this decade will be? Make predictions about computer size, cost, ease of use, and primary functions in business and home during the next decade.

Project 1-4
Interview a technical support person. Locate a technical support person at your school, your work, or a local company. Find out the following information:
1. Does the person support internal or external users?
2. With what resources does the person work (i.e., hardware, software, peripherals, networks, information)?
3. What types of applications do end users work with most frequently in their jobs?
4. Do any users or applications present difficult problems for him or her as a technical support person?
5. Which of the end-user problems described in this chapter does the person encounter most often?
6. Does the organization have a policy on software piracy, invasion of privacy, or virus protection?
Write a one-page summary of the information you collect.

Project 1-5
Discuss a privacy issue. An organization opposed to the use of supermarket identification cards maintains a Web site at www.nocards.org/faq/index.shtml. Find out why it thinks identification cards are an invasion of privacy. Summarize its arguments in a brief report. Do you agree or disagree with its positions? Explain why.
Project 1-6

**Identify software packages.** Find a mail-order computer catalog (in your computer room or library) or an Internet site that sells applications software packages of the types described in this chapter. For each category—electronic mail and instant messaging, Web browser, word processing, spreadsheets, database management, graphics, planning and scheduling, desktop publishing, Web site development, and educational and entertainment software—list the names of two or three representative packages. Include the price range for a typical package in each category.

Project 1-7

**Identify computer users’ health concerns.** Interview three classmates or coworkers about their health concerns related to their use of computers. Make a list of their health, safety, and productivity concerns. Are there any similarities to their concerns? Did any of their concerns surprise you?

Project 1-8

**Evaluate TCO.** A Houston, Texas, consulting company, JDA Professional Services, provides an online worksheet for calculating the total cost of ownership (TCO) of computer technology. Read about the factors they think contribute to the total cost of ownership at its Web site [www.jdapsi.com/client/Articles/Default.php?Article=tco](http://www.jdapsi.com/client/Articles/Default.php?Article=tco). Write a one-page report that describes how the factors JDA considers significant are different from those in this chapter.

Click the JDA’s Online TCO Worksheet link. Enter the data for the following scenario: An instructional computer lab manager wants to purchase 10 computers for a new lab at a cost of $1200 per machine. The cost of a network server and laser printer and related hardware and software is expected to be $5000. The lab will require two part-time support staff, expected to cost $15,000 each. Use the GartnerGroup’s recommended percentage for hidden costs. Answer the following questions:

1. What is the total cost of ownership per machine?
2. Is this a one-time cost or an annual cost?

Project 1-9

**Research computer history.** Use the Web-based computer history timelines mentioned in this chapter to find answers to the following computer trivia questions.

1. Put the following familiar computer hardware manufacturers in order from oldest to newest: Apple, IBM, Hewlett-Packard
2. An error in a software program is called a “bug.” How did this name originate?
3. When was a computer first used to predict the outcome of a presidential election in the United States?
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4. Put these programming languages in order from oldest to newest: BASIC, C++, COBOL, Fortran. How did the C language get its name?

5. What university first organized a department of computer science?

6. The mouse and floppy disk became popular in the 1980s. When were these devices actually invented?

7. Who first noted that adding programmers to a project that is behind schedule just makes the project further behind schedule?

8. The Macintosh was not the first computer built by Apple. Name three of its predecessors.

9. A decision to store the year in computers as a two-digit code caused the Y2K crisis. When was that decision made?

10. The ARPA network, which eventually became the Internet, linked four sites. Where were they?

11. The first operating system for microcomputers wasn’t DOS. What was it?

12. What computer program developed in the late 1970s convinced many people to buy their first personal computer?

13. How large was the first “portable” computer?

14. How long did it take before the first IBM PC clone was developed?

15. How old is the Windows operating system?

Case Projects

1. TCO of a $500 Computer

Your friend Ron has asked for your help in buying a home computer system. He is skeptical of ads for computers that cost less than $500. He intends to use the computer for word processing, e-mail, entertainment, and Internet access, and he wants your advice about how much he should budget for a home personal computer system. What is a realistic amount your friend might expect to spend, both at the time of initial purchase and over the next four years of ownership? Use catalogs, computer magazines, or the Internet to obtain current price information. Draw up a sample budget showing your recommended initial expenditure and the annual cost for the next four years. Break down the costs by the categories described in this chapter. Show the total cost of ownership over the four years that Ron plans to own the computer.
2. Technical Support for Wiley Corporation

Wiley Corporation has just relocated to a town near you and is actively seeking technical support employees. At a local job fair, you meet Cynthia, a recruiter for the company. While there, you decide to learn more about end-user computing and the technical support function. Based on what you have learned in this chapter, write a list of 10 questions you would ask Cynthia to obtain a profile of the categories of end users and the problems for which they need technical support at Wiley.

3. Tablet PC Versus Desktop PC

A new competitor to desktop PCs for some end users is a device called a tablet PC. Learn about the features of tablet PCs at the Web site www.tabletpctalk.com. Make a list of three important ways the tablet PC is similar to a desktop PC and three important ways it is different from a desktop PC. For what categories of end users would a tablet PC be appropriate? Some industry analysts think that tablet PCs represent a new and different form of end-user computing. Do you agree that the tablet PC is the next logical step in the development of end-user computing? Why, or why not?

4. Re-Nu-Cartridge’s Network Server

Re-Nu-Cartridge is a case study that appears at the end of each chapter in this book. You will learn more about this company and its support problems in subsequent chapters.

Re-Nu-Cartridge is a business that remanufactures and sells replacement ink-jet printer and copier cartridges. It employs a staff of about 40 workers and currently sells close to $5 million per year in remanufactured printer and copier cartridges. Re-Nu-Cartridge sells locally through a retail store located on the same site as its manufacturing plant, and it wholesales remanufactured cartrdges to retail computer stores in eight nearby states. The company would eventually like to sell its products nationwide over the Internet, but does not have the technology or expertise to operate an e-business, such as an Internet store.

Fred Long, the chief executive officer (CEO) of Re-Nu-Cartridge says the company is organized into four groups:

- Cartridge remanufacturing (the largest group)
- Retail sales
- Marketing (the wholesale operation)
- Administration (including accounting, human resources, purchasing)

The cartridge remanufacturing group operates the equipment that cleans used cartridges, mixes ink chemicals to original manufacturer specifications, refills the cartridges, and packages and ships cartridges to both retail and wholesale customers. The retail sales group operates a retail store that sells cartridges and printer supplies direct to local customers. The
marketing group consists of outside sales representatives who call on retail computer stores that carry the Re-Nu-Cartridge brand of remanufactured cartridges in the region.

Fred reports that the company currently has about 25 desktop computers, mostly in the Administration department, although there are a few in each of the other departments. Most of the computers are standalone PCs that the company has purchased over the last 12 years, although several of the PCs can connect to the Internet via a dial-up capability.

Several of Fred’s employees who use computers have suggested that the company could increase employee productivity if they made better use of e-mail communications. And, they point out, Re-Nu-Cartridge could move toward operation of a Web-based e-business if they had a company-wide network. Fred has an appointment next week with a local vendor that provides network computer solutions for small businesses. He is very concerned about the cost of a company network, and wants to be prepared to ask the network vendor about all the cost factors he should budget for as the company considers a network.

1. Prepare a list for Fred of the cost categories he should ask the network vendor about.
2. Which of the cost categories you listed are initial, start-up costs, and which are ongoing, operational costs?
3. What other issues should the Re-Nu-Cartridge company be concerned about when it considers the problems of installing and operating a network server in its business?

Write a memo to Fred that responds to these questions.