When Schools Financial Credit Union decided to take the plunge, it included safeguards to prevent abuse. Customers must use their existing secure online banking log-in, and they can't transmit items more than twice a day.

Users have a time limit to scan and deposit the check online, and checks must meet specific requirements before they are deposited. Post-dated, damaged, or lightly printed checks, for instance, will not scan properly and cannot be deposited.

"So many people prefer to do self-service. They choose to go online—maybe they're parents with small kids, or they might not want to go to an ATM at 3 a.m.," says Golden One's chief executive officer, Teresa Halleck.

"People are already online," she says. "They're comfortable with electronic delivery and they're looking for more."

SOURCE: Darrell Smith, "Forget the ATM—Some Banks Allow Check Deposits via Scanner, iPhone," *The Sacramento Bee*, October 26, 2009.

Other Input Technologies

Magnetic stripe technology is a familiar form of data entry that helps computers read credit cards. The coating of the magnetic stripe on the back of such cards can hold about 200 bytes of information. Customer account numbers can be recorded on the magnetic stripe so that it can be read by bank ATMs, credit card authorization terminals, and many other types of magnetic stripe readers.

Smart cards that embed a microprocessor chip and several kilobytes of memory into debit, credit, and other cards are popular in Europe and becoming available in the United States. One example is in the Netherlands, where millions of smart debit cards have been issued by Dutch banks. Smart debit cards enable you to store a cash balance on the card and electronically transfer some of it to others to pay for small items and services. The balance on the card can be replenished in ATMs or other terminals. The smart debit cards used in the Netherlands feature a microprocessor and either 8 or 16 kilobytes of memory, plus the usual magnetic stripe. The smart cards are widely used to make payments in parking meters, vending machines, newsstands, pay telephones, and retail stores.

Digital cameras represent another fast-growing set of input technologies. Digital still cameras and digital video cameras (digital camcorders) enable you to shoot, store, and download still photos or full-motion video with audio into your PC. Then you can use image-editing software to edit and enhance the digitized images and include them in newsletters, reports, multimedia presentations, and Web pages. Today's typical mobile phone includes digital camera capabilities as well.

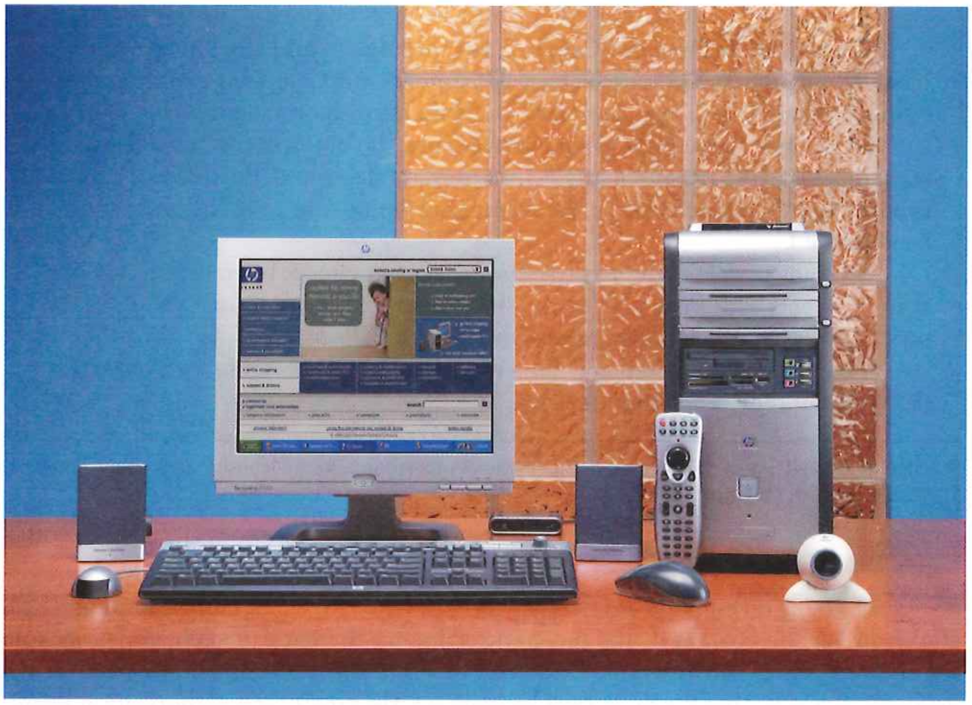
The computer systems of the banking industry can magnetically read checks and deposit slips using magnetic ink character recognition (MICR) technology. Computers can thus sort and post checks to the proper checking accounts. Such processing is possible because the identification numbers of the bank and the customer's account are preprinted on the bottom of the checks with an iron oxide–based ink. The first bank receiving a check after it has been written must encode the amount of the check in magnetic ink on the check's lower righthand corner. The MICR system uses 14 characters (the 10 decimal digits and 4 special symbols) of a standardized design. *Reader-sorter* equipment reads a check by first magnetizing the magnetic ink characters and then sensing the signal induced by each character as it passes a reading head. In this way, data are electronically captured by the bank's computer systems.

OUTPUT TECHNOLOGIES

LO 3-3
LO 3-4

Computers provide information in a variety of forms. Video displays and printed documents have been, and still are, the most common forms of output from computer systems. Yet other natural and attractive output technologies, such as voice response systems and multimedia output, are increasingly found along with video displays in business applications.

FIGURE 3.20
The flat-panel LCD video monitor is becoming the de facto standard for a desktop PC system.



SOURCE: Courtesy of Hewlett-Packard.

For example, you have probably experienced the voice and audio output generated by speech and audio microprocessors in a variety of consumer products. Voice messaging software enables PCs and servers in voice mail and messaging systems to interact with you through voice responses. Of course, multimedia output is common on the Web sites of the Internet and corporate intranets.

Video Output

Video displays are the most common type of computer output. Many desktop computers still rely on video monitors that use a *cathode ray tube* (CRT) technology similar to the picture tubes used in home television sets. Usually, the clarity of the video display depends on the type of video monitor you use and the graphics circuit board installed in your computer. These can provide a variety of graphics modes of increasing capability. A high-resolution, flicker-free monitor is especially important if you spend a lot of time viewing multimedia on CDs, or on the Web, or the complex graphical displays of many software packages.

The biggest use of liquid crystal displays (LCDs) has been to provide a visual display capability for portable microcomputers and PDAs. However, the use of "flat-panel" LCD video monitors for desktop PC systems has become common as their cost becomes more affordable. See Figure 3.20. These LCD displays need significantly less electric current and provide a thin, flat display. Advances in technology such as *active matrix* and *dual scan* capabilities have improved the color and clarity of LCD displays. In addition, high-clarity flat-panel televisions and monitors using *plasma* display technologies are becoming popular for large-screen (42- to 80-inch) viewing.

FIGURE 3.21
Modern laser printers produce high-quality color output with high speed.

SOURCE: Courtesy of Xerox.

Printed Output

Printing information on paper is still the most common form of output after video displays. Thus, most personal computer systems rely on an inkjet or laser printer to produce permanent (hard-copy) output in high-quality printed form. Printed output is still a common form of business communication and is frequently required for legal documentation. Computers can produce printed reports and correspondence; documents such as sales invoices, payroll checks, and bank statements; and printed versions of graphic displays. See Figure 3.21.

Inkjet printers, which spray ink onto a page, have become the most popular, low-cost printers for microcomputer systems. They are quiet, produce several pages per minute of high-quality output, and can print both black-and-white and high-quality color graphics. Laser printers use an electrostatic process similar to a photocopying machine to produce many pages per minute of high-quality black-and-white output. More expensive color laser printers and multifunction inkjet and laser models that print, fax, scan, and copy are other popular choices for business offices.

STORAGE TRADE-OFFS

LO 3-3
LO 3-4

Data and information must be stored until needed using a variety of storage methods. For example, many people and organizations still rely on paper documents stored in filing cabinets as a major form of storage media. However, you and other computer users are more likely to depend on the memory circuits and secondary storage devices of computer systems to meet your storage requirements. Progress in very-large-scale integration (VLSI), which packs millions of memory circuit elements on tiny semiconductor memory chips, is responsible for continuing increases in the main-memory capacity of computers. Secondary storage capacities are also escalating into the billions and trillions of characters, due to advances in magnetic and optical media.

There are many types of storage media and devices. Figure 3.22 illustrates the speed, capacity, and cost relationships of several alternative primary and secondary storage media. Note the cost/speed/capacity trade-offs as you move from semiconductor memories to magnetic disks to optical disks and to magnetic tape. High-speed storage media cost more per byte and provide lower capacities. Large-capacity storage media cost less per byte but are slower. These trade-offs are why we have different kinds of storage media.

However, all storage media, especially memory chips and magnetic disks, continue to increase in speed and capacity and decrease in cost. Developments like automated high-speed cartridge assemblies have given faster access times to magnetic tape, and the speed of optical disk drives continues to increase.

Note in Figure 3.22 that semiconductor memories are used mainly for primary storage, although they are sometimes used as high-speed secondary storage devices. Magnetic disk and tape and optical disk devices, in contrast, are used as secondary storage devices to enlarge the storage capacity of computer systems. Also, because most primary storage circuits use RAM (random-access memory) chips, which lose their contents when electrical power is interrupted, secondary storage devices provide a more permanent type of storage media.

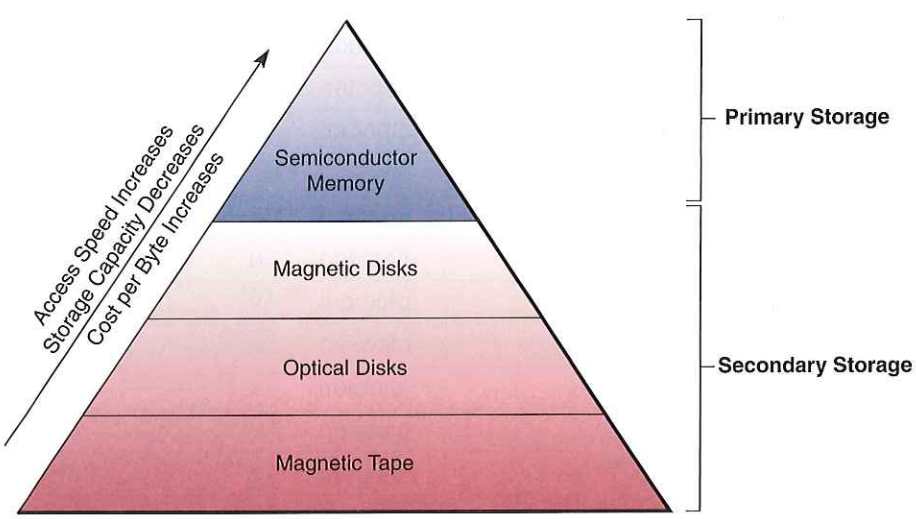


FIGURE 3.22
Storage media cost, speed, and capacity trade-offs. Note how cost increases with faster access speeds but decreases with the increased capacity of storage media.

Computer Storage Fundamentals

Data are processed and stored in a computer system through the presence or absence of electronic or magnetic signals in the computer's circuitry or in the media it uses. This character is called "two-state" or ***binary representation*** of data because the computer and the media can exhibit only two possible states or conditions, similar to a common light switch: "on" or "off." For example, transistors and other semiconductor circuits are in either a conducting or a nonconducting state. Media such as magnetic disks and tapes indicate these two states by having magnetized spots whose magnetic fields have one of two different directions, or polarities. This binary characteristic of computer circuitry and media is what makes the binary number system the basis for representing data in computers. Thus, for electronic circuits, the conducting ("on") state represents the number 1, whereas the nonconducting ("off") state represents the number 0. For magnetic media, the magnetic field of a magnetized spot in one direction represents a 1, while magnetism in the other direction represents a 0.

The smallest element of data is called a ***bit,*** short for *binary digit,* which can have a value of either 0 or 1. The capacity of memory chips is usually expressed in terms of bits. A ***byte*** is a basic grouping of bits that the computer operates as a single unit. Typically, it consists of eight bits and represents one character of data in most computer coding schemes. Thus, the capacity of a computer's memory and secondary storage devices is usually expressed in terms of bytes. Computer codes such as ASCII (American Standard Code for Information Interchange) use various arrangements of bits to form bytes that represent the numbers 0 through 9, the letters of the alphabet, and many other characters. See Figure 3.23.

Since childhood, we have learned to do our computations using the numbers 0 through 9, the digits of the decimal number system. Although it is fine for us to use 10 digits for our computations, computers do not have this luxury. Every computer processor is made of millions of tiny switches that can be turned off or on. Because these switches have only two states, it makes sense for a computer to perform its computations with a number system that has only two digits: the *binary number system.* These digits (0 and 1) correspond to the off/on positions of the switches in the computer processor. With only these two digits, a computer can perform all the arithmetic that we can with 10 digits. Figure 3.24 illustrates the basic concepts of the binary system.

FIGURE 3.23
Examples of the ASCII computer code that computers use to represent numbers and the letters of the alphabet.

Character	ASCII Code	Character	ASCII Code	Character	ASCII Code
0	00110000	A	01000001	N	01001110
1	00110001	B	01000010	O	01001111
2	00110010	C	01000011	P	01010000
3	00110011	D	01000100	Q	01010001
4	00110100	E	01000101	R	01010010
5	00110101	F	01000110	S	01010011
6	00110110	G	01000111	T	01010100
7	00110111	H	01001000	U	01010101
8	00111000	I	01001001	V	01010110
9	00111001	J	01001010	W	01010111
		K	01001011	X	01011000
		L	01001100	Y	01011001
		M	01001101	Z	01011010

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1

To represent any decimal number using the binary system, each place is simply assigned a value of either 0 or 1. To convert binary to decimal, simply add up the value of each place.

Example:

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	0	0	1	1	0	0	1
128	0	0	16	8	0	0	1

128 + 0 + 0 + 16 + 8 + 0 + 0 + 1 = 153

10011001 = 153

FIGURE 3.24
Computers use the binary system to store and compute numbers.

The binary system is built on an understanding of exponentiation (raising a number to a power). In contrast to the more familiar decimal system, in which each place represents the number 10 raised to a power (ones, tens, hundreds, thousands, and so on), each place in the binary system represents the number 2 raised to successive powers (2^0, 2^1, 2^2, and so on). As shown in Figure 3.24, the binary system can be used to express any integer number by using only 0 and 1.

Storage capacities are frequently measured in ***kilobytes*** (KB), ***megabytes*** (MB), ***gigabytes*** (GB), or ***terabytes*** (TB). Although *kilo* means 1,000 in the metric system, the computer industry uses *K* to represent 1,024 (or 2^{10}) storage positions. For example, a capacity of 10 megabytes is really 10,485,760 storage positions, rather than 10 million positions. However, such differences are frequently disregarded to simplify descriptions of storage capacity. Thus, a megabyte is roughly 1 million bytes of storage, a gigabyte is roughly 1 billion bytes, and a terabyte represents about 1 trillion bytes, while a ***petabyte*** is more than 1 quadrillion bytes.

To put these storage capacities in perspective, consider the following: A terabyte is equivalent to about 20 million typed pages, and it has been estimated that the total size of all the books, photographs, video and sound recordings, and maps in the U.S. Library of Congress approximates 3 petabytes (3,000 terabytes).

Direct and Sequential Access

Primary storage media such as semiconductor memory chips are called ***direct access*** memory or random-access memory (RAM). Magnetic disk devices are frequently called direct access storage devices (DASDs). In contrast, media such as magnetic tape cartridges are known as ***sequential access*** devices.

The terms *direct access* and *random access* describe the same concept. They mean that an element of data or instructions (such as a byte or word) can be directly stored and retrieved by selecting and using any of the locations on the storage media. They also mean that each storage position (1) has a unique address and (2) can be individually accessed in about the same length of time without having to search through other storage positions. For example, each memory cell on a microelectronic semiconductor RAM chip can be individually sensed or changed in the same length of time. Also, any data record stored on a magnetic or optical disk can be accessed directly in about the same period. See Figure 3.25.

Sequential access storage media such as magnetic tape do not have unique storage addresses that can be directly addressed. Instead, data must be stored and retrieved using a sequential or serial process. Data are recorded one after another in a predetermined sequence (e.g., numeric order) on a storage medium. Locating an

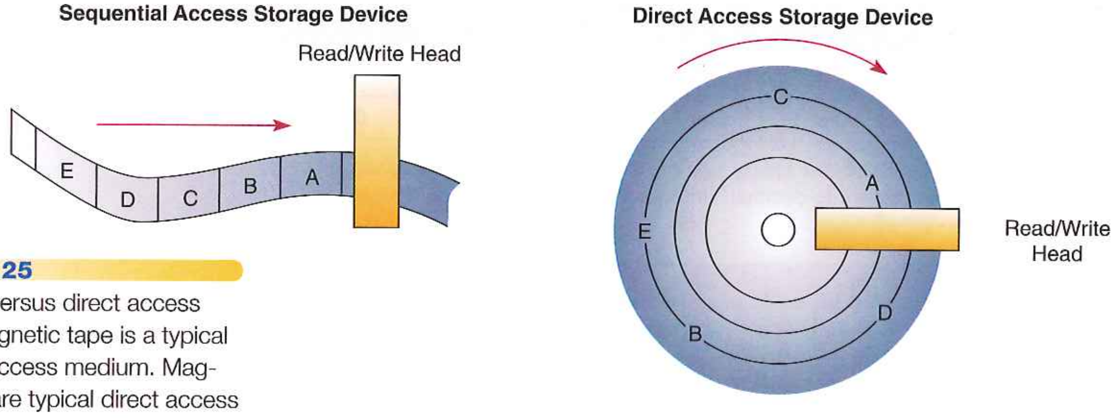


FIGURE 3.25

Sequential versus direct access storage. Magnetic tape is a typical sequential access medium. Magnetic disks are typical direct access storage devices.

individual item of data requires searching the recorded data on the tape until the desired item is located.

SEMICONDUCTOR MEMORY

Memory is the coal man to the CPU's locomotive: For maximum PC performance, it must keep the processor constantly stoked with instructions. Faster CPUs call for larger and faster memories, both in the cache where data and instructions are stored temporarily and in the main memory.

The primary storage (main memory) of your computer consists of microelectronic ***semiconductor memory*** chips. It provides you with the working storage your computer needs to process your applications. Plug-in memory circuit boards containing 256 megabytes or more of memory chips can be added to your PC to increase its memory capacity. Specialized memory can help improve your computer's performance. Examples include external cache memory to help your microprocessor work faster or a video graphics accelerator card for faster and clearer video performance. Removable credit-card-size and smaller "flash memory" RAM devices like a jump drive or a memory stick can also provide gigabytes of erasable direct access storage for PCs, PDAs, or digital cameras.

Thus, there are two basic types of semiconductor memory: ***random-access memory (RAM)*** and ***read-only memory (ROM).***

- **RAM, random-access memory.** These memory chips are the most widely used primary storage medium. Each memory position can be both sensed (read) and changed (written), so it is also called read/write memory. This is a ***volatile*** memory.
- **ROM, read-only memory.** Nonvolatile random-access memory chips are used for permanent storage; ROM can be read but not erased or overwritten. Frequently used control instructions in the control unit and programs in primary storage (such as parts of the operating system) can be permanently burned into the storage cells during manufacture, sometimes called *firmware*. Variations include PROM (programmable read-only memory) and EPROM (erasable programmable read-only memory), which can be permanently or temporarily programmed after manufacture.

FIGURE 3.26

A USB flash memory drive.

SOURCE: © 2011 Lexar Media, Inc.

A now common, but still quite innovative, form of storage that uses semiconductor memory is the *flash drive* (sometimes referred to as a *JumpDrive*). Figure 3.26 shows a common flash memory drive.

Flash memory uses a small chip containing thousands of transistors that can be programmed to store data for virtually unlimited periods without power. The small drives can be easily transported in your pocket and are highly durable. Storage capacities currently range as high as 250 gigabytes, but newer flash technologies are making even higher storage capacities a reality. The advent of credit-card-like memory cards and ever-smaller storage technologies puts more data into the user's pocket every day.

ReadyBoost

The higher storage volumes provided by flash drives require new technologies intended to take advantage of it. Microsoft's *ReadyBoost* is one such example. ReadyBoost is a disk cache component, first introduced with Microsoft's Windows Vista in 2006 and bundled with Windows 7 in 2009. It works by using the flash drive, SD card, or any kind of portable flash mass-storage system as a cache.

Using ReadyBoost-capable flash memory (NAND memory devices) for caching allows Windows 7 to service random disk reads with performance that is typically 80–100 times faster than random reads from traditional hard drives. This caching applies to all disk content, not just the page file or system DLLs. Flash devices typically are slower than a hard disk for sequential input/output so, to maximize performance, ReadyBoost includes logic that recognizes large, sequential read requests and makes sure the hard disk services these requests. When a compatible device is plugged in, the Windows AutoPlay dialog offers an additional option to use the flash drive to speed up the system; an additional "ReadyBoost" tab is added to the drive's properties dialog where the amount of space to be used can be configured. The system can use up to 256 GB of flash memory.

Solid-State Drive

Semiconductor memory has also allowed for the successful development of the *solid-state drive*. A solid-state drive (SSD) is a data storage device that uses semiconductor memory to store persistent data with the intention of providing access in the same manner as that of a hard disk drive. SSDs are distinguished from traditional hard disk drives (HDDs), which are electromechanical magnetic storage devices containing spinning disks and movable read/write heads. SSDs, in contrast, use microchips which retain data in nonvolatile memory chips and contain no moving parts. Compared to electromechanical HDDs, SSDs are typically less susceptible to physical shock, are silent, and have lower access times and latency. SSDs use the same connector interface as hard disk drives, thus making them easy to add to an existing computer.

As of 2010, most SSDs use NAND-based flash memory, which retains memory even without power. SSDs using volatile random-access memory (RAM) also exist for situations that require even faster access, they but do not necessarily need data persistence after power loss, or use external power or batteries to maintain the data after power is removed. A hybrid drive combines the features of an HDD and an SSD in one unit, containing a large HDD, with a smaller SSD cache to improve performance of frequently accessed files. These can offer near-SSD performance in most applications (such as system start-up and loading applications) at a lower price than an SSD. Regardless of the configuration, SSDs that have the operating system loaded display significant performance improvements over even the fastest of hard drives.

Work 7×24: Collaboration Technology for Small Companies

Technology is becoming more and more pervasive in all industries throughout the world. All companies that are either very large, large, or medium-sized are already greatly based on technology in one way or the other. On the consumer side of things, new products are introduced almost every day, from social media innovations to tablets to cloud-based music services. Many of these products are based on mobile platforms that come with cameras and GPS systems as defaults. But smaller companies have yet to fully embrace all of these developments.

"There are a lot that focus on consumers, but nothing for smaller enterprises and the like," says Jens Lundström, CEO of Two Story Software, the Swedish start-up behind Work 7×24, a service that allows small businesses with employees out on the field to collaborate and keep everybody updated without the need to fill out paperwork. To make things easier for smaller businesses with more limited resources and technical expertise, the service is hosted remotely and can be accessed from any device with a connection to the Internet.

"Usually handymen, including electricians, plumbers, and installers, have a mobile phone and a notepad, and that is their back office support. When they head out in the field they have work orders written on a note," says Lundström. The service is targeted to organizations where a large portion of their workforce does not work at an office all day, but is rather out in the field and, most often, out of touch with headquarters for hours at a time. The goal is to take advantage of already built-in features of mobile phones to give these smaller businesses a leg up against larger operations.

Work 7×24 allows managers to enter new work orders or update existing ones from the office and then notifies employees through an e-mail or text message, which contains a link that can be used to access the update and enter any necessary information. It can also be used to provide information on the customer or location the employee is about to visit. Any images or instructions that can be of help can also be included.

After the visit to the customer is over, employees can use the same service to upload information back to the office, which can then be shared with other employees in the future. For example, salespeople can include photographs of new equipment installed at a customer site so that repair technicians know what to expect when they go out in the field to service it. They can also include useful nearby locations, or geo-tagged directions when customers are located in remote and hard-to-access rural areas. Work 7×24 also includes support for quotes and invoicing on the spot, as well as reporting of any materials used and the number of hours worked.

And the best part? It is all paperless. "Our goal is to make it simpler for small companies to work together and document what they have done, and do it faster with less paperwork," says Lundström.

SOURCE: Mikael Ricknäs, "Camera Phones and GPS are for SMBs Too, Says Startup," *IDG News Service*, November 7, 2008, and www.twostorysoftware.com, accessed May 15, 2011.

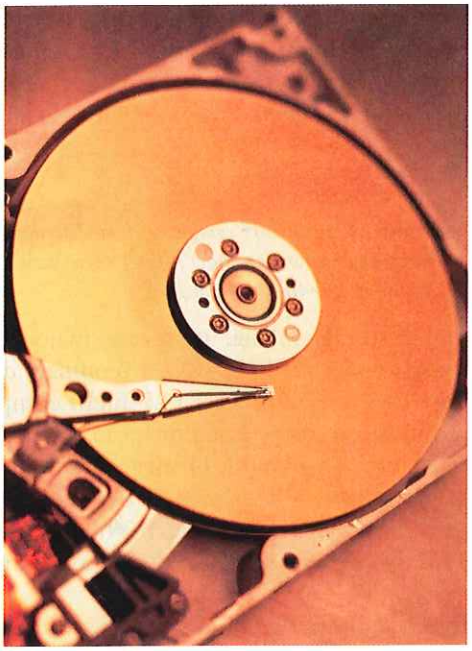
MAGNETIC DISKS

Multigigabyte magnetic disk drives aren't extravagant, considering that full-motion video files, sound tracks, and photo-quality images can consume colossal amounts of disk space in a blink.

Magnetic disks are the most common form of secondary storage for your computer system. That's because they provide fast access and high storage capacities at a reasonable cost. Magnetic disk drives contain metal disks that are coated on both sides with an iron oxide recording material. Several disks are mounted together on a vertical shaft, which typically rotates the disks at speeds of 3,600 to 7,600 revolutions per minute (rpm). Electromagnetic read/write heads are positioned by access arms between the slightly separated disks to read and write data on concentric, circular tracks. Data are recorded on tracks in the form of tiny magnetized spots to form the binary digits of common computer codes. Thousands of bytes can be recorded on each track, and there are several hundred data tracks on each disk surface, thus providing you with billions of storage positions for your software and data. See Figure 3.27.

RAID Storage

RAID computer storage equipment—big, refrigerator-size boxes full of dozens of interlinked magnetic disk drives that can store the equivalent of 100 million tax returns—hardly gets the blood rushing. But it should. Just as speedy and reliable networking opened the floodgates to cyberspace and e-commerce, ever-more-turbocharged data storage is a key building block of the Internet.



SOURCE: © Stockbyte/PunchStock.

SOURCE: © Royalty Free/Corbis.

FIGURE 3.27
Magnetic disk media: a hard magnetic disk drive and a 3½-inch floppy disk.

Disk arrays of interconnected microcomputer hard disk drives have replaced large-capacity mainframe disk drives to provide virtually unlimited online storage. Known as ***RAID (redundant arrays of independent disks),*** they combine from 6 to more than 100 small hard disk drives and their control microprocessors into a single unit. These RAID units provide large capacities (as high as 1–2 terabytes or more) with high access speeds because data are accessed in parallel over multiple paths from many disks. Also, RAID units provide a *fault-tolerant* capacity, in that their redundant design offers multiple copies of data on several disks. If one disk fails, data can be recovered from backup copies automatically stored on other disks. Storage area networks (SANs) are high-speed *fiber channel* local area networks that can interconnect many RAID units and thus share their combined capacity through network servers with many users.

There are a variety of classifications of RAID, and newer implementations include not only hardware versions, but also software methods. The technical aspects of RAID are beyond the scope of this text and probably beyond the needs of the modern business technologist as well. It is sufficient to note that the storage mechanisms in the modern organization are probably using some type of RAID technology. If you are interested in drilling deeper into this technology and how it works, a wide variety of Internet resources are available.

MAGNETIC TAPE

Tape storage is moving beyond backup. Although disk subsystems provide the fastest response time for mission-critical data, the sheer amount of data that users need to access these days as part of huge enterprise applications, such as data warehouses, requires affordable (magnetic tape) storage.

Magnetic tape is still being used as a secondary storage medium in business applications. The read/write heads of magnetic tape drives record data in the form of magnetized spots on the iron oxide coating of the plastic tape. Magnetic tape devices include tape reels and cartridges in mainframes and midrange systems and small cassettes or cartridges for PCs. One growing business application of magnetic tape involves the use of high-speed 36-track magnetic tape cartridges in robotic automated drive assemblies that can directly access hundreds of cartridges. These devices provide lower-cost storage to supplement magnetic disks to meet massive data warehouse and other online business storage requirements. Other major applications for magnetic tape include long-term *archival* storage and backup storage for PCs and other systems.

OPTICAL DISKS

Optical disk technology has become a necessity. Most software companies now distribute their elephantine programs on CD-ROMs. Many corporations are now rolling their own CDs to distribute product and corporate information that once filled bookshelves.

Optical disks, a fast-growing type of storage media, use several major alternative technologies. See Figure 3.28. One version is called CD-ROM (compact disk–read-only memory). CD-ROM technology uses 12-centimeter (4.7-inch) compact disks (CDs) similar to those used in stereo music systems. Each disk can store more than 600 megabytes. That's the equivalent of more than 400 1.44-megabyte floppy disks or more than 300,000 double-spaced pages of text. A laser records data by burning permanent microscopic pits in a spiral track on a master disk from which compact disks can be mass produced. Then CD-ROM disk drives use a laser device to read the binary codes formed by those pits.

CD-R (compact disk–recordable) is another popular optical disk technology. CD-R drives or CD *burners* are commonly used to record data permanently on CDs. The major limitation of CD-ROM and CD-R disks is that recorded data cannot be erased. However, CD-RW (CD-rewritable) drives record and erase data by using a laser to heat a microscopic point on the disk's surface. In CD-RW versions using magneto-optical technology, a magnetic coil changes the spot's reflective properties from one direction to another, thus recording a binary 1 or 0. A laser device can then read the binary codes on the disk by sensing the direction of reflected light.

DVD technologies have dramatically increased optical disk capacities and capabilities. DVD (digital video disk or digital versatile disk) optical disks can hold from

FIGURE 3.28
Comparing the capabilities of optical disk drives.

Optical Disk Drive Capabilities
• **CD-ROM** A CD-ROM drive provides a low-cost way to read data files and load software onto your computer, as well as play music CDs.
• **CD-RW** A CD-RW drive allows you to easily create your own custom data CDs for data backup or data transfer purposes. It will also allow you to store and share video files, large data files, digital photos, and other large files with other people that have access to a CD-ROM drive. This drive will do anything your CD-ROM drive will do; it reads all of your existing CD-ROMs, audio CDs, and CDs that you have created with your CD burner.
• **CD-RW/DVD** A CD-RW/DVD combination drive brings all of the advantages of CD-RW, CD-ROM, and DVD-ROM to a single drive. With a CD-RW/DVD combo drive, you can read DVD-ROM and CD-ROM disks, as well as create your own custom CDs.
• **DVD-ROM** A DVD-ROM drive allows you to enjoy the crystal-clear color, picture, and sound clarity of DVD video on your PC. It will also prepare you for future software and large data files that will be released on DVD-ROM. A DVD-ROM drive can also read CD-ROM disks, effectively providing users with full optical read capability in one device.
• **DVD+RW/+R with CD-RW** A DVD+RW/+R with CD-RW drive is a great all-in-one drive, allowing you to burn DVD+RW or DVD+R disks, burn CDs, and read DVDs and CDs. It enables you to create DVDs to back up and archive up to 4.7GB of data files (that's up to 7 times the capacity of a standard 650MB CD) and store up to to 2 hours of MPEG2 digital video.

SOURCE: "Learn More—Optical Drives," www.dell.com.

SOURCE: Photodisc/Getty Images.

FIGURE 3.29
Optical disk storage includes CD and DVD technologies.

3.0 to 8.5 gigabytes of multimedia data on each side. The large capacities and high-quality images and sound of DVD technology are expected to replace CD technologies for data storage and promise to accelerate the use of DVD drives for multimedia products that can be used in both computers and home entertainment systems. Thus, DVD-ROM disks are increasingly replacing magnetic tape videocassettes for movies and other multimedia products, while DVD+RW disks are being used for backup and archival storage of large data and multimedia files. See Figure 3.29.

RADIO FREQUENCY IDENTIFICATION

One of the newest and most rapidly growing storage technologies is ***radio frequency identification (RFID),*** a system for tagging and identifying mobile objects such as store merchandise, postal packages, and sometimes even living organisms (like pets). Using a special device called an RFID reader, RFID allows objects to be labeled and tracked as they move from place to place.

The RFID technology works using small (sometimes smaller than a grain of sand) pieces of hardware called RFID chips. These chips feature an antenna to transmit and receive radio signals. Currently, there are two general types of RFID chips: *passive* and *active*. Passive RFID chips do not have a power source and must derive their power from the signal sent from the reader. Active RFID chips are self-powered and do not need to be close to the reader to transmit their signal. Any RFID chips may be attached to objects or, in the case of some passive RFID systems, injected into objects. A recent use for RFID chips is the identification of pets, such as dogs or cats. By having a tiny RFID chip injected just under their skin, they can be easily identified if they become lost. The RFID chip contains contact information about the owner of the pet. Taking this a step further, the Transportation Security Administration is considering using RFID tags embedded in airline boarding passes to keep track of passengers.

Whenever a reader within range sends appropriate signals to an object, the associated RFID chip responds with the requested information, such as an identification number or product date. The reader, in turn, displays the response data to an operator. Readers may also forward data to a networked central computer system. Such RFID systems generally support storing information on the chips as well as just reading data.

The RFID systems were created as an alternative to common bar codes. Relative to bar codes, RFID allows objects to be scanned from a greater distance, supports storing of data, and allows more information to be tracked per object.

Recently RFID has raised some privacy concerns as a result of the invisible nature of the system and its capability to transmit fairly sophisticated messages. As these types of issues are resolved, we can expect to see RFID technology used in just about every way imaginable.

RFID Privacy Issues

How would you like it if, for instance, one day you realized your underwear was reporting on your whereabouts?—California State Senator Debra Bowen, at a 2003 hearing on RFID privacy concerns.

The use of RFID technology has caused considerable controversy and even product boycotts by consumer privacy advocates who refer to RFID tags as *spychips*. The two main privacy concerns regarding RFID are:

- Because the owner of an item will not necessarily be aware of the presence of an RFID tag, and the tag can be read at a distance without the knowledge of the individual, it becomes possible to gather sensitive data about an individual without consent.
- If a customer pays for a tagged item by credit card or in conjunction with a loyalty card, then it would be possible to deduce the identity of the purchaser indirectly by reading the globally unique ID of that item (contained in the RFID tag).

Most concerns revolve around the fact that RFID tags affixed to products remain functional even after the products have been purchased and taken home; thus, they can be used for surveillance and other purposes unrelated to their supply chain inventory functions.

Read range, however, is a function of both the reader and the tag itself. Improvements in technology may increase read ranges for tags. Having readers very close to the tags makes short-range tags readable. Generally, the read range of a tag is limited to the distance from the reader over which the tag can draw enough energy from the reader field to power the tag. Tags may be read at longer ranges by increasing reader power. The limit on read distance then becomes the signal-to-noise ratio of the signal reflected from the tag back to the reader. Researchers at two security conferences have demonstrated that passive UHF RFID tags (not the HF-type used in U.S. passports), normally read at ranges of up to 30 feet, can be read at ranges of 50–69 feet using suitable equipment. Many other types of tag signals can be intercepted from 30–35 feet away under good conditions, and the reader signal can be detected from miles away if there are no obstructions.

The potential for privacy violations with RFID was demonstrated by its use in a pilot program by the Gillette Company, which conducted a "smart shelf" test at a Tesco in Cambridge, England. They automatically photographed shoppers taking RFID-tagged safety razors off the shelf to see if the technology could be used to deter shoplifting. This trial resulted in consumer boycott against Gillette and Tesco. In another incident, uncovered by the *Chicago Sun-Times*, shelves in a Wal-Mart in Broken Arrow, Oklahoma, were equipped with readers to track the Max Factor Lipfinity lipstick containers stacked on them. Webcam images of the shelves were viewed 750 miles away by Procter & Gamble researchers in Cincinnati, Ohio, who could tell when lipsticks were removed from the shelves and observe the shoppers in action.

The controversy surrounding the use of RFID technologies was furthered by the accidental exposure of a proposed Auto-ID consortium public relations campaign that was designed to "neutralize opposition" and get consumers to "resign themselves to the inevitability of it" while merely pretending to address their concerns. During the U.N. World Summit on the Information Society (WSIS) on November 16–18, 2005, Richard Stallman, founder of the free software movement, protested the use of RFID security cards. During the first meeting, it was agreed that future meetings would no longer use RFID cards; upon finding out this assurance was broken, he covered his card in tin foil and would uncover it only at the security stations. This protest caused the security personnel considerable concern. Some did not allow him to leave a conference room in which he had been the main speaker, and then prevented him from entering another conference room, where he was due to speak.

The Food and Drug Administration in the United States has approved the use of RFID chips in humans. Some business establishments have also started to "chip" customers, such as the Baja Beach Nightclub in Barcelona. This has provoked concerns into privacy of individuals, as they can potentially be tracked wherever they go by an identifier unique to them. There are concerns that this could lead to abuse by an authoritarian government or lead to removal of other freedoms.

In July 2006, Reuters reported that Newitz and Westhues, two hackers, showed at a conference in New York City that they could clone the RFID signal from a human-implanted RFID chip, which proved that the chip is not as secure as was previously believed.

All of these examples share a common thread, showing that whatever can be encoded can also be decoded. RFID presents the potential for enormous efficiencies and cost savings. It also presents significant challenges to privacy and security. Until these issues are worked through, much controversy will continue to surround RFID technologies.

Kimberly-Clark: Secrets to RFID Success

While you may not immediately recognize the name Kimberly-Clark, you have surely purchased one or more of its products: Scott, Huggies, Pull-Ups, Kleenex, and Kotex are some of its better-known brands. In fact, the company holds the number 1 or 2 spot in market share in more than 80 countries. At last count, more than 1.3 billion people use its products every day, which helps explain how sales for 2010 topped $19.7 billion. None of this would be possible without a razor-sharp global supply chain that coordinates manufacturing operations in 37 different countries, and distribution and sales in 150 countries overall—that is pretty much every country on the planet. Radio Frequency Identification (RFID) is the key to that effort.

Kimberly-Clark was one of the first large companies to get heavily involved with RFID, and it has been a strong believer in the technology. "Our goal is to evolve the capabilities of our supply chain to a demand-driven network. One of the keys to achieving that vision is to have a highly integrated suite of supply chain systems that provide end-to-end visibility and as close to real-time information as possible," says Mark Jamison, vice president of customer supply chain management at Kimberly-Clark.

How much "real-time" should real-time data be is an important issue. It is unlikely that most companies will need to know, on an hour-by-hour basis, what is going on with their products and customers; getting that information two or three times a day may be enough to understand the market. Yet being able to see how promotions are taking off, which products are moving more or less than expected, and how production volumes are coming along allows Kimberly-Clark to keep its products always on the shelf in the right quantity—so they're are not too many and not too few.

"Our strategy around RFID has been to focus on business processes and develop repeatable, scalable business processes that are enabled by the technology. The technology in and of itself is not going to bring value to the supply chain. The value to the supply chain comes from reengineering your business processes and enabling those new business processes to work with the technology," notes Jamison.

Consider, for example, product promotions and their delivery and execution. Kimberly-Clark managers found out that their promotional materials and displays arrive in the stores only 55 percent of the time to meet promotion or advertising dates. Only 55 percent of the time! The company redesigned the process to start tracking these materials using real-time data. They began to chart progress against plans, and they also involved their retail operation employees, who are the ones in daily contact with the stores and chains. Now, on a day-to-day basis, managers know which stores have not executed the promotions as necessary, and they can then send people to make those promotions happen immediately. Timely execution of promotions went up to 75 percent afterwards, resulting also in increased sales. And all of this was possible thanks to the timely data afforded by their RFID deployment.

"In the supply chain, potentially, we could bring RFIDs back into the manufacturing environment, and trace raw materials. We've found that the bigger payback in the short term for us has been reducing out-of-stocks on the shelf. But we believe there are a lot more opportunities with RFID," says Jamison.

SOURCE: Thomas Wailgum, "Kimberly-Clark's Secrets to RFID Success," *CIO Magazine*, July 30, 2007, and www.kimberly-clark.com, accessed May 11, 2011.

PREDICTIONS FOR THE FUTURE

If Moore's law prevails and technology advancement continues, we can expect to see our lives change in remarkable and unimaginable ways. Although we cannot really predict the future, it is interesting and fun to read the predictions of futurists—people whose job is to think about what the future might bring. Here's one man's perspective on what computing technology might do to change our lives in the decades to come.

Computers Will Enable People to Live Forever

In just 15 years, we'll begin to see the merger of human and computer intelligence that ultimately will enable people to live forever. At least that's the prediction of author and futurist Ray Kurzweil. Kurzweil suggests that nanobots will roam our bloodstreams, fixing diseased or aging organs, while computers will back up our human memories and rejuvenate our bodies by keeping us young in appearance and health.

The author of the book *The Singularity Is Near*, Kurzweil says that within a quarter of a century, nonbiological intelligence will match the range and subtlety of human intelligence. He predicts that it will then soar past human ability because of the continuing acceleration of information-based technologies, as well as the ability of machines to share their knowledge instantly.

Kurzweil predicts people and computers will intermix with nanobots, blood cell-sized robots, that will be integrated into everything from our clothing to our bodies and brains. People just need to live long enough—another 15–30 years—to live forever. Think of it as replacing everyone's "human body version 1.0" with nanotechnology that will repair or replace ailing or aging tissue, he says. Parts will become easily replaceable." A $1,000 worth of computation in the 2020s will be 1,000 times more powerful than the human brain," says Kurzweil, adding that in 25 years we'll have multiplied our computational power by a billion. "Fifteen years from now, it'll be a very different world. We'll have cured cancer and heart disease, or at least rendered them to manageable chronic conditions that aren't life threatening. We'll get to the point where we can stop the aging process and stave off death." Actually, we'll hit a point where human intelligence just can't keep up with, or even follow, the progress that computers will make, according to Kurzweil. He expects that nonbiological intelligence will have access to its own design plans and be able to improve itself rapidly. Computer, or nonbiological, intelligence created in the year 2045 will be one billion times more powerful than all human intelligence today.

"Supercomputing is behind the progress in all of these areas," says Kurzweil, adding that a prerequisite for nonbiological intelligence is to reverse-engineer biology and the human brain. That will give scientists a "toolkit of techniques" to apply when developing intelligent computers. In a written report, he said, "We won't experience 100 years of technological advance in the 21st century; we will witness on the order of 20,000 years of progress, or about 1,000 times greater than what was achieved in the 20th century."

According to Kurzweil, here's what we can expect in the not-so-distant future:

- Doctors will be doing a backup of our memories by the late 2030s.
- By the late 2020s, doctors will be sending intelligent bots, or nanobots, into our bloodstreams to keep us healthy, and into our brains to keep us young.
- In 15 years, human longevity will be greatly extended. By the 2020s, we'll be adding a year of longevity or more for every year that passes.
- In the same time frame, we'll routinely be in virtual reality environments. Instead of making a call on a cell phone, we will "meet" someone in a virtual world, take a walk on a virtual beach, and chat. Business meetings and conference calls will be held in calming or inspiring virtual locations.
- When you're walking down the street and see someone you've met before, background information about that person will pop up on your glasses or in the periphery of your vision.
- Instead of spending hours in front of a desktop machine, computers will be more ingrained in our environment. For instance, computer monitors could be replaced by projections onto our retinas or on a virtual screen hovering in the air.
- Scientists will be able to rejuvenate all of someone's body tissues and organs by transforming his or her skin cells into youthful versions of other cell types.
- Need a little boost? Kurzweil says scientists will be able to regrow our own cells, tissues, and even whole organs, and then introduce them into our bodies, all without surgery. As part of what he calls the "emerging field of rejuvenation medicine," new tissue and organs will be built out of cells that have been made younger.
- Got heart trouble? No problem, says Kurzweil. "We'll be able to create new heart cells from your skin cells and introduce them into your system through the bloodstream. Over time, your heart cells get replaced with these new cells, and the result is a rejuvenated, young heart with your own DNA."
- One trick we'll have to master is staying ahead of the game. Kurzweil warns that terrorists could obviously use this same technology against us. For example, they could build and spread a bioengineered biological virus that's highly powerful and stealthy.

According to Kurzweil, we're not that far away from solving a medical problem that has plagued scientists and doctors for quite some time now: the common cold. He notes that although nanotechnology could go into our bloodstreams and knock it out, before we even get to that stage, biotechnology should be able to cure the cold in just 10 years.

SOURCE: Sharon Gaudin, "Kurzweil: Computers Will Enable People to Live Forever," *InformationWeek*, November 21, 2006.

real world SOLUTION

Budway Enterprises Inc.—Custom Technology with Standard Components

Budway Enterprises, a family-owned business, is one of the leading providers of transloading, logistics solutions and supply chain services for the specialty metals industry in southern California. Operating out of a major facility in Fontana, the company has grown from a same-day delivery service for downtown Los Angeles into the largest rail-transloader for the Burlington Northern Santa Fe Railway. As the company continued to grow and sought to expand into more value-added services, management realized that its reliance on paper documents to run the business would only allow the company to get so far, and decided to launch an initiative to go all digital. Although the company has clearly identified the major business and technological objectives that any solution must be able to deliver, it has become apparent that no existing alternatives in the market are exactly what the company is looking for. In addition, given the limited resources of a family-owned enterprise, financial constraints must also be taken into account.

Budway executives looked at the handheld devices that the small package delivery companies, such as FedEx or UPS, use. Although these devices offered wireless access as well as data collection and scanning capabilities, none of the hardware vendors provided software that would connect these devices to the existing systems at Budway. They were also more expensive than a small company could afford. Budway also looked at GPS tracking solutions, which are transmitters that are installed on vehicles to provide real-time data about the locations visited and routes taken. Although much less expensive, these solutions did not provide digital Proof-of-Delivery (POD—the central document in the freight industry) or work order monitoring. It quickly became evident that the company would need to create its own solution by integrating parts of existing technologies.

In the end, Budway opted for a smartphone combined with other technologies and service providers to achieve the required functionality. As its hardware platform the company selected the Palm Treo Smartphone, which at the time was one of only two cell phones that had touch-screen capabilities that would allow the capture of signatures using a stylus pen. Given the wide availability of these phones and their relatively low cost compared to more specialized handheld devices, such as those used by FedEx or UPS, this was an attractive alternative. Budway chose Sprint as the service provider, through its Sprint Business Mobility Framework offerings. Given the extensive coverage that Sprint offered within Budway's area of operations, this ensured that employees would always be within reach of the wireless service.

The Palm Treo Smartphone already had an integrated GPS device which, when used within Sprint's network, automatically provided location updates every 10 minutes. Testing determined that this time frame was more than adequate for the needs of Budway. Having found an adequate hardware and communications setup, the company now turned to the software needed to support their business processes. Although the phones themselves did not come with any work order management applications, Agilis Systems, a Sprint partner, offered work-flow software that could be customized and integrated with current software at Budway, which was an important consideration. Best of all, this hybrid solution came at a low cost to the company: Initial cost for each phone was $250 with a $ 75-per-month service charge, which included both Sprint service and the software packages developed by Agilis.

The resulting benefits are too long to list, but a few samples will give you an idea of the value that Budway has been able to deliver from this project. For example, clients can confirm receipt of products within minutes of delivery, helping their invoicing efforts. All parties involved have real-time access to tracking information about products being shipped, and clients can see what products are en route and when they will reach their destination. Having access to better and more updated information allowed Budway to offer new services, such as optimizing delivery schedules and redirecting drivers to take advantage of any opportunities, as well as being more proactive overall in managing any issues that may arise, sometimes even before drivers get to their destination.

Many clients have been very impressed by Budway's ability to deliver a rather sophisticated solution and help them improve their own business processes. One particular customer, Harbor Pipe & Steel Inc., has gone one step further. It now uses Budway almost exclusively for inbound materials coming into the ports of Los Angeles and Long Beach that need to be delivered to its facility in Riverside, California. Harbor Pipe & Steel uses the digital POD data and other online tools that Budway provides to track its products from the harbor to its facilities. "With the use of the Web site, I can see where my material is located at all times. This allows me to see if the material is in Budway's yard or on a truck heading our way with an estimated time of arrival," says Bob Line, Transportation Manager at Harbor Pipe & Steel. Making POD documents available electronically has been a major cost- and time-saver for this customer. "If there is any problem or question that arises on any coil, we can easily download the POD. This has taken a huge burden off of my shoulders since I have to reconcile all of the loads being picked up and shipped from the harbor," says Line.

Budway management has always been committed to using technology to gather as much data as possible and improving the way they run their business, so top management support was easy to come by. Prior to this project, all software had been developed by a member of management. The company had to hire a full-time programmer to work on the software integration between the components developed by Agilis Systems and internal Budway systems, but the benefits provided by the new technology, as well as its low initial cost of deployment, also made this decision a clear one. There were some issues along the way. For instance, Agilis had not fully developed the programming interface that Budway needed to communicate with the smartphones, and so the provider was building features as Budway was requesting them.

Although digital PODs are quite common, they had never been used in this particular industry before. As a result, some clients were initially skeptical about the new technology and insisted on signing an actual document in addition to the touch screen. Budway was happy to oblige, providing drivers with both options until customers became more comfortable with the new approach. However, once clients started to realize the many benefits associated with the technology, the need for actual paper documents quickly evaporated. These days, nobody wants to go back to "good old paper" anymore.

The most significant aspect of this project is that, taken individually, none of the technologies involved in the final solution was, by itself, terribly innovative. Taken together, however—and properly integrated—the resulting functionality was original enough that none of the other companies involved in the project had ever conceptualized it before getting involved with Budway. Using a cell phone as the only device also provided some unexpected benefits, as drivers only needed to use a single piece of hardware for all of their work. This helped simplify training and reduce barriers to adoption for the new technology. Although major carriers have the human and financial resources necessary to develop a custom solution, smaller companies like Budway are forced to think creatively about the best way to use standard, off-the-shelf technologies in ever more innovative ways. While large companies may have the scale necessary to justify proprietary developments, smaller businesses will not likely see a return on investment that justifies going to those lengths. Moreover, Budway management believes that the resulting solution is actually more powerful than any of the higher-end alternatives on the market at the time, and all for a fraction of the cost.

SOURCE: "Low-Cost GPS Tracking and Digital PODs Using Smartphones," *Computerworld Honors Program Case Study*, Budway Enterprises Inc., http://www.cwhonors.org/viewCaseStudy2008.asp?NominationID=2056, accessed May 14, 2011, and "Productivity Picks Up for Budway by Use of Tracking and Resource Management Software," *Agilis Systems Case Study*.

QUESTIONS TO CONSIDER

1. Did Budway management take on an unnecessary risk by becoming the principal integrator of all of these components, instead of delegating the task to an outside partner, such as a consulting company? What are the advantages and disadvantages of each approach?
2. Now that the new systems are in place and working properly, what is the next step for Budway? Where do you think management could still improve their operations with the use of technology?

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

These are the key terms and concepts of this chapter. The page number of their first reference appears in parentheses.

1. Binary representation (110)
2. Central processing unit (97)
3. Computer system (96)
4. Computer terminal (90)
5. Cycles per second (98)
6. Direct access (111)
7. Graphical user interface (100)
8. Information appliance (91)
9. Magnetic disks (114)
   a. RAID (redundant array of independent disks) (115)
10. Magnetic stripe (107)
11. Magnetic tape (115)
12. Mainframe system (93)
13. Microcomputer (88)
14. Midrange system (92)
15. MIPS (million instructions per second) (98)
16. Moore's law (98)
17. Network computer (91)
18. Network server (88)
19. Network terminal (90)
20. Off-line (100)
21. Online (100)
22. Optical disks (116)
23. Optical scanning (105)
24. Peripherals (100)
25. Pointing devices (100)
26. Primary storage unit (97)
27. Processing speed (97)
   a. Millisecond (97)
   b. Microsecond (97)
   c. Nanosecond (97)
   d. Picosecond (97)
28. RFID (radio frequency identification) (117)
29. Secondary storage (97)
30. Semiconductor memory (112)
   a. RAM (random-access memory) (112)
   b. ROM (read-only memory) (112)
31. Sequential access (111)
32. Speech recognition (103)
33. Storage capacity (111)
   a. Bit (110)
   b. Byte (110)
   c. Kilobyte (111)
   d. Megabyte (111)
   e. Gigabyte (111)
   f. Terabyte (111)
   g. Petabyte (111)
34. Supercomputer (93)
35. Volatility (112)
36. Workstation computer (88)

review quiz

Match one of the previous key terms and concepts with one of the following brief examples or definitions. Try to find the best fit for answers that seem to fit more than one term or concept. Defend your choices.

____ 1. A computer is a combination of components that perform input, processing, output, storage, and control functions.

____ 2. The main processing component of a computer system.

____ 3. A measure of computer speed in terms of processor cycles.

____ 4. Devices for consumers to access the Internet.

____ 5. The memory of a computer.

____ 6. Magnetic disks and tape and optical disks perform this function.

____ 7. Input/output and secondary storage devices for a computer system.

____ 8. Connected to and controlled by a CPU.

____ 9. Separate from and not controlled by a CPU.

____ 10. Results from the presence or absence or change in direction of electric current, magnetic fields, or light rays in computer circuits and media.

_____ 11. A common computer interface using a desktop metaphor and icons.
_____ 12. Can be a desktop/laptop or handheld computer.
_____ 13. A computer category between microcomputers and mainframes.
_____ 14. Low-cost microcomputers for use with the Internet and corporate intranets.
_____ 15. A redundant array of inexpensive hard drives.
_____ 16. A terminal that depends on network servers for its software and processing power.
_____ 17. A computer that manages network communications and resources.
_____ 18. The most powerful type of computer.
_____ 19. A magnetic tape technology for credit cards.
_____ 20. One-billionth of a second.
_____ 21. Roughly 1 billion characters of storage.
_____ 22. Includes electronic mice, trackballs, pointing sticks, and touch pads.
_____ 23. The largest of the three main types of computers.
_____ 24. Processor power measured in terms of number of instructions processed.
_____ 25. Prediction that computer power will double approximately every 18 to 24 months.
_____ 26. Promises to be the easiest, most natural way to communicate with computers.
_____ 27. Capturing data by processing light reflected from images.
_____ 28. The speed of a computer.
_____ 29. One one-thousandth of a second.
_____ 30. 1,024 bytes.
_____ 31. A device with a keyboard and a video display networked to a computer is a typical example.
_____ 32. The amount of data a storage device can hold.
_____ 33. A personal computer used as a technical workstation.
_____ 34. The smallest unit of data storage.
_____ 35. One trillion bytes.
_____ 36. You cannot erase the contents of these storage circuits.
_____ 37. The memory of most computers consists of these storage circuits.
_____ 38. The property that determines whether data are lost or retained when power fails.
_____ 39. Each position of storage can be accessed in approximately the same time.
_____ 40. Each position of storage can be accessed according to a predetermined order.
_____ 41. Microelectronic storage circuits on silicon chips.
_____ 42. Uses magnetic spots on metal or plastic disks.
_____ 43. Uses magnetic spots on plastic tape.
_____ 44. Uses a laser to read microscopic points on plastic disks.
_____ 45. A millionth of a second.
_____ 46. A trillionth of a second.
_____ 47. A grouping of eight bits that represents one alphabetic or special character.
_____ 48. A short-range wireless technology most commonly used to tag, track, and identify objects.
_____ 49. Around a million bytes; more precisely, 2 to the 20th power.
_____ 50. A unit of information or computer storage equal to one quadrillion bytes, or 1,024 terabytes.

discussion questions

1. What trends are occurring in the development and use of the major types of computer systems?
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?
3. Review the Real World Challenge introduced in the chapter. Since the proof-of-delivery (POD) documents are in essence the only binding evidence that products were delivered safe, sound, and on time, what are some of the issues that customers may raise when Budway proposes to do away with this document? What are some strategies Budway can use to assuage any concerns?
4. Do you think that information appliances like PDAs will replace personal computers (PCs) in business applications? Explain.
5. Are networks of PCs and servers making mainframe computers obsolete? Explain.
6. Consider the Real World Solution discussed in the chapter. How are the challenges encountered by a small company, such as Budway, different from those faced by larger enterprises? How was it possible for Budway to create a superior solution at a lower cost than some of the higher-end systems used by major companies in their industry?
7. What are several trends that are occurring in computer peripheral devices? How do these trends affect business uses of computers?

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

analysis exercises

1. **Hardware Costs**
Purchasing Computer Systems for Your Workgroup
You have been asked to get pricing information for a potential purchase of PCs for the members of your workgroup. Go to the Internet to get prices for these units from Dell and Hewlett Packard. Look for a high-end office desktop model.
The list below shows the specifications for the basic system you have been asked to price and potential upgrades to each feature. You will want to get a price for the basic system described below and a separate price for each of the upgrades shown.

Component	Basic Unit	Upgrade
CPU (gigahertz)	2.8	3.4
Hard Drive (gigabytes)	160	500
RAM (gigabytes)	1	2
Removable media	16× DVD-R/W	48× DVD-R/W
Monitor	17-inch flat screen	19-inch flat screen

Select the standard software licenses; your IT department will install the necessary software for your workgroup. Take a two-year warranty and servicing coverage offered by each supplier. If a two-year warranty is not available, simply note any differences in the coverage with the closest match.

a. Prepare a spreadsheet summarizing this pricing information and showing the cost, from each supplier, of the following options:
   a. units with the basic configuration,
   b. the incremental cost of each upgrade separately, and
   c. the cost of a fully upgraded unit. If you cannot find features that exactly match the requirements, then use the next higher standard for comparison and make a note of the difference.
b. Prepare a set of PowerPoint slides summarizing your results. Include a discussion of the warranty and servicing contract options offered by each supplier.

2. **Price and Performance Trends for Computer Hardware**
Hardware Analysis
The table below details price and capacity figures for common components of personal computers. Typical prices for microprocessors, Random Access Memory (RAM), and hard disk storage prices are displayed. The performance of typical components has increased substantially over time, so the speed (for the microprocessor) or the capacity (for the storage devices) is also listed for comparison purposes. Although not all of the improvements in these components are reflected in these capacity measures, it is interesting to examine trends in these measurable characteristics.

a. Create a spreadsheet based on the figures below and include a new row for each component showing the price per unit of capacity (cost per megahertz of speed for microprocessors and cost per megabyte of storage for RAM and hard disk devices).
b. Create a set of graphs highlighting your results and illustrating trends in price per unit of performance (speed) or capacity.
c. Write a short paper discussing the trends you found. How long do you expect these trends to continue? Why?
d. Prepare a summary presentation outlining the points from your paper (above). Be sure to *link* your Excel chart into the PowerPoint presentation so it automatically updates when any data changes in the spreadsheet.

3. **Can Computers Think Like People?**
The Turing Test
The Turing Test is a hypothetical test to determine whether or not a computer system reached the level of "artificial intelligence." If the computer can fool a person into thinking it is another person, then it has artificial intelligence. Except in very narrow areas, no computer has passed the Turing Test.
Free e-mail account providers such as Hotmail or Yahoo take advantage of this fact. They need to distinguish between new account registrations generated by a person and registrations generated by spammers' software. Why? Spammers burn through thousands of e-mail accounts in order to send

	1991	1993	1995	1997	1999	2001	2003	2005
Processor Speed MHz	25	33	100	125	350	1000	3,000	3,800
Cost	$180	$125	$275	$250	$300	$251	$395	$549
RAM Chip Mb per Chip	1	4	4	16	64	256	512	2,000
Cost	$55	$140	$120	$97	$125	$90	$59	$149
Hard Drive Gb per drive	.105	.250	.540	2.0	8.0	40.0	160.0	320
Cost	$480	$375	$220	$250	$220	$138	$114	$115

millions of e-mails. To help them, spammers need automated tools to generate these accounts. Hotmail fights this practice by requiring registrants to correctly enter an alphanumeric code hidden within an image. Spammers' programs have trouble correctly reading the code, but most humans do not. With this reverse Turing test, also called a " captcha," Hotmail can distinguish between a person and program and allow only humans to register. As a result, spammers must look elsewhere for free accounts.

a. Aside from those mentioned above, in what applications might businesses find it useful to distinguish between a human and a computer?

b. Describe a Turing test that a visually impaired person but not a computer might pass.

c. Search the Internet for the term "captcha" and describe its strengths and weaknesses.

4. **Radio Frequency Identification**
Input Device or Invasion of Privacy?
Punch cards, key boards, bar code scanners—the trend is clear. Input devices have continued to promote faster and more accurate data entry. Key to this is capturing data at its source, and no tool does this better than radio frequency identification systems (RFID). An RFID transmitter sends out a coded radio signal. An RFID tag changes and reflects this signal back to an antenna. The RFID system can read the reflection's unique patter and record it in a database. Depending on the system, this pattern may be associated with a product line, shipping pallet, or even a person. Although an RFID system's range is limited to a few dozen feet, this approach enables remarkable inventory tracking that doesn't rely on a human to keyboard or scan. Except for the presence of a 1-inch square (5-cm square) RFID tag, humans may have no idea an RFID system is in operation.

Indeed, that may be part of the problem. Consumers have expressed concern that RFID chips attached to products they purchase may be used to track them. Others fear the government may require embedded RFID chips as a form of personal identification and tracking. What started as a new and improved input device has devolved into a matter of public policy.

a. How would you feel if your university used RFID tags embedded in your student IDs to replace the magnetic "swipe" strip? On a campus, RFID tags might be used to control building access, manage computer access, or even automatically track class attendance.

b. Enter "RFID" into an Internet search engine and summarize the search results. Of the top twenty results, how many were positive, negative, or neutral?

c. Enter "RFID" and "privacy" into an Internet search engine, select a page expressing privacy concerns, and summarize them in a brief essay. Do you find these concerns compelling?

5. **Gadgets**
Getting to Know All about You
For two decades, user input devices typically comprised a keyboard and a mouse. This left computers virtually "blind" to the world. A whole new class of devices has now changed this. Read Wired.com's article *How Context-Aware Computing Will Make Gadgets Smarter* (http://bit.ly/av0V7w) and answer the following questions:

a. What additional context-sensitive inputs are computing devices now able to acquire automatically?

b. Briefly explain the difference between "hard-sensing" and "soft-sensing." Provide an example of each.

c. The more our computers know about us, the more useful they can become—and the more invasive. Hundreds of detective stories and spy novels feature futuristic tracking devices, yet here we are in the future and we're carrying them willingly, albeit perhaps unknowingly. Read MSNBC.com's article, *Government officials want answers to secret iPhone tracking* (http://bit.ly/fR3SVu), and answer the following questions.

d. Do you agree with researchers Allan and Warden that "there's no immediate harm that would seem to come from the availability of this data"? Give several examples of harm that might arise from having this information fall into the wrong hands.

e. Has Apple's response to this revelation been adequate? Why or why not?

real world

CASE 1

AstraZeneca, UnitedHealth, and Others: IT-Asset Management—Do You Know What You've Got?

Global pharmaceuticals giant AstraZeneca needed some strong medicine of its own to fix a burgeoning IT-asset-management problem brought about by multiple acquisitions and their nonstandard gear, a high-tech workforce spread across 255 facilities in 147 countries, and in total more than 67,000 employees using more than 90,000 hardware and software assets ranging from notebooks up to SAP and Oracle enterprise applications and databases.

With software vendors becoming more aggressive on audits as sales of new products are generally weak, and with greater internal collaboration requiring a more consistent set of tools to simplify processes and maintenance, the $31 billion pharmaceuticals company realized a few years ago that Microsoft's Systems Management Server was simply overmatched for the job of managing the global enterprise's complex base of IT assets.

So Microsoft recommended the asset-management products offered by a French company called PS'Soft, which is a subsidiary of BDNA Corp., a top provider of IT infrastructure inventory and analysis solutions. And in the years that AstraZeneca has been steadily getting its IT assets under control, PS'Soft has distinguished itself like few other IT vendors, according to AstraZeneca Global IT Asset leader Bernard Warrington.

"In all my years, our engagement with PS'Soft was one of the first and only times we had an IT vendor show such willingness to work as a true partner and really try to solve our problems with us," Warrington says. Referring to PS'Soft's Julian Moreau, Warrington described the uniquely open collaboration that allowed him and his team to understand the problem, design the solution, and then execute that plan.

"Julian and I worked extremely closely together, and from there our partnership cascaded down to the other members of the team," Warrington says. "But I need to be very clear about that: In the beginning, the knowledge and expertise were clearly with them—they were teaching and we were learning."

The problem, Warrington says, is that in the increasingly strategic world of IT-asset management, "the tool set itself meets only 30 percent of the overall need: On top of that, you need to build the processes, understand the costs, come up with standards, develop interfaces with other major vendors, and much more—we simply didn't have all the skills necessary to cover that total life cycle. But PS'Soft did have those skills, both in-house and through their contacts."

In addition, says Warrington, PS'Soft and BDNA had the global experience necessary to help AstraZeneca get its arms around its global sprawl of IT gear, which was essential for two reasons: First, so that the company could begin to gain greater leverage in purchasing negotiations, and second, so it could be able to fairly, but aggressively, hold its own during audits by software vendors.

"In so many countries where we operate, the tradition has been that budgets are managed locally, making it impossible to see the global aggregate in detail," Warrington says. "We simply did not have the ability to get a global view. The old tools we used gave us something of a snapshot, but didn't let us have enough insight to be able to manage the situation. At the same time, the IT vendors are getting very aggressive with audits, and without offering a specific number I can tell you that millions and millions of dollars are at stake—and before our engagement with PS'Soft, no matter how hard we tried with the old tool set, we were just not able to achieve those potential cost savings from vendors."

Over time, Warrington says, AstraZeneca gained that necessary level of control and knowledge: "Now AstraZeneca is in a position to enter negotiations from a position of strength, confidence, and knowledge." And that achievement has given the company a new perspective on the realm of IT-asset management, Warrington said: "Too many companies just look on IT- asset management as nothing more than bean counting, versus looking deeper and understanding the ROI and ROA that can be achieved.

"But we learned firsthand that there is a huge opportunity to get control over what you have, to satisfy even the most rigorous audit, and to negotiate better contracts. And that's a lot more than bean counting," says Warrington.

IT organizations in diversified companies—particularly those grown through acquisition—wage a seemingly endless battle against unnecessary IT diversity and related costs. Conceived, planned, and executed in 18 months, UnitedHealth Group's (UHG) Hercules program proves the complexity can be conquered, while protecting or improving IT's service levels. By creating a standard desktop configuration and consistent management processes, Hercules reduced total cost of ownership to $76 per month per desktop, from more than $240.

In 2004, with the CEO's support, Alistair Jacques, then SVP of UHG-IT, launched Hercules, focusing it on standardizing and streamlining the processes behind desktop management: procurement, configuration, installation, life cycle and asset management. In addition to this focus on process, two techniques stand out as key to the program's success. Working with finance, IT developed a chargeback model that imposes a premium on nonstandardized desktop configurations: $170 per month versus $45 per month for a standard configuration. This value price encourages business managers to choose the more efficient infrastructure. UHG also reduced costly on-site support by reorganizing it: A central IT team manages high-level support activities, completing 95 percent remotely, while select, on-site end users (often non-IT administrative staff trained by IT) provide basic support to colleagues.

UHG-IT treated desktop management as a business process challenge rather than a technology issue. This approach freed them to employ tactics like non-IT staff for desktop support and value pricing. To date, UHG has converted 75,000 out of 90,000 devices to the new standards, delivering $42 million in annual savings. Effectively, UHG can now manage nearly four times the number of end users with the same number of IT personnel as in 2004. All while actually improving—not diminishing—service levels: IT now deploys 99.4 percent of releases, updates and patches in three hours, instead of 65 percent in three weeks.

Indeed, companies that blow off asset management do so at their own peril. At the same time, 99 percent of companies that her organization comes across don't have a proper asset management process in place, according to Elisabeth Vanderveldt, vice president of business development at Montreal-based IT services and consulting firm Conamex International Software Corp. That's a staggering number, considering the value that life-cycle management can bring to an organization. And it's indicative of the widespread lack of respect for this important aspect of IT operations.

The ideal time to start considering an asset management program is before the business and its IT infrastructure is even up and running, but the common scenario is that corporations look to asset management after they've encountered a problem running the infrastructure.

The mentality around asset management is evolving, however. Companies used to consider only reliability, availability, and overall equipment effectiveness in that equation. But now there is recognition of factors like continuing pressures on cost, and green technology. "It really requires a mature organization to understand what's going to be needed to assess and execute a life-cycle management strategy," says Don Barry, associate partner in global business services in the supply chain operations and asset management solutions group at IBM.

Why is a life-cycle management program important? For one thing, it puts IT in much better control of its assets, and this can have a number of benefits.

"IT can make really intelligent decisions around what they should get rid of, and they might even find they have more money in the budget and they can start taking a look at newer technology and see if they can bring it in-house. Without that big picture, they just end up spending more and more money than had they been proactive," says Vanderveldt.

Life-cycle management also has value as a risk management tool and it aids in the disaster recovery process as well, she adds. "It's also beneficial for those moments that are just completely out of your control, like mergers, acquisitions and uncontrolled corporate growth, either organic or inorganic," says Darin Stahl, an analyst at London, Ontario–based Info-Tech Research Group. "IT leaders without this tool set are now charged with pulling all this information together on short notice. That could be diminished considerably in terms of turnaround time and effort for IT guys if they have a holistic asset management program in place."

SOURCE: Bob Evans, "Global CIO Quick Takes: AstraZeneca Saves Millions with BDNA," *InformationWeek*, February 22, 2010; Rick Swanborg, "Desktop Management: How UnitedHealth Used Standardization to Cut Costs," *CIO.com*, April 28, 2009; and Kathleen Lau, "Asset Management: Do You Know What You've Got?" *CIO Canada*, August 13, 2008.

CASE STUDY QUESTIONS

1. What are the companies mentioned in the case trying to control, or manage, through these projects? What is the problem? And how did they get there?
2. What are the business benefits of implementing strong IT-asset management programs? In what ways have the companies discussed in the case benefited? Provide several examples.
3. One of the companies in the case, UnitedHealth Group, tackled the issue by imposing standardization and charging those stepping outside standard models. How should they balance the need to standardize with being able to provide business units with the technologies best suited to their specific needs? Justify your answer.

REAL WORLD ACTIVITIES

1. An important metric in this area considered by companies is the Total Cost of Ownership (TCO) of their IT assets. Go online and research TCO and how it is related to IT-asset management. How are companies using TCO to manage their IT investments? Prepare a presentation to share your research with the rest of your class.
2. What does Don Barry of IBM mean by "life-cycle" in the context of this case? How would this life-cycle management work when it comes to IT assets? Break into small groups with your classmates and create a working definition of life-cycle management and how it works as you understand it from the case.

real world

CASE 2

IT in Health Care: Voice Recognition Tools Make Rounds at Hospitals

The infamous doctor's scrawl may finally be on its way out.

Voice technology is the latest tool health care providers are adopting to cut back on time-consuming manual processes, freeing clinicians to spend more time with patients and reduce costs.

At Butler Memorial Hospital, voice-assisted technology has dramatically reduced the amount of time the Butler, Pa., hospital's team of intravenous (IV) nurses spends recording information in patients' charts and on other administrative tasks. And at the Cleveland Clinic's Fairview Hospital, doctors are using speech recognition to record notes in patients' e-medical records.

Butler recently completed a pilot project where three IV nurses used Vocollect's AccuNurse hands-free, voice-assisted technology along with Boston Software System's work-flow automation tools. The nurses were able to cut the time they spend on phone calls and manual processes, including patient record documentation, by at least 75 percent. Now Butler is rolling out the voice technology for its full IV team of four nurses and seven other clinicians to use for patient care throughout the facility.

The productivity boost from the voice-assisted tools also helps with the hospital's expansion plans, says Dr. Tom McGill, Butler vice present of quality and safety. Butler will soon add about 70 beds—growing from 235 beds now to more than 300—but it won't need to expand the IV nursing team because of the time savings from the voice-assisted technology, McGill says.

In the past, when a patient needed IV care, such as a change in the intravenous medication being administered, an IV nurse would be paged. The nurse would have to call the patient's nursing station or the doctor requesting the IV to obtain details. The nurse then would prioritize the request with all of the existing IV orders. Once IV care was completed, nurses would record what they did in the patient's e-medical record.

With the AccuNurse, which combines the use of speech recognition and synthesis for charting and communication, Butler's IV nurses wear lightweight headsets and small pocket-sized wireless devices that enable them to hear personalized care instructions and other information about patients' IV needs.

IV requests are entered into Butler's computer system, which sends them through the Vocollect system to the appropriate headset. IV nurses listen to details about new orders and use the system to prioritize IV orders.

When they finish caring for a patient, nurses record what they did in the patient's e-medical record using voice commands. "The nurses can document as they're walking to the next patient's room," says McGill. Once they finish with one patient, nurses say "next task" to obtain instructions for the next patient, McGill says.

The system has shown itself to be capable of understanding different accents, he said. Butler is evaluating expanding use of the voice-assisted technology to other clinical areas, including surgery. The technology could be used to help ensure that surgical staff complete patient safety checklists.

McGill wouldn't say how much Butler paid for the system, but he expects the ROI will be realized in 12 to 18 months. "It's very affordable," he notes. Meanwhile, Dr. Fred Jorgenson, a faculty physician at Cleveland Clinic's Fairview Hospital, is using Nuance's Dragon Medical speech recognition technology to speak patient notes into the hospital's Epic EMR (electronic medical records) system.

"I'm not a fast typist," Jorgenson says. "Many doctors over a certain age aren't. If I had to type all the time, I'd be dead." And, at 13 cents to 17 cents per line, dictation transcription services are expensive. "In primary care, patient notes can be 30 to 40 lines. That adds up," he says. Fairview is saving about $2,000 to $3,000 a month that might have otherwise been spent on transcription, Jorgenson said. It cost about $3,500 to get Dragon up and running.

With transcription services, the turnaround time is 24 to 36 hours before information is available in the EMR. Spoken notes are available immediately.

Jorgensen describes the accuracy of Dragon Medical's speech-to-text documentation as "very good," especially with medical terms and prescriptions. "It rarely gets medical words wrong," he says. "If you see a mistake, it's usually with 'he' or 'she,' and you can correct it when you see it."

Mount Carmel St. Ann's hospital in Columbus, Ohio, has been among the early wave of health care providers using electronic clinical systems bolstered with speech recognition capabilities. About seven years ago, emergency department doctors at Mount Carmel St. Ann's hospital began having access to Dragon's speech recognition software not long after an e-health record system from Allscripts was rolled out there.

When the e-health record was first rolled out—without the voice capabilities—Mount Carmel St. Ann's doctors didn't necessarily see the kind of productivity boost they had been hoping for, in large part because they found themselves spending a lot of time typing notes, notes Dr. Loren Leidheiser, chairman and director of emergency medicine at Mount Carmel St. Ann's emergency department. But as more of Mount Carmel St. Ann's ER doctors began incorporating the speech recognition capabilities into their work flow—whether speaking notes into a lapel microphone or into a computer in the patient room or hallway—the efficiency picked up tremendously, says Leidheiser.

Also, before using the Dragon software, the ER department spent about $500,000 annually in traditional dictation transcription costs for the care associated with the hospital's 60,000 to 70,000 patient visits yearly at the time. That was cut down "to zero," he says. The return on investment on the speech recognition, combined with the use of the e-health record system, was "within a year and a half," notes Leidheiser.

Leidheiser also makes use of time stuck in traffic to dictate notes that are later incorporated into patient records or turned into e-mails or letters. Using a Sony digital recorder, Leidheiser can dictate a letter or note while in his car, then later plug the recorder into his desktop computer, where his spoken words are converted to text.

Speech recognition technology is also helping U.S. military doctors keep more detailed patients notes while cutting the time they spend typing on their computers. By 2011, the U.S. Department of Defense expects to have implemented its integrated, interoperable electronic medical record system, AHLTA, at more than 500 military medical facilities and hospitals worldwide.

The system will be used for the care of more than 9 million active military personnel, retirees, and their dependents. Military doctors using the AHLTA system also have access to Dragon NaturallySpeaking Medical speech recognition technology from Nuance Communications' Dictaphone health care division, allowing doctors to speak "notes" into patient records, as an alternative to typing and dictation. Over the last year, the adoption of Dragon has doubled, with approximately 6,000 U.S. military doctors using the software at health care facilities of all military branches, including the Air Force, Army, Navy, and Marine Corps.

The use of Dragon Naturally Speaking voice recognition software with the AHLTA e-health record systems is freeing doctors from several hours of typing into the AHLTA their various patient notes each week, he said. Being able to speak notes into an e-health record at the patient's bedside—rather than staring at a computer screen typing—also helps improves doctors' bedside manner and allows them to narrate more comprehensive notes while the patients are there, or right after a visit. That cuts down on mistakes caused by memory lapses and boosts the level of details that are included in a patient record, says Dr. Robert Bell Walker, European Regional Medical Command AHLTA consultant and a family practice physician for the military.

The voice capability "saves a lot of time and adds to the thoroughness of notes from a medical and legal aspect," says Dr. Craig Rohan, a U.S. Air Force pediatrician at Peterson Air Force base in Colorado. The ability to speak notes directly into a patient's electronic chart is particularly helpful in complicated cases, where a patient's medical history is complex, he says. Text pops up on the computer screen immediately after words are spoken into the system, so doctors can check the accuracy, make changes, or add other details.

Also, because spoken words are immediately turned into text, the medical record has "a better flow" to document patient visits. Previously, "the notes that had been created by [entering] structured text into the AHLTA system looks more like a ransom note," says Walker, with information seemingly randomly pasted together.

Doctors can speak into a microphone on their lapels to capture notes in tablet PCs during patient visits, or speak into headsets attached to desktop or wall-mounted computers. The storage requirement of voice notes is "small," especially when compared with other records, such as medical images, says Walker. By adding spoken notes to medical records, e-mails, and letters, "it's easier to tell the story," remarks Leidheiser.

SOURCE: Marianne Kolbasuk McGee, "Voice Recognition Tools Make Rounds at Hospitals," *InformationWeek*, September 17, 2009; Marianne Kolbasuk McGee, "Doctors Use Speech Recognition Tools to Enhance Patient E-Health Records," *InformationWeek*, May 19, 2008; and Matt Hamblen, "Doctors' Notes Get Clearer with Speech Recognition Software," *Computerworld*, May 16, 2008.

CASE STUDY QUESTIONS

1. What are some of the benefits afforded to organizations implementing voice recognition technologies in these settings? How can you quantify these benefits to assess the value of the investment? Provide several examples from the case.
2. There is no margin for error when working in a health care setting. How would you go about implementing these technologies in this high-risk environment? What precautions or approaches would you take to minimize risks? Develop some recommendations.

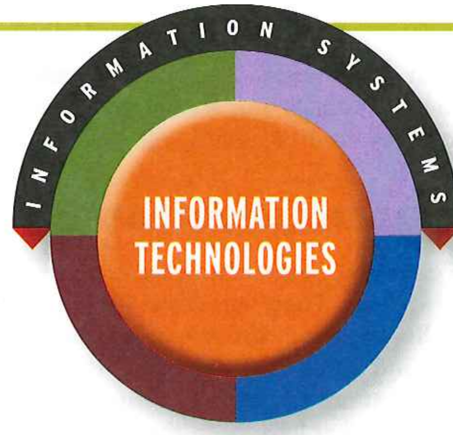
3. In what other areas of medicine would you expect technology to make inroads next? Where do you think it would be most beneficial, and how would it change the way doctors and nurses work today? Provide several examples.

REAL WORLD ACTIVITIES

1. The case talks about electronic medical or health records systems. These are slowly becoming standard in many hospitals and clinics, both private and public. Go online and search for reports of these implementations. What are the main benefits derived from their adoption? What have been the major roadblocks preventing their acceptance? Prepare a report to share your findings.
2. The case above was presented from the perspective of practitioners and hospital administrators. How comfortable would you feel, as a patient, knowing that your health care providers are using these technologies? Would you have any concerns? Break into small groups with your classmates to discuss this issue.

chapter 4

COMPUTER SOFTWARE



CHAPTER HIGHLIGHTS

Application Software: End-User Applications

Introduction to Software

REAL WORLD CHALLENGE: Japan Post Network—from Government Entity to Private Company

Business Application Software
Software Suites and Integrated Packages
Web Browsers and More
Electronic Mail, Instant Messaging, and Blogs
Word Processing and Desktop Publishing
Spreadsheets
Presentation Graphics
Personal Information Managers
Groupware
Software Alternatives

System Software: Computer System Management

System Software Overview
Operating Systems
Other System Management Programs
Programming Languages
Web and Internet Languages and Services
Programming Software

REAL WORLD SOLUTION: Japan Post Network—Savings and Competitive Advantage with Software as a Service and Cloud Computing

REAL WORLD CASE: GE, H.B. Fuller Co., and Others: Successful Implementations of Software as a Service

REAL WORLD CASE: U.S. Department of Defense: Enlisting Open-Source Applications

LEARNING OBJECTIVES

4-1 Describe several important trends occurring in computer software.

4-2 Give examples of several major types of application and system software.

4-3 Explain the purpose of several popular software packages for end-user productivity and collaborative computing.

4-4 Define and describe the functions of an operating system.

4-5 Describe the main uses of computer programming software, tools, and languages.

4-6 Describe the issues associated with open-source software.