



Chapter 4

IT Infrastructure: Hardware and Software



Essentials of Management Information Systems

Chapter 4 IT Infrastructure: Hardware and Software

STUDENT LEARNING OBJECTIVES

- **What are the components of IT infrastructure?**
- **What are the major computer hardware, data storage, input, and output technologies used in business?**
- **What are the major types of computer software used in business?**



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STUDENT LEARNING OBJECTIVES

- **What are the most important contemporary hardware and software trends?**
- **What are the principal issues in managing hardware and software technology?**

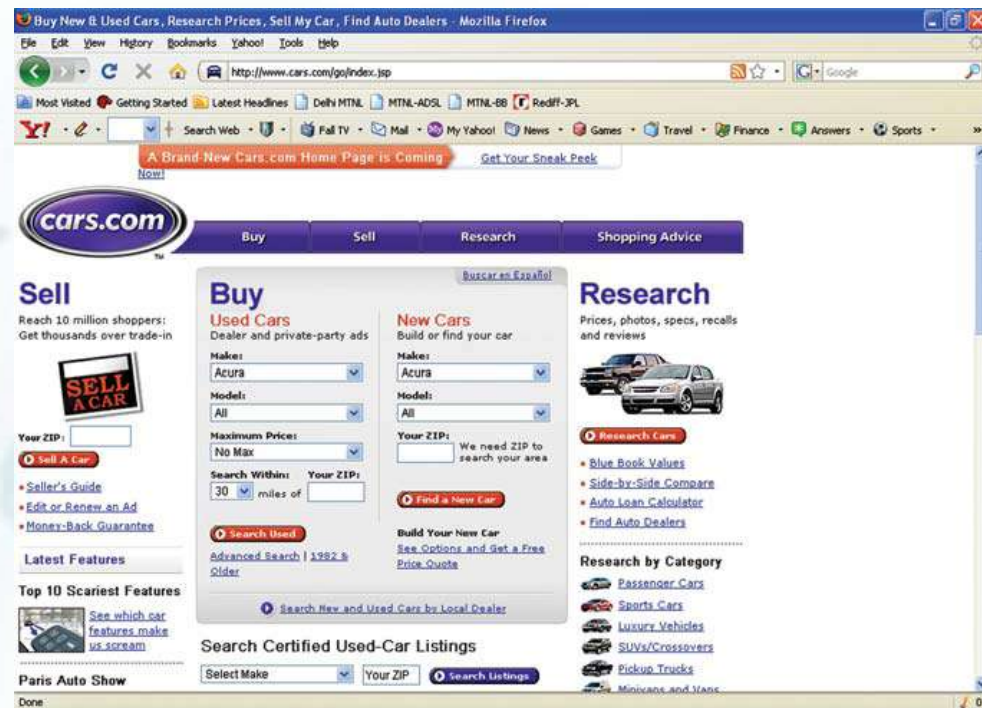


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Cars.com's IT Infrastructure Drives Rapid Business Growth

- **Problem:** Cars.com's information systems unable to keep pace with site's explosive growth.
- **Solutions:** use IBM storage technology to reduce infrastructure spending and conserve space.





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Cars.com's IT Infrastructure Drives Rapid Business Growth

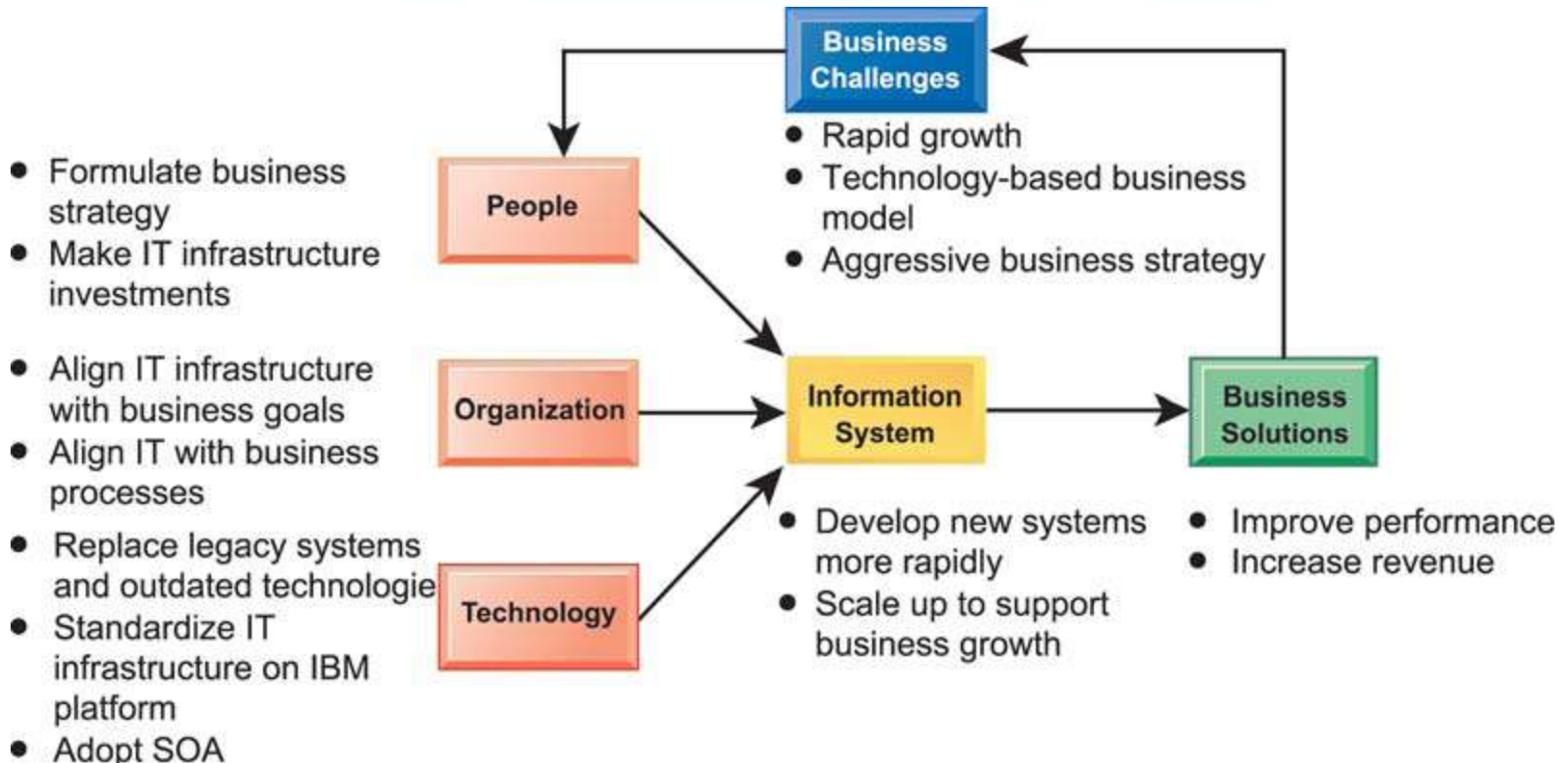
- **IBM's WebSphere application server** helped reduce data center costs and IBM Rational software helps programmers rapidly design, develop, and test Java applications.
- Demonstrates IT's role in standardizing technology and managing infrastructure.
- Illustrates digital technology's role cutting costs and increasing resource utilization rates.



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Cars.com's IT Infrastructure Drives Rapid Business Growth





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IT Infrastructure: Computer Hardware

Infrastructure Components

- **IT infrastructure:** provides platform for supporting all information systems in the business
 - **Computer hardware**
 - **Computer software**
 - **Data management technology**
 - Organizes, manages, and processes business data concerned with inventory, customers, and vendors
 - **Networking and telecommunications technology**
 - **Technology services**
 - E.g., consultants for systems integration with legacy systems



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IT Infrastructure Components

A firm's IT infrastructure is composed of hardware, software, data management technology, networking technology, and technology services.

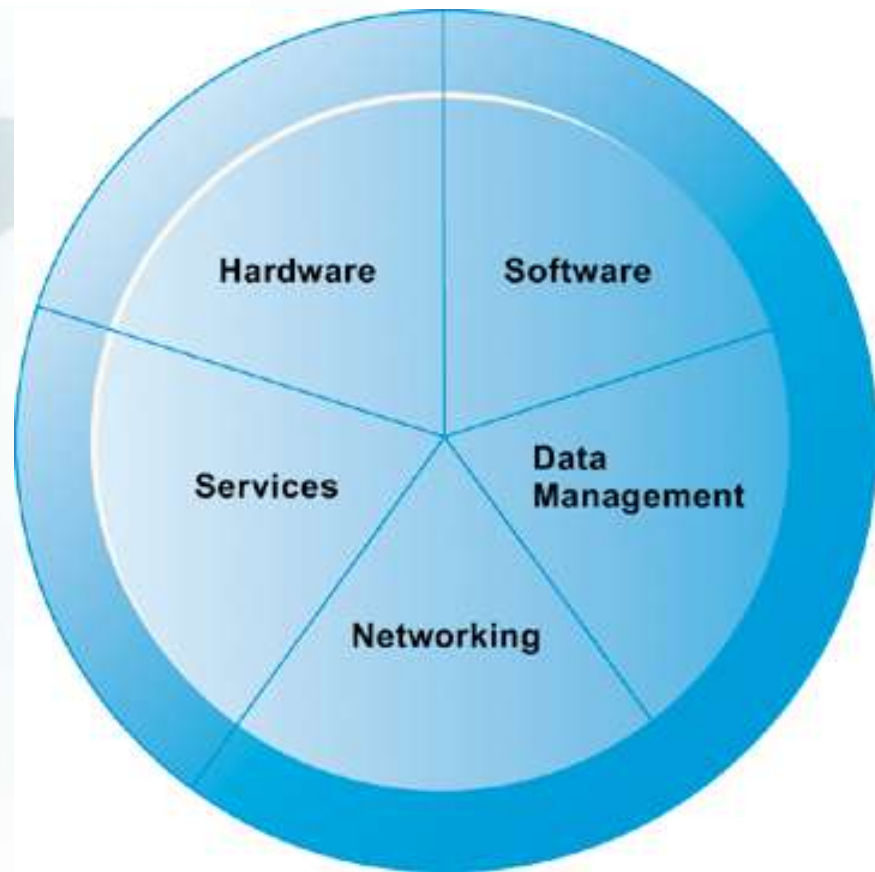


Figure 4-1



Types of Computers

- **Computers come in different sizes with varying capabilities for processing information.**
 - FLOPS (Floating point operations per second)
- **Smartphones, netbooks, e-book readers**
- **PCs**
- **Workstations**
 - More powerful mathematical and graphics-processing capabilities than a PC



Types of Computers

- **Servers:**
 - Type of midrange computer.
 - Support computer network, sharing files and resources.
 - Provide hardware platform for e-commerce.
- **Mainframes:**
 - Large-capacity, high-performance computer that can process large amounts of data very rapidly
 - E.g., used by airlines for thousands of reservations per second



Types of Computers

- **Supercomputer:**
 - More sophisticated computer used for tasks requiring extremely rapid and complex calculations with thousands of variables, millions of measurements
 - Used in engineering, scientific simulations, military/weapons research, weather forecasting
- **Grid computing:**
 - Power of geographically remote computers connected into single network to act as “virtual supercomputer”



Types of Computers

- **Client/server computing:**
 - Form of distributed computing
 - Splits processing between “clients” and “servers”
 - **Clients:** user point of entry
 - **Servers:** store and process shared data and perform network management activities



Types of Computers

- **Client/server computing (cont.):**
 - **Two-tiered client/server architecture**
 - Uses two types of machines
 - **Multitiered client/server architecture (N-tier)**
 - Balances load of network over several levels of servers
 - E.g., Web servers and application servers



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Client/Server Computing

In client/server computing, computer processing is split between client machines and server machines linked by a network. Users interface with the client machines.

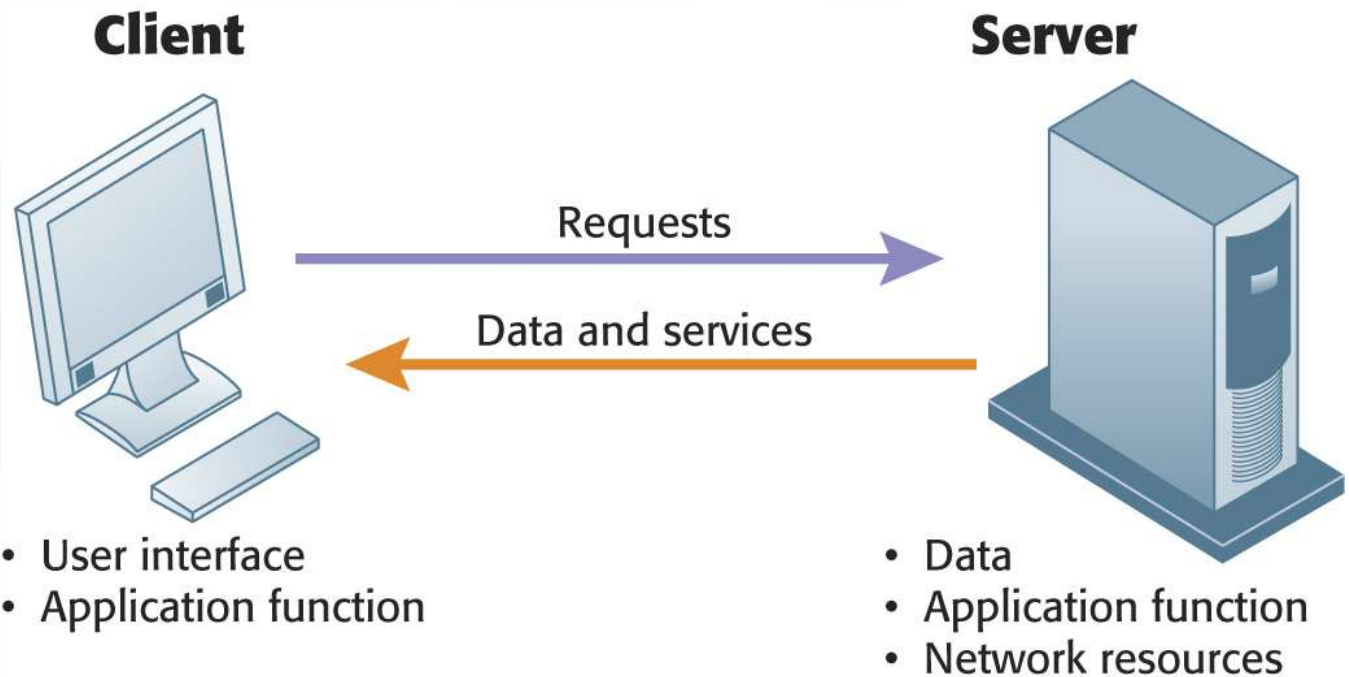


Figure 4-2

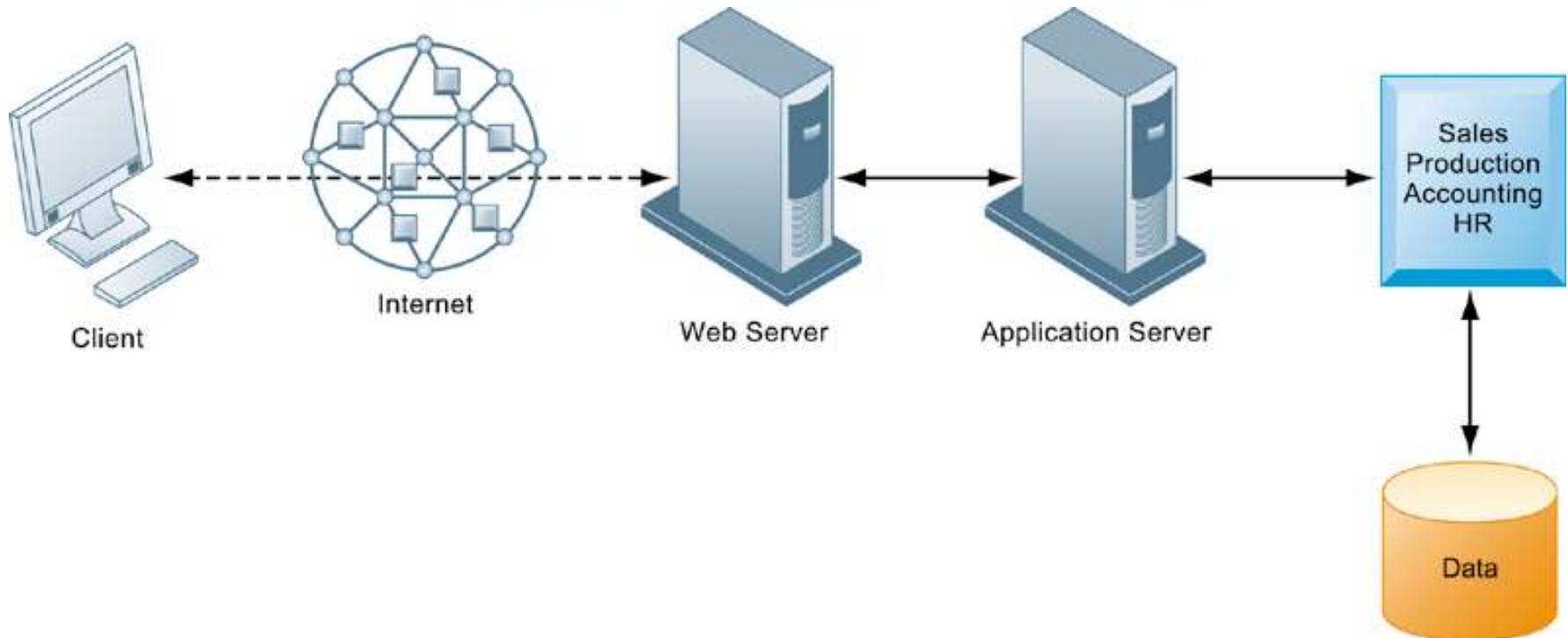


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A Multitiered Client/Server Network (N-Tier)



In a multitiered client/server network, client requests for service are handled by different levels of servers.

Figure 4-3



Storage, Input, and Output Technology

- **Primary secondary storage technologies**
 - **Magnetic disk:**
 - Hard drives, USB flash drives
 - RAID: can package hundreds of drives for massive storage requirements
 - **Optical disks**
 - CD-ROM, CD-RW, DVD
 - **Magnetic tape**
 - **Storage networking: SANs**
 - Connect multiple storage devices on a separate high-speed network dedicated to storage



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A Storage Area Network (SAN)

A typical SAN consists of a server, storage devices, and networking devices, and is used strictly for storage. The SAN stores data on many different types of storage devices, providing data to the enterprise. The SAN supports communication between any server and the storage unit as well as between different storage devices in the network.

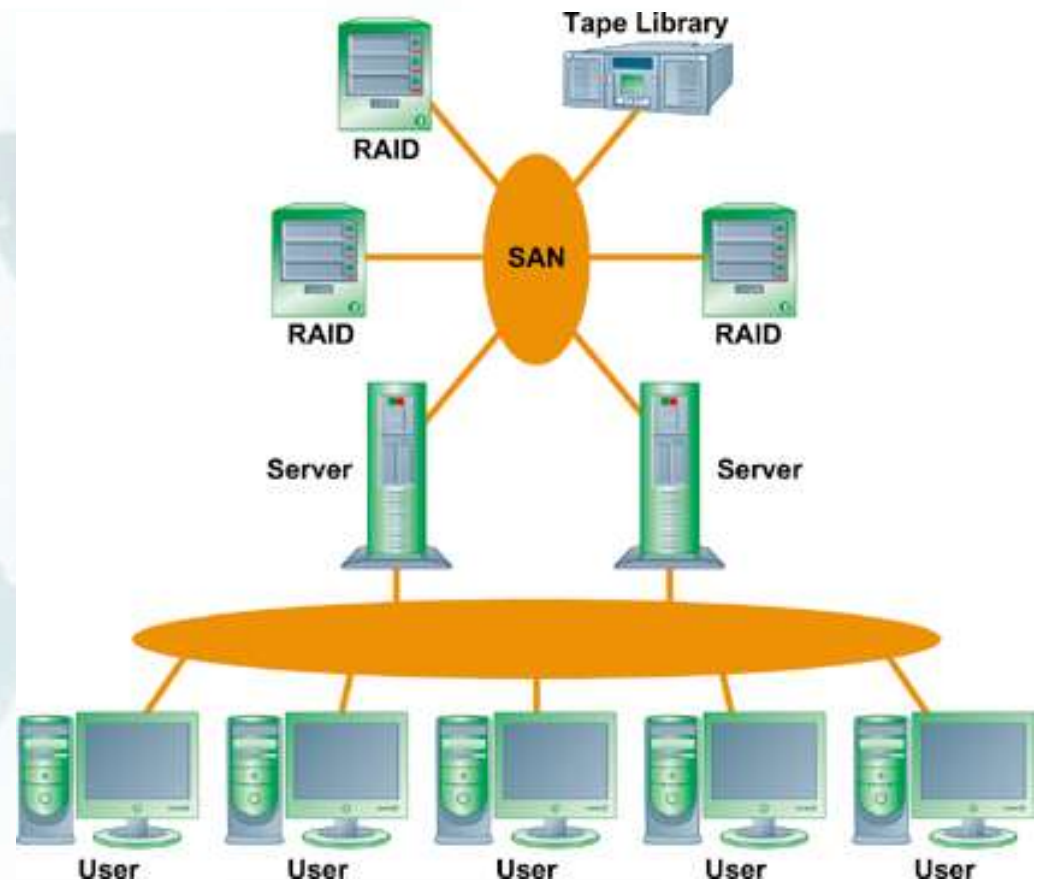


Figure 4-4



Storage, Input, and Output Technology

- **Input devices:**
 - Gather data and convert them into electronic form.
 - Keyboard
 - Computer mouse
 - Touch screen
 - Optical character recognition
 - Magnetic ink character recognition
 - Pen-based input
 - Digital scanner
 - Audio input
 - Sensors



Storage, Input, and Output Technology

- **Output devices:**
 - Display data after they have been processed.
 - Monitor
 - Printer
 - Audio output
- **Information systems collect and process information in one of two ways.**
 - **Batch processing:** transactions stored for predefined amount of time, then processed as group
 - **Online processing:** transactions processed immediately



Contemporary Hardware Trends

- **The emerging mobile digital platform**
 - Based on new handheld hardware like cell phones, netbooks, and tablet computers. A new “platform.”
 - Wireless communications through 3G cell networks and Wi-Fi.
 - New software apps.
- **Nanotechnology**
 - Creating computer chips and other devices thousands of times smaller through manipulating individual atoms, molecules



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Examples of Nanotubes

Nanotubes are tiny tubes about 10,000 times thinner than a human hair. They consist of rolled up sheets of carbon hexagons, have potential uses as minuscule wires or in ultrasmall electronic devices, and are very powerful conductors of electrical current.

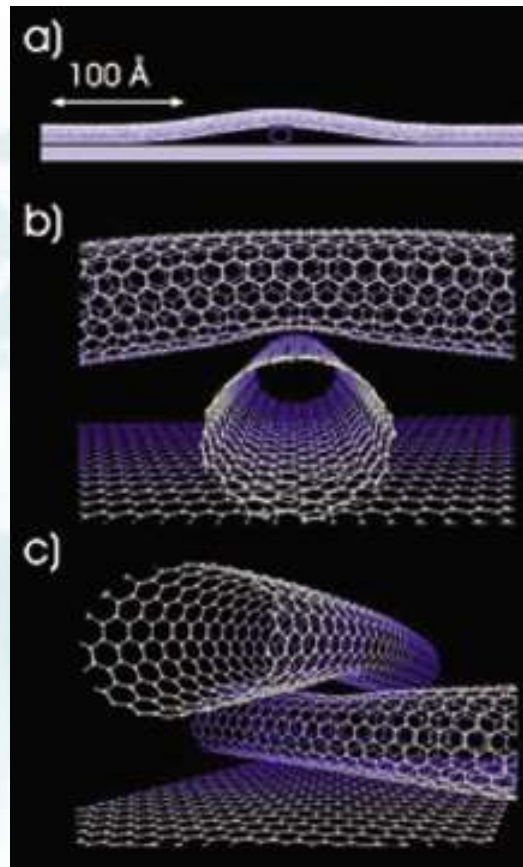


Figure 4-5



Contemporary Hardware Trends

- **Cloud Computing:**

- A model of computing in which firms and individuals obtain computing resources over the Internet
 - Cloud infrastructure as a service
 - Cloud platform as a service
 - Cloud software as a service

- **Autonomic computing:**

- Development of systems that can configure themselves, heal themselves; e.g., self-updating antivirus software

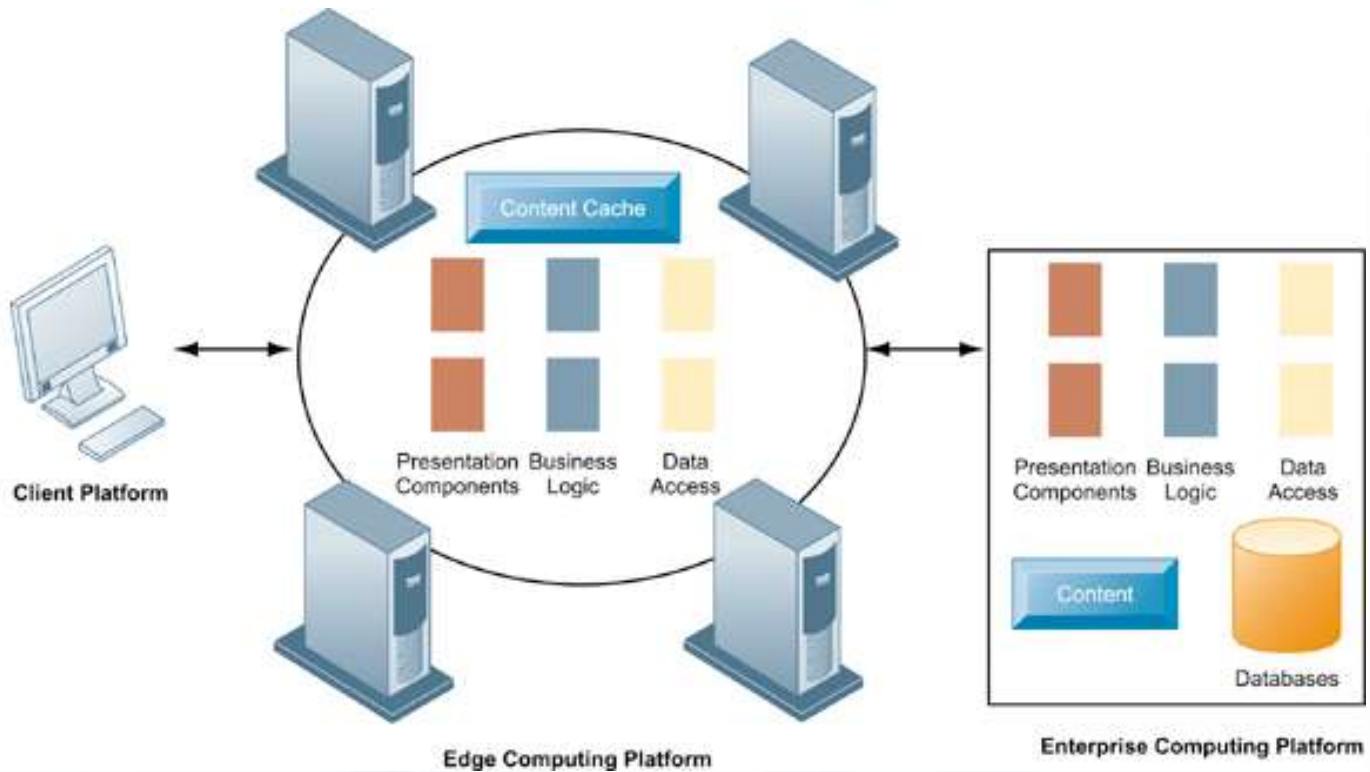


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IT Infrastructure: Computer Software

Edge Computing Platform



Edge computing involves the use of the Internet to balance the processing load of enterprise platforms across the client and edge computing platform.

Figure 4-6



Contemporary Hardware Trends

- **Virtualization:**
 - Process of presenting a set of computing resources so they can be accessed in ways that are unrestricted by physical configuration or geographic location
 - **Server virtualization:** running more than one operating system at the same time on single machine.



Contemporary Hardware Trends

- **Multicore processors:**
 - Integrated circuit with two or more processors
 - Enhanced performance, reduced power consumption, and more efficient simultaneous processing of multiple tasks



Operating System Software

- **The software that manages and controls the computer's activities**
- **PC operating systems and graphical user interfaces**
 - **GUIs**
 - **Windows XP, Windows Vista, and Windows Server 2003**
 - **UNIX**
 - **Linux**
 - **Open-source software**



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IT Infrastructure: Computer Software

The Major Types of Software

The relationship among the system software, application software, and users can be illustrated by a series of nested boxes. System software—consisting of operating systems, language translators, and utility programs—controls access to the hardware. Application software, including programming languages and “fourth-generation” languages, must work through the system software to operate. The user interacts primarily with the application software.

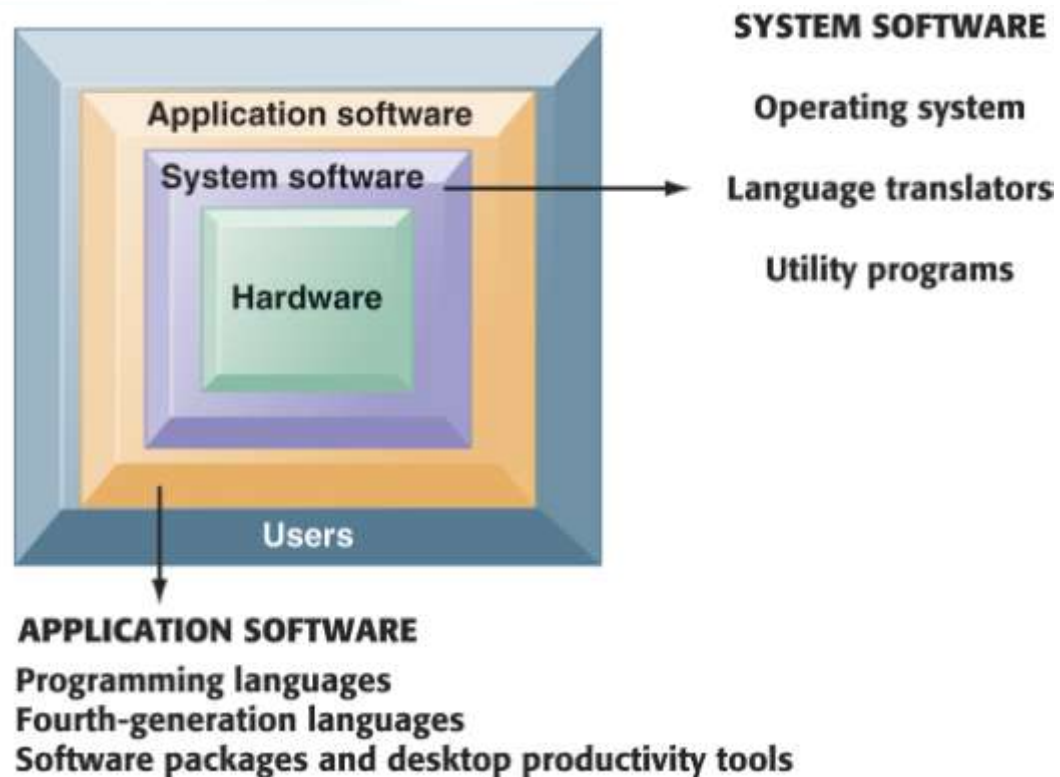


Figure 4-7



Application Software and Desktop Productivity Tools

- **Application programming languages for business**
 - COBOL
 - C, C++
 - Visual Basic: Visual programming language
- **Fourth-generation languages**
 - Software tools that enable end-users to develop software applications
 - Tend to be nonprocedural, may use natural languages



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Categories of Fourth-Generation Languages

Tool	Description	Example
PC software tools	General-purpose software packages for PCs	WordPerfect Microsoft Access
Query language	Languages for retrieving data stored in databases or files	SQL
Report generator	Specialized tools for creating highly customized reports	Crystal Reports
Graphics language	Display data from databases in graphic format	SAS Graph Systat
Application generator	Preprogrammed modules to generate entire applications	FOCUS QuickBase
Application software package	Software programs that eliminate need for custom, in-house software	Oracle PeopleSoft HCM mySAP ERP



Application Software and Desktop Productivity Tools

- **Software packages and desktop productivity tools**
 - **Word processing software**
 - **Spreadsheet software**
 - **Data management software**
 - **Presentation graphics**
 - **Software suites**
 - **Web browsers**



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Spreadsheet Software

Figure 4-8

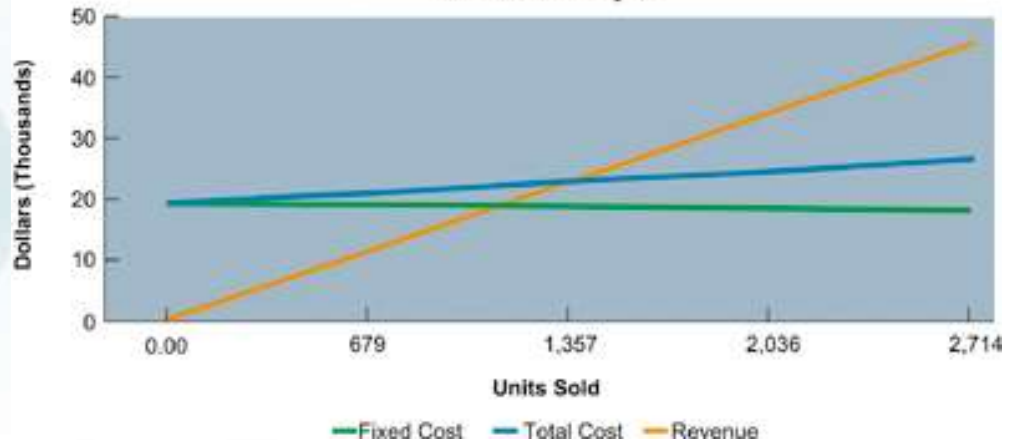
Spreadsheet software organizes data into columns and rows for analysis and manipulation. Contemporary spreadsheet software provides graphing abilities for a clear, visual representation of the data in the spreadsheets. This sample break-even analysis is represented as numbers in a spreadsheet as well as a line graph for easy interpretation.

Total fixed cost	19,000.00
Variable cost per unit	3.00
Average sales price	17.00
Contribution margin	14.00
Break-even point	1,357

Custom Neckties Pro Forma Income Statement

	0.00	679	1,357	2,036	2,714
Units sold					
Revenue	0	11,536	23,071	34,607	46,143
Fixed cost	19,000	19,000	19,000	19,000	19,000
Variable cost	0	2,036	4,071	6,107	8,143
Total cost	19,000	21,036	23,071	25,107	27,143
Profit/Loss	(19,000)	(9,500)	0	9,500	19,000

Custom Neckties
Break-even Analysis





Software for the Web: Java, AJAX, and HTML

- **Java:**
 - Operating system-independent, processor-independent, object-oriented programming language
- **AJAX:**
 - Allows a client and server to exchange data behind the scenes to avoid reloading a Web page after each change
- **Hypertext markup language (HTML):**
 - Page description language for specifying how elements are placed on a Web page and for creating links to other pages and objects



Web Services

- **Web services:**
 - Software components that exchange information with one another using universal Web communication standards and languages
 - **XML (extensible markup language)**
 - **SOAP** (simple object access protocol)
 - **WSDL** (Web services description language)
 - **UDDI** (universal description, discovery, and integration)
 - **Service oriented architecture (SOA)**



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IT Infrastructure: Computer Software

How Dollar Rent-A-Car Uses Web Services

Dollar Rent-A-Car uses Web services to provide a standard intermediate layer of software to “talk” to other companies’ information systems. Dollar Rent-A-Car can use this set of Web services to link to other companies’ information systems without having to build a separate link to each firm’s systems.

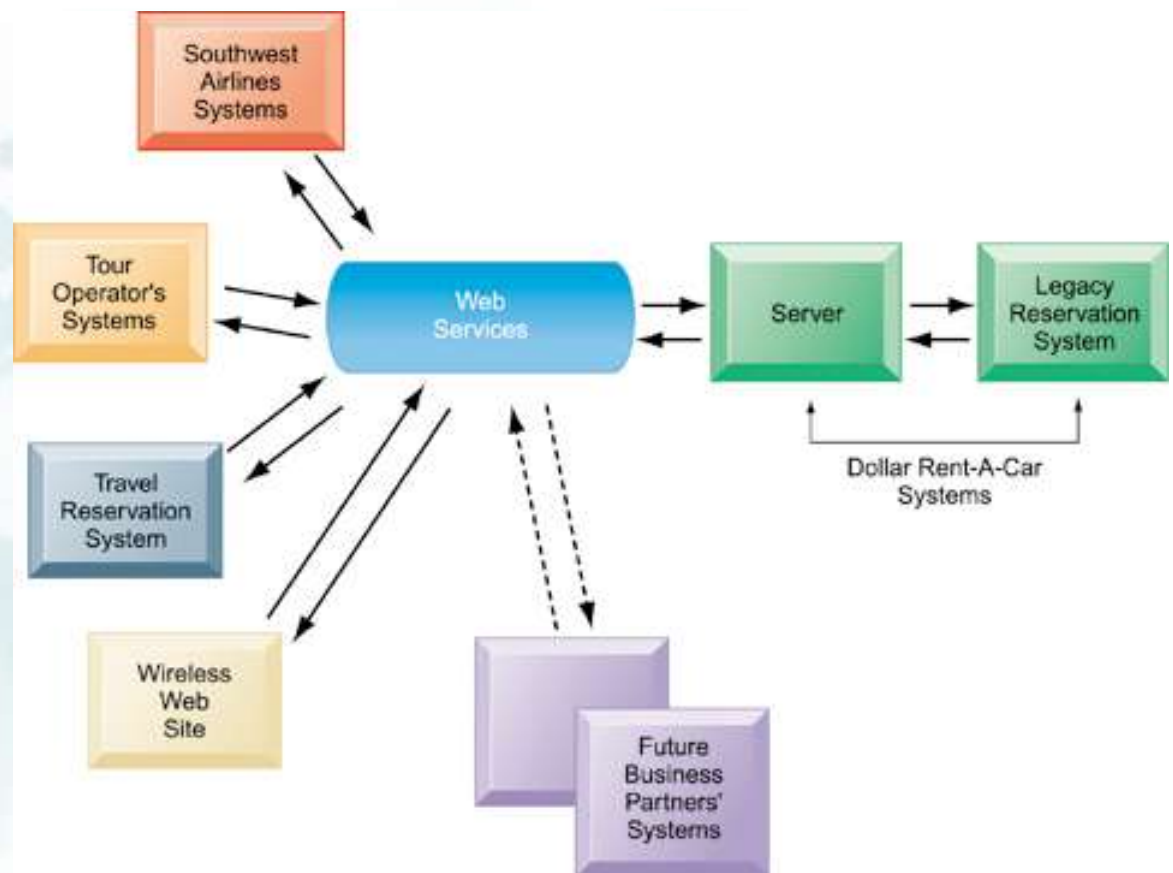


Figure 4-9



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Software Trends

- **Open Source Software**
 - Linux, Apache
- **Cloud Computing**
 - Google Apps, Office Web Apps
- **Mashups**
 - Faceforce, ZipRealty, BidNearBy
- **Widgets**
 - Apple Dashboard, Yahoo! Weather
- **Software as a Service (SaaS)**
 - Salesforce.com



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Managing Hardware and Software Technology

- **Capacity planning**
 - Process of predicting when hardware system becomes saturated
 - Ensuring firm has enough computing power for current and future needs
 - **Factors include:**
 - Maximum number of users
 - Impact of current, future software
 - Performance measures
- **Scalability:** ability of system to expand to serve large number of users without breaking down



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Managing Hardware and Software Technology

- **Total Cost of Ownership (TCO) model**
 - Used to analyze direct and indirect costs to help determine the actual cost of owning a specific technology
 - **Direct costs: hardware, software purchase costs**
 - **Indirect costs: ongoing administration costs, upgrades, maintenance, technical support, training, utility, and real estate costs**
 - **Hidden costs: support staff, downtime, additional network management**
 - TCO can be reduced through increased centralization, standardization of hardware and software resources.



Managing Hardware and Software Technology

- **Using technology service providers**
 - **Outsourcing**
 - Using external provider to:
 - Run networks.
 - Host, manage Web site(s).
 - Develop software (**offshore software outsourcing**).
 - Manage IT infrastructures.
 - Requires **Service Level Agreements (SLAs)**



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Managing Hardware and Software Technology

- **Using cloud services**
 - Small businesses “rent” infrastructure from another firm to avoid expenses of maintaining hardware and software on their own.
 - Off-loading peak demand to remote data centers
- **Managing mobile platforms**
 - Balancing gains in productivity from using mobile devices with expenses of equipping employees with these devices
 - TCO for wireless devices ranges from \$1,000 to \$3,000



Managing Hardware and Software Technology

- **Managing software localization for global business**
 - Local language interfaces
 - English not typically standard at middle, lower levels
 - Interfaces are complex: menu bars, error messages, online forms, search results, and so on
 - Differences in local cultures
 - Differences in business processes
- All of these factors add to TCO of using technology service providers