IT Infrastructure: Hardware and Software

LEARNING OBJECTIVES

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

VIDEO CASES AND LEARNING TRACKS

Learning Tracks

1. How Computer Hardware and Software Work
2. Service Level Agreements
3. Cloud Computing
4. The Open Source Software Initiative
5. The Evolution of IT Infrastructure
6. Technology Drivers of IT Infrastructure

Video Cases

Case 2: ESPN.com: Getting to eXtreme Scale On the Web

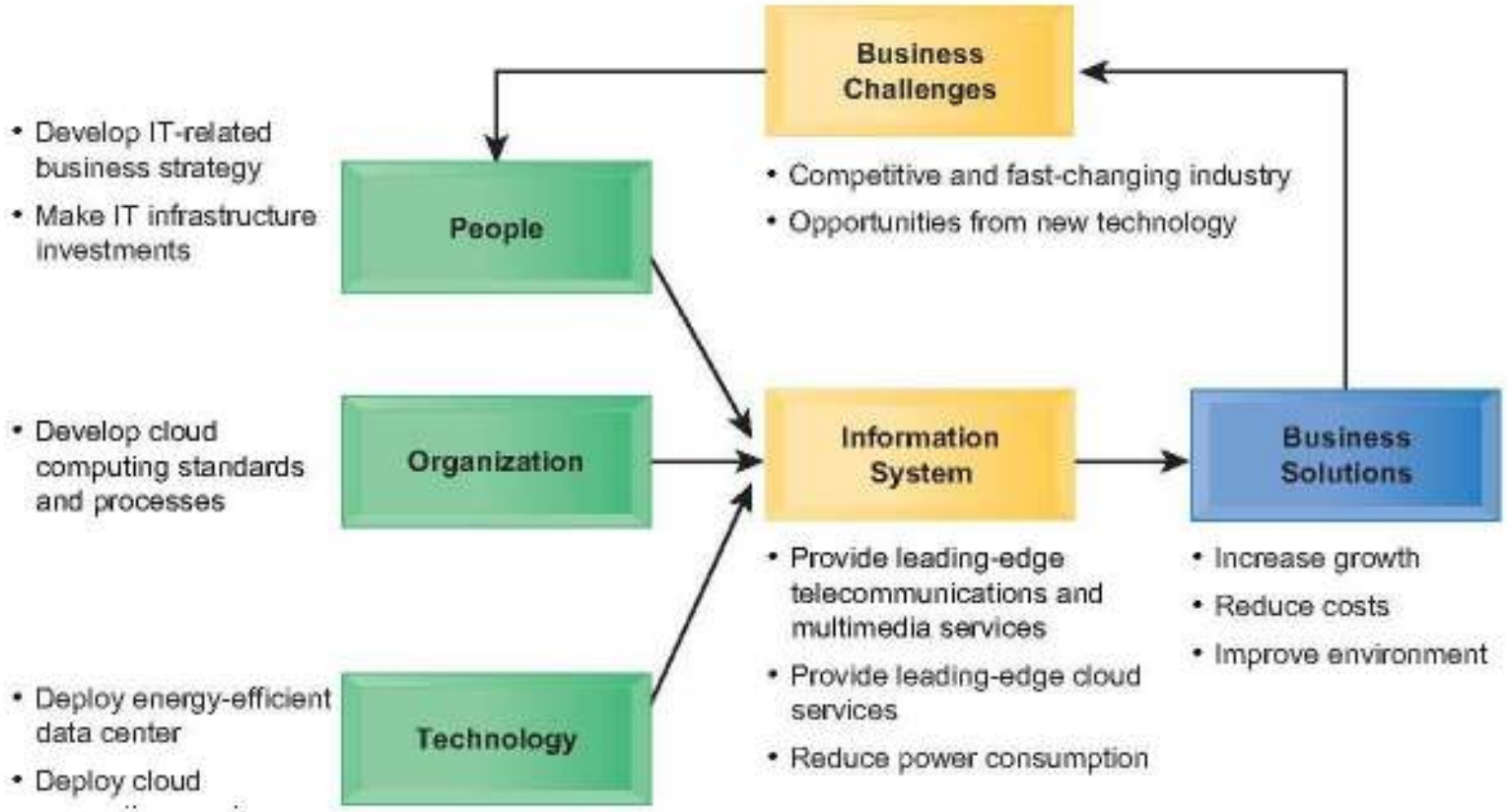
Case 1: Rockwell Automation fuels the oil and gas industry with the Internet of Things (IoT)

Instructional Video 1: IBM Blue Cloud Is Ready-to-Use Computing

Toyota Motor Europe Reaches for the Cloud

- **Problem:** Providing a consistent maintenance service to millions of customers
- **Solution:** Cloud-based computing service that manages onboard computers in Toyota vehicles
- Demonstrates IT's role in reducing costs and improving security and customer service

Toyota Motor Europe Reaches for the Cloud



What are the components of IT infrastructure?

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
    - Data centers
  - **Networking and telecommunications technology**
  - **Technology services**
    - E.g., consultants for systems integration with legacy systems

What are the components of IT infrastructure?

IT Infrastructure Components

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

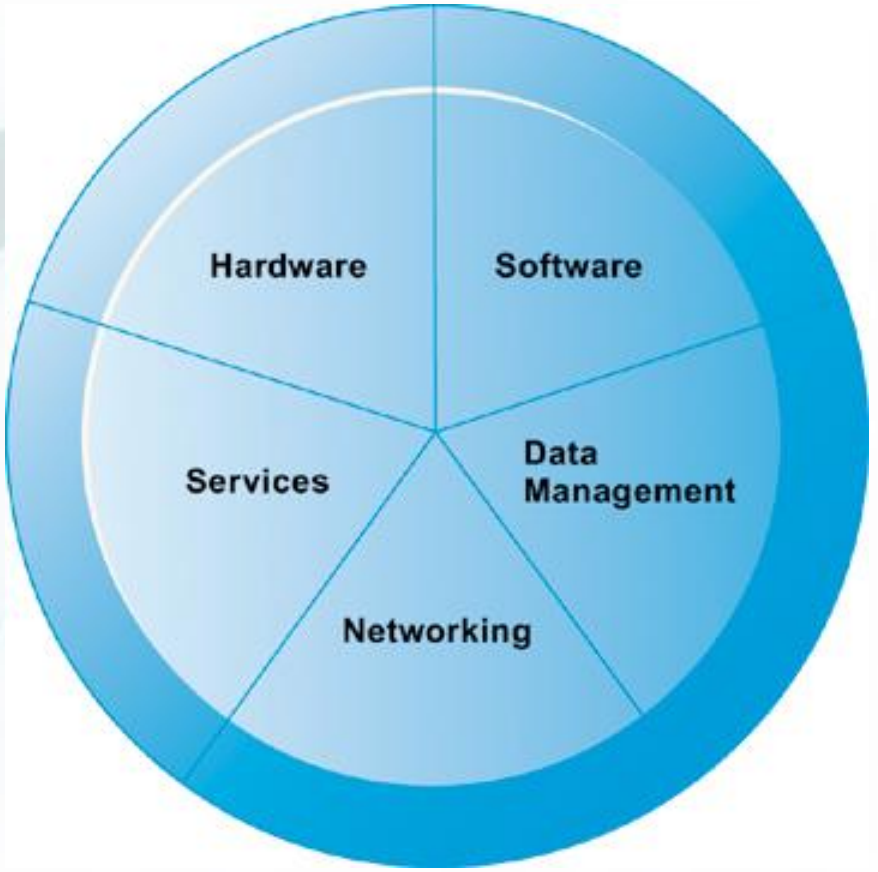


Figure 5.1

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Types of Computers

- **Computers come in different sizes with varying capabilities for processing information**
- **Personal computers**
- **Mobile devices (smartphones, tablets)**
- **Workstations**
  - More powerful mathematical and graphics-processing capabilities than a PC

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Types of Computers

- **Servers:**
  - 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 to handle thousands of reservations per second

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

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”

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

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

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Types of Computers

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

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

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.

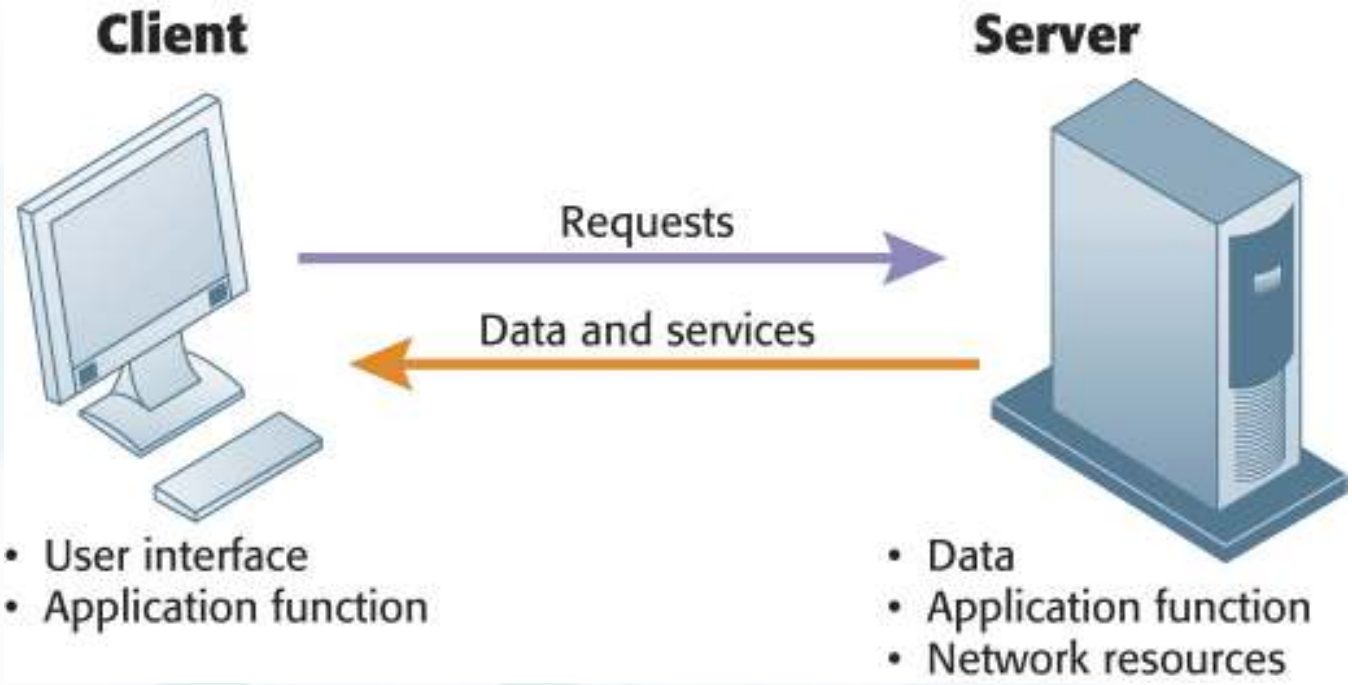
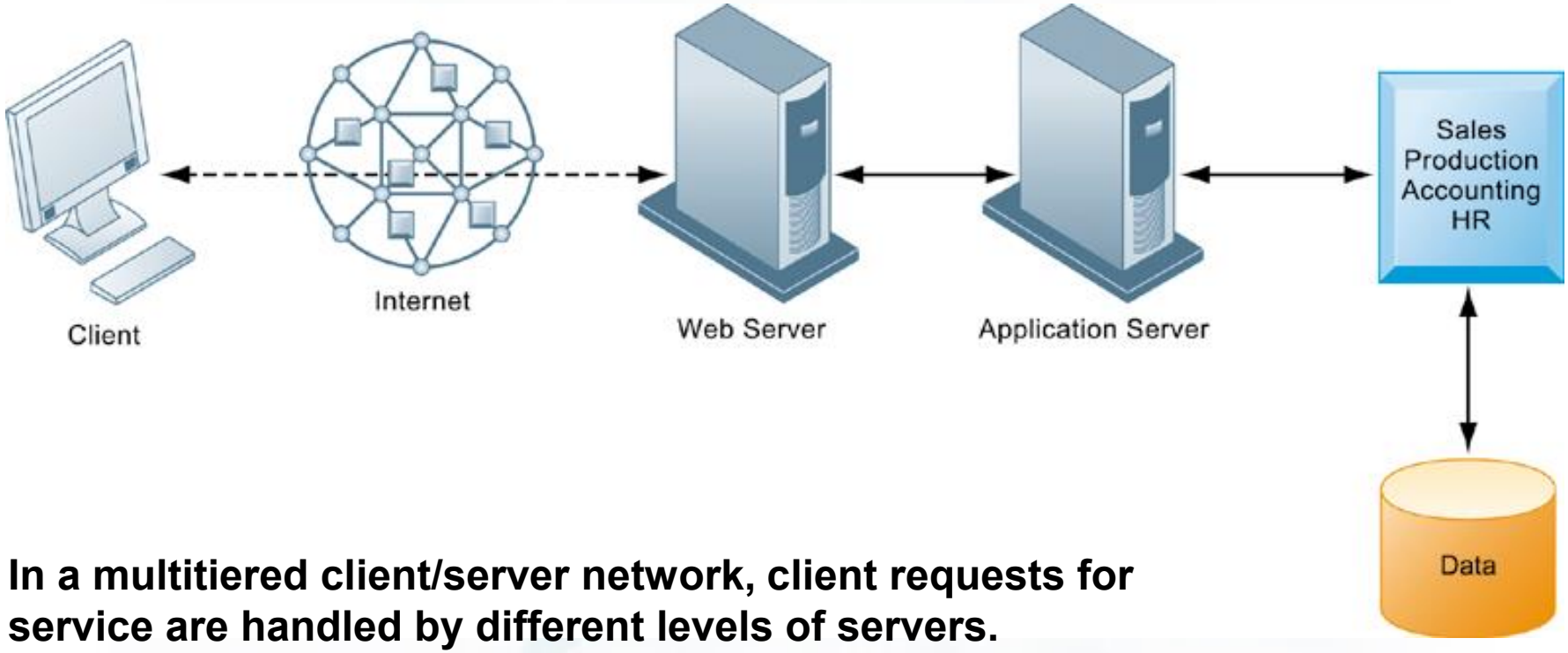


Figure 5.2

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

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 5.3

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Storage, Input, and Output Technology

- **Primary secondary storage technologies**
  - **Magnetic disk:**
    - Hard drives, USB flash drives
    - Solid state drives (SSDs)
  - **Optical disks**
    - CD-ROM, CD-RW, DVD, DVD-RW
  - **Magnetic tape**
  - **Storage networking: SANs**
    - **Connect multiple storage devices on a separate high-speed network dedicated to storage**

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

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.

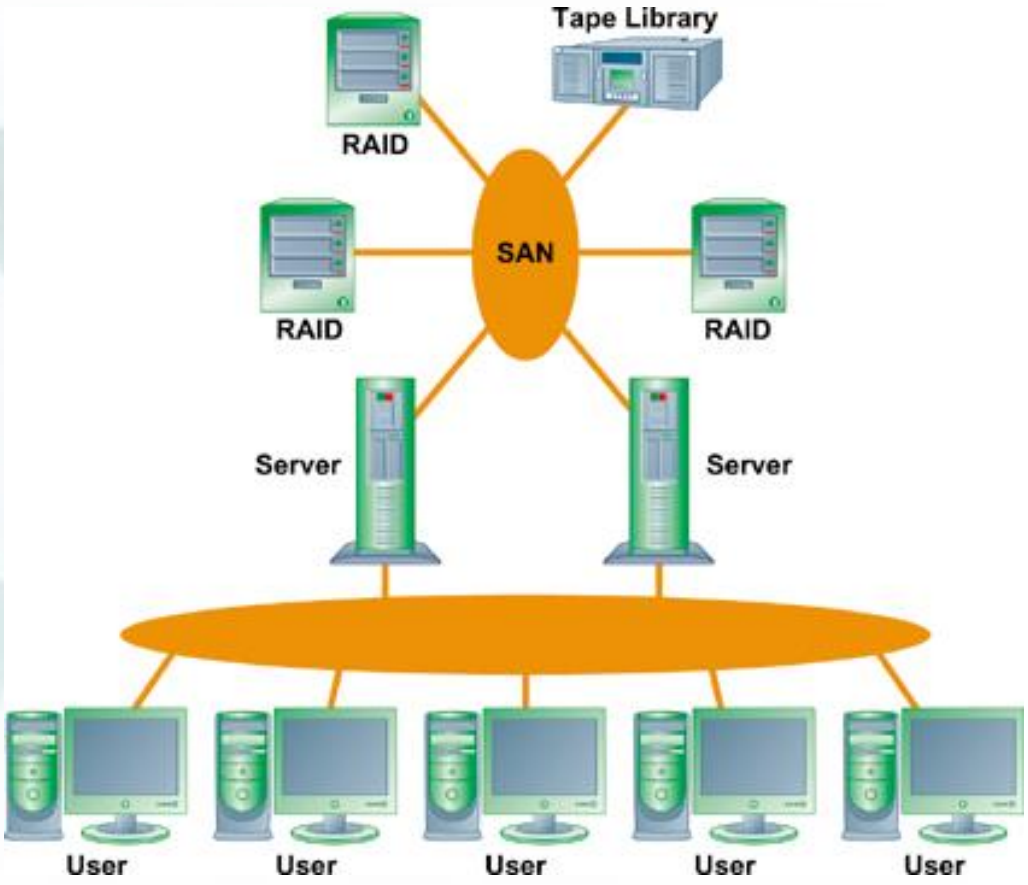


Figure 5.4

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Storage, Input, and Output Technology

- **Input devices:**
  - Gather data and convert them into electronic form.
    - Keyboard, computer mouse, touch screen, pen-based input, optical character recognition, magnetic ink character recognition, digital scanner, audio input, sensors
- **Output devices:**
  - Display data after they have been processed
    - Monitor (flat-panel, CRT)
    - Printer (impact, nonimpact)
    - Audio output

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Contemporary Hardware Trends

- **The mobile digital platform**
  - Mobile devices, smartphone
  - Netbooks and tablet computers
  - E-book readers
- **Consumerization of IT**
  - New technology that emerges in consumer market spreads into business organizations
  - BYOD (bring your own device): business use of personal mobile devices

Interactive Session: Management
The Greening of the Data Center

- **Read the Interactive Session and then discuss the following questions:**

- What business and social problems does data center power consumption cause?
- What solutions are available for these problems? Are they management, organizational, or technology solutions? Explain your answer.
- What are the business benefits and costs of these solutions?
- Should all firms move toward green computing? Why or why not?

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

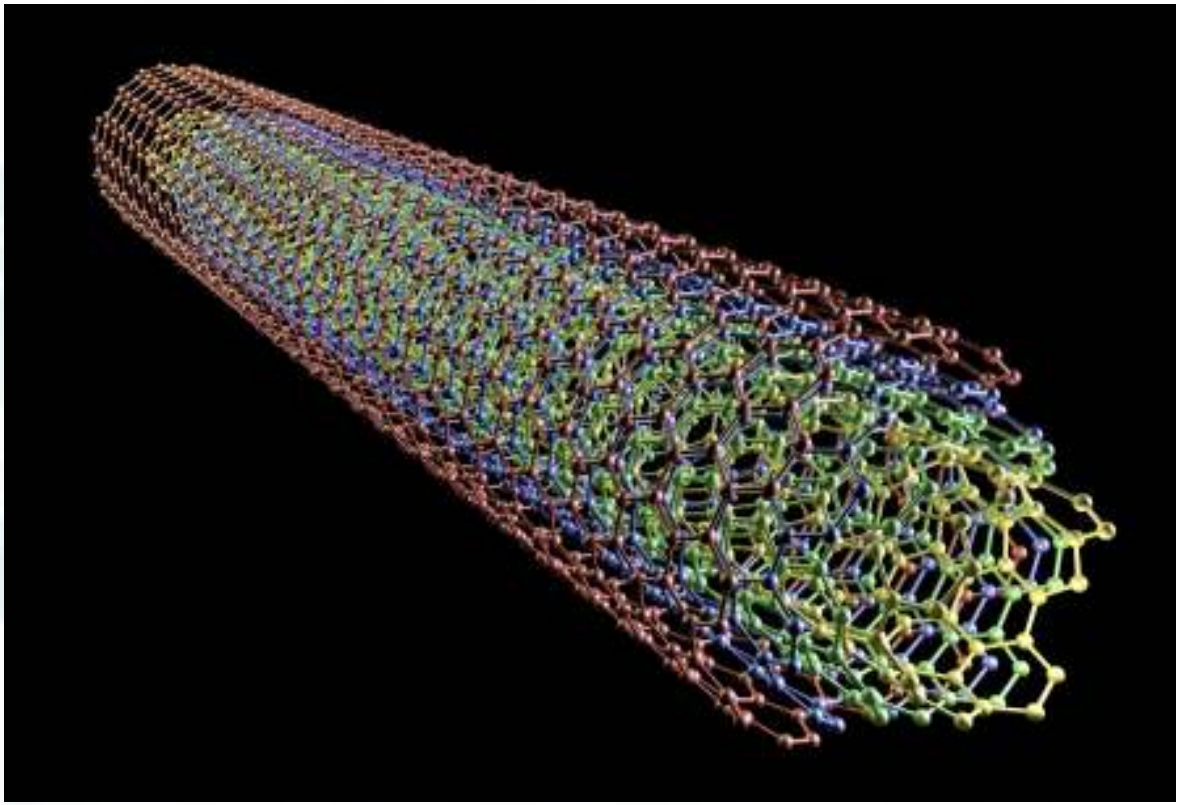
Contemporary Hardware Trends

- **Nanotechnology**
  - Uses individual atoms and molecules to create computer chips and other devices thousands for times smaller than current technologies
- **Quantum computing**
  - Uses principles of quantum physics to represent data and perform operations on the data
  - Enables processing times that are millions of times faster than current high-speed processing

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

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.



What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

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
  - Enables single physical resource to appear to the user as multiple resources
  - Enables companies to host multiple systems on single machine

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

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 (IaaS)
    - Cloud platform as a service
    - Cloud software as a service (SaaS)
  - Public vs. private clouds
  - Utility computing, on-demand computing
  - Data storage security is in hands of provider

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Cloud Computing Platform

In cloud computing, hardware and software capabilities are provided as services over the Internet. Businesses and employees have access to applications and IT infrastructure anywhere at any time using an Internet-connected device.

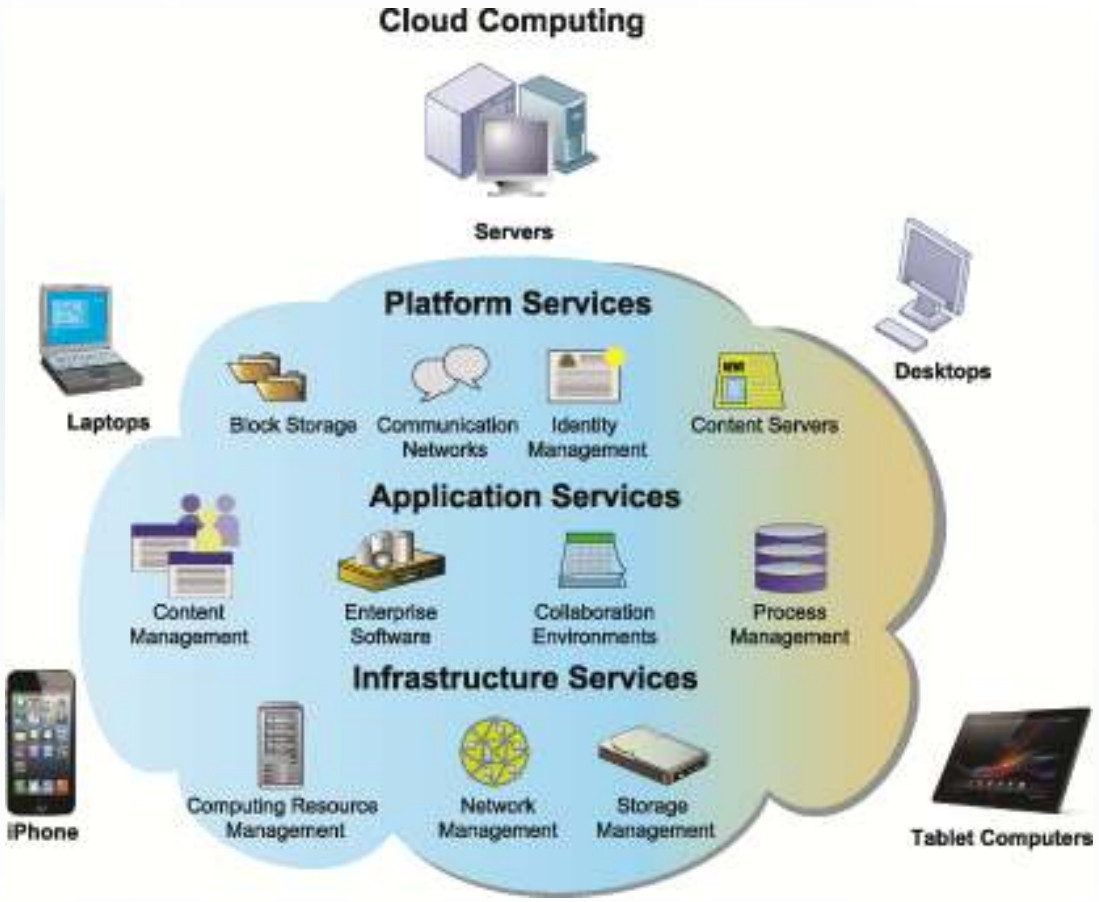


Figure 5.5

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Amazon Web Services (AWS) is a collection of web services that Amazon provides to users of its cloud platform. AWS is the largest provider of cloud-based services in the United States.

Figure 5.6

Interactive Session: Cloud Computing Is the Future

Read the Interactive Session and then discuss the following questions:

- **What business benefits do cloud computing services provide? What problems do they solve?**
- **What are the disadvantages of cloud computing?**
- **What kinds of businesses are most likely to benefit from using cloud computing? Why?**

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Contemporary Hardware Trends

- **Green computing**
  - Practices and technologies for designing, making, using, and disposing of computer hardware to reduce environmental impact
  - Key priority is power reduction
  - IT in U.S. provides 2% of U.S. power demand and 2% of world's greenhouse gases

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Contemporary Hardware Trends

- **High-performance and power-saving processors**
  - Multicore processor:
    - Integrated circuit with two or more processors
    - Enhanced performance and reduced power consumption
  - Power-efficient processors
    - Low power consumption essential in mobile computing.

What are the major computer hardware, data storage, input, and output technologies used in business and the major hardware trends?

Contemporary Hardware Trends

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

What are the major types of computer software used in business and the major software trends?

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.

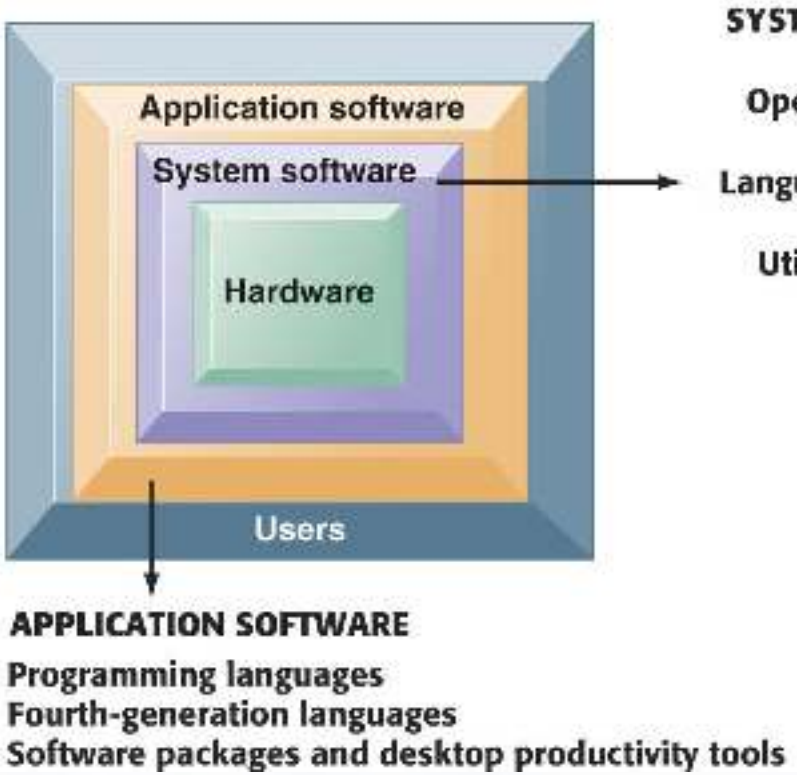


Figure 5.7

What are the major types of computer software used in business and the major software trends?

Operating System Software

- The software that controls computer activities
- GUIs and multitouch
- PC operating systems
  - Windows (Windows 8)
  - Mac (OSX Lion)
  - UNIX
  - Linux (open source)
- Mobile operating systems
  - Chrome, Android, iOS

What are the major types of computer software used in business and the major software trends?

Application Software and Desktop Productivity Tools

- **Programming languages for business**
  - C
  - C++ - newer, object-oriented version of C
  - Visual Basic: Visual programming language for MS Windows applications
  - Java: OS-independent object-oriented programming language
    - Migrated to mobile applications, game machines, cable TV systems
    - Java Virtual Machine

What are the major types of computer software used in business and the major software trends?

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

What are the major types of computer software used in business and the major software trends?

Spreadsheet Software

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

Units sold	0.00	679	1,357	2,036	2,714
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

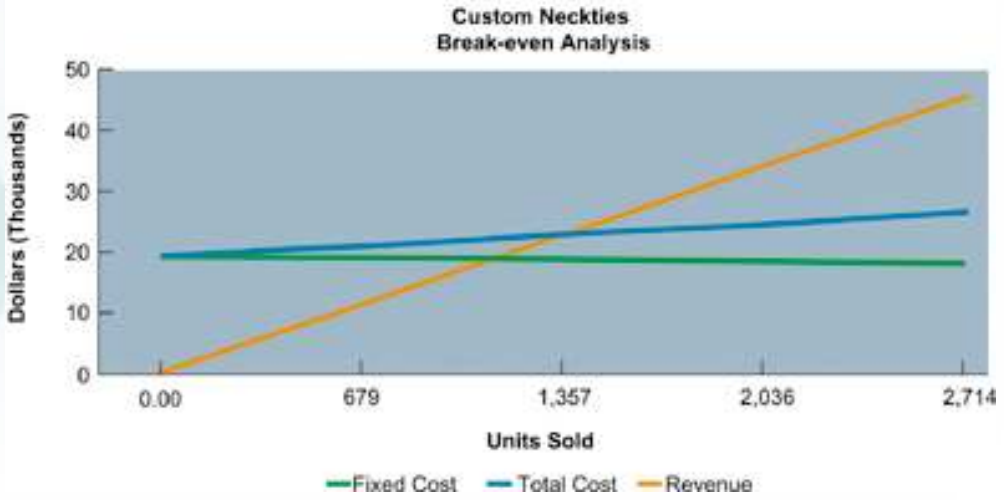


Figure 5.8

What are the major types of computer software used in business and the major software trends?

HTML and HTML5

- **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
- **HTML5**
  - Next evolution of HTML
  - Enables multimedia embedding without 3rd party plugins like Flash

What are the major types of computer software used in business and the major software trends?

Web Services

- **Web services:**
  - Software components that exchange information with one another using universal Web communication standards and languages
  - **XML (eXtensible Markup Language)**
    - Foundation of Web services
  - **Service oriented architecture (SOA)**
    - Collection of services used to build an organization's software systems

What are the major types of computer software used in business and the major software trends?

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.

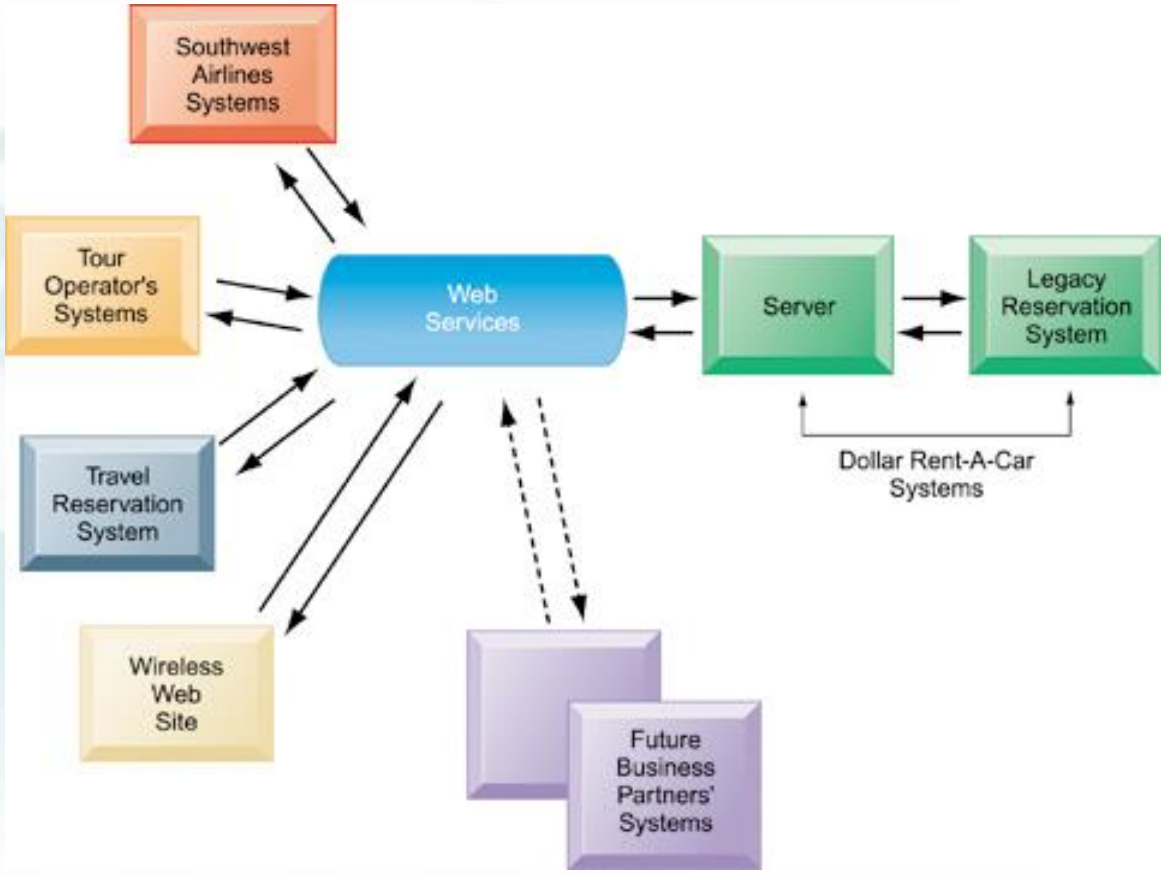


Figure 5.9

What are the major types of computer software used in business and the major software trends?

Software Trends

- **Open source software**
  - Linux, Apache
- **Cloud-based software and tools**
  - **SaaS** (software as a service)
    - Google Docs
  - **Mashups**
    - Zip Realty uses Google Maps and Zillow.com
  - **Apps**
    - Mobile apps

What are the principal issues in managing hardware and software technology?

Capacity Planning and Scalability

- **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

What are the principal issues in 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.

What are the principal issues in 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)

What are the principal issues in managing hardware and software technology?

- Using cloud services
  - Small businesses "rent" infrastructure from provider to avoid expenses of maintaining hardware and software on their own.
  - Hybrid cloud computing model
- Managing mobile platforms
  - Balancing gains in productivity from using mobile devices with expenses of equipping employees with these devices
  - Mobile device management (MDM) software

What are the principal issues in 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