LESSON 01

Information Systems in Global Business Today

Why Study Information Systems?

- After graduating, a management major might be hired to work with computerized employee files and records for a shipping company.
- A marketing major might work for a large retail store analyzing customer needs with a computer.
- An accounting major might work for an accounting or consulting firm using a computer to audit other companies' financial records.

Why Study Information Systems?

- A real estate major might use the internet and work within a loose organizational structure with clients, builders and a legal team located around the world.
- A biochemist could work for a large drug company and use a computer to analyze the potential for a new cancer drug.
- A lawyer might use information systems to develop contracts and other legal documents for their firm.

Why Study Information Systems?

- A production manager at a car company might oversee robots, a specialized information system that attach windscreen to cars or paint a body panels.
- A finance graduate (as a young stock trader) might use a system called a neural network to uncover patterns and make money trading stocks and stock options.
- If you are in the military, you might use computer simulation as a training tool to prepare for combat.

Why Study Information Systems?

- In a petroleum company, you might use an expert system to determine where to drill for oil and gas.

While your career might be deferent from your classmates', you will almost certainly be working with computers and information systems to help your organization become more efficient, effective, productive, and competitive in its industry.

The Role of Information Systems in Business Today

- **How information systems are transforming business**
  - Increase in wireless technology use, Web sites
  - Shifts in media and advertising
- **Globalization opportunities**
  - Internet has drastically reduced costs of operating on global scale
  - Presents both challenges and opportunities

The Role of Information Systems in Business Today

- **Business firms invest heavily in information systems to achieve six strategic business objectives:**
  - Operational excellence
  - New products, services, and business models
  - Customer and supplier intimacy
  - Improved decision making
  - Competitive advantage
  - Survival

The Role of Information Systems in Business Today

- **Operational excellence:**
  - Improvement of efficiency to attain higher profitability
  - Information systems, technology an important tool in achieving greater efficiency and productivity
  - Wal-Mart's RetailLink system links suppliers to stores for superior replenishment system
  - Ghana Customs & Excise and DVLA using GC Net has consolidated all processes and payments for clearing goods at the harbour and licensing a vehicle

The Role of Information Systems in Business Today

- **New products, services, and business models:**
  - Business model: describes how company produces, delivers, and sells product or service to create wealth
  - Information systems and technology a major enabling tool for new products, services, business models
    - Examples: Apple's iPod, iTunes, and iPhone, Netflix's Internet-based DVD rentals

The Role of Information Systems in Business Today

- **Customer and supplier intimacy:**
  - Serving customers well leads to customers returning, which raises revenues and profits
    - Example: High-end hotels that use computers to track customer preferences and use to monitor and customize environment
  - Intimacy with suppliers allows them to provide vital inputs, which lowers costs
    - Example: J.C.Penney's information system which links sales records to contract manufacturer

The Role of Information Systems in Business Today

- **Improved decision making**
  - Without accurate information:
    - Managers must use forecasts, best guesses, luck
    - Leads to:
      - Overproduction, underproduction of goods and services
      - Misallocation of resources
      - Poor response times
    - Poor outcomes raise costs, lose customers
  - Example: Verizon's Web-based digital dashboard to provide managers with real-time data on customer complaints, network performance, line outages, etc.

The Role of Information Systems in Business Today

- Operational excellence:
  - Improvement of efficiency to attain higher profitability
- New products, services, and business models:
  - Enabled by technology
- Customer and supplier intimacy:
  - Serving customers raises revenues and profits
  - Better communication with suppliers lowers costs
- Improved decision making
  - More accurate data leads to better decisions

The Role of Information Systems in Business Today

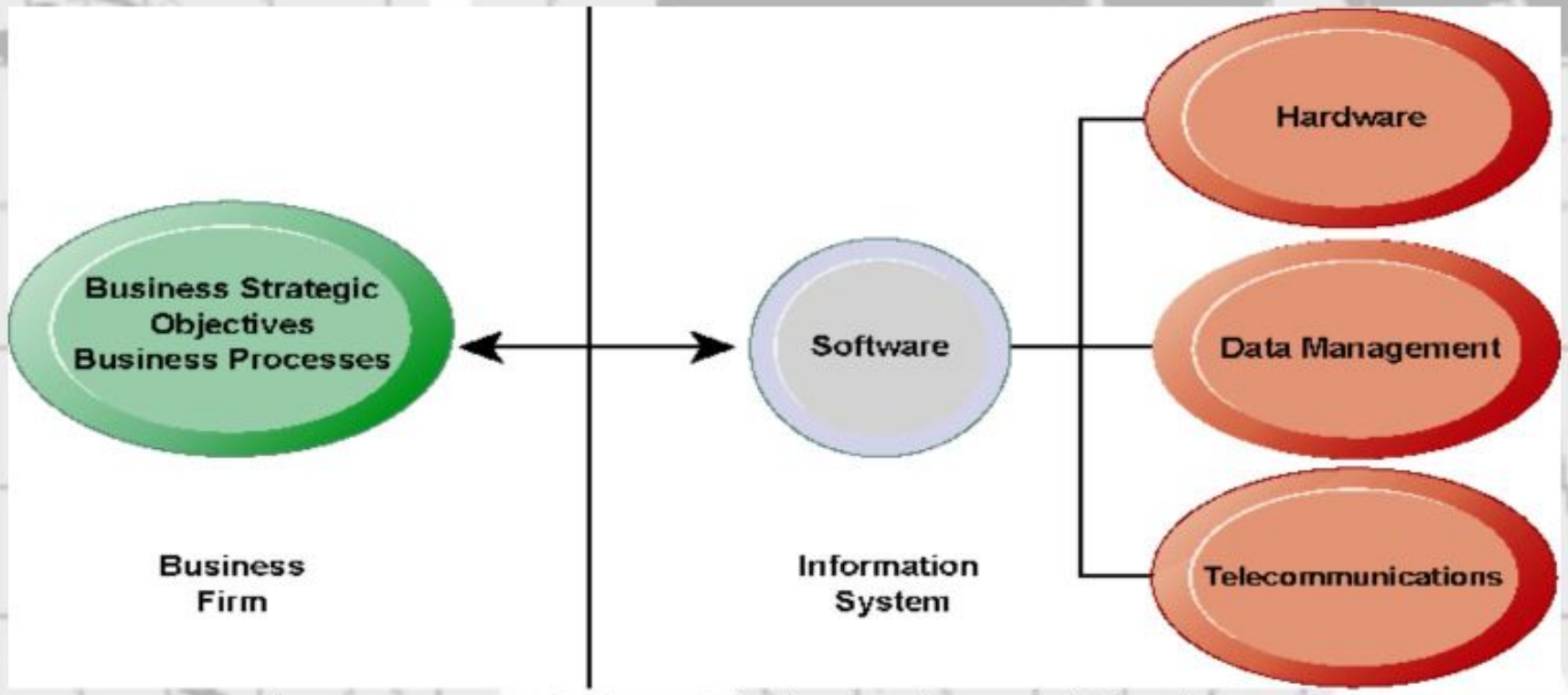
- **Competitive advantage**
  - Delivering better performance
  - Charging less for superior products
  - Responding to customers and suppliers in real time
  - Example: Toyota and TPS (Toyota Production System) enjoy a considerable advantage over competitors – information systems are critical to the implementation of TPS

The Role of Information Systems in Business Today

- Survival
  - Information technologies as necessity of business
  - May be:
    - Industry-level changes, e.g. Commercial bank's introduction of ATMs, Bank of Ghana's E-ZWICH
    - Governmental regulations requiring record-keeping
      - Examples: Toxic Substances Control Act, Sarbanes-Oxley Act

The Role of Information Systems in Business Today

The Interdependence Between Organizations and Information Technology



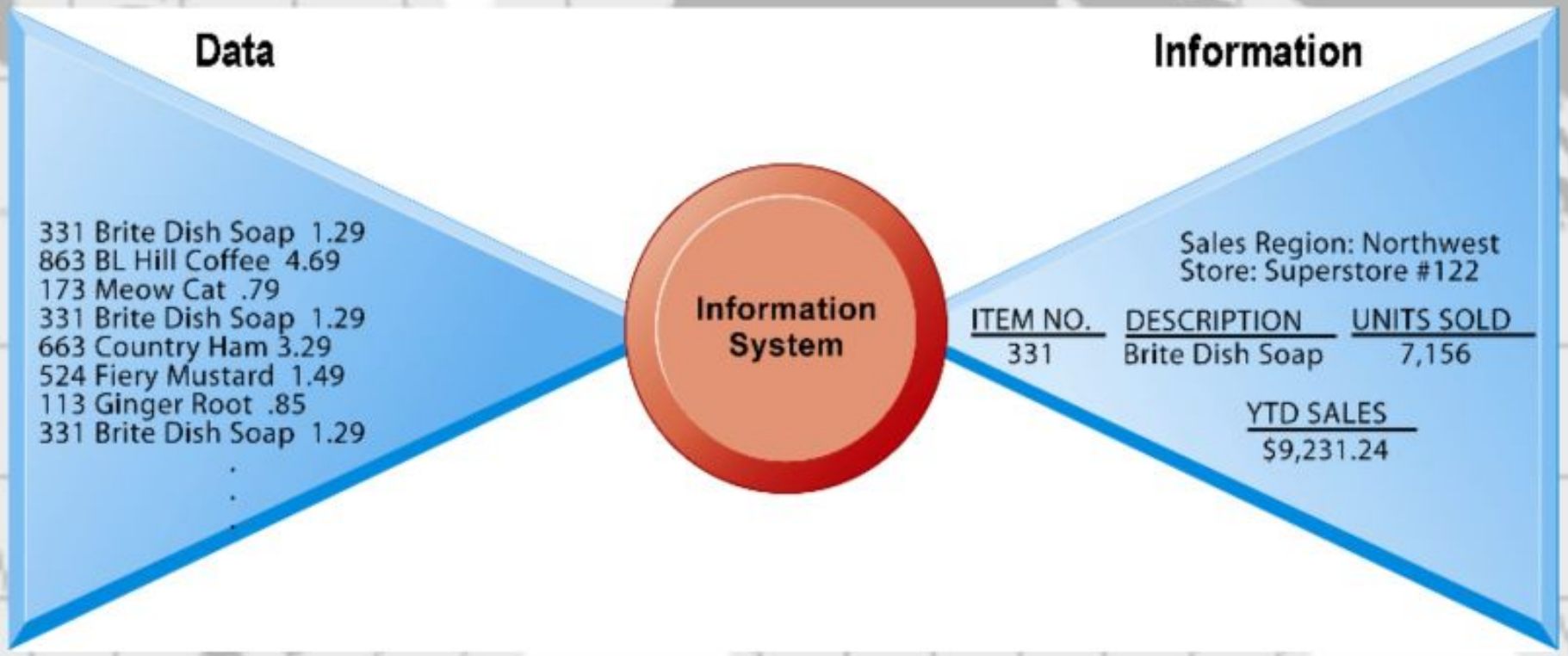
In contemporary systems there is a growing interdependence between a firm's information systems and its business capabilities. Changes in strategy, rules, and business processes increasingly require changes in hardware, software, databases, and telecommunications. Often, what the organization would like to do depends on what its systems will permit it to do.

Perspectives on Information Systems

- **Information system:**
  - Set of interrelated components that collect, process, store and distribute information used by/ support one or more business process
  - Support decision making, coordination, and control
- **Information vs. data**
  - Data are streams of raw facts
  - Information is data shaped into meaningful form

Perspectives on Information Systems

Data and Information



Raw data from a supermarket checkout counter can be processed and organized to produce meaningful information, such as the total unit sales of dish detergent or the total sales revenue from dish detergent for a specific store or sales territory.

Figure 1-3

Perspectives on Information Systems

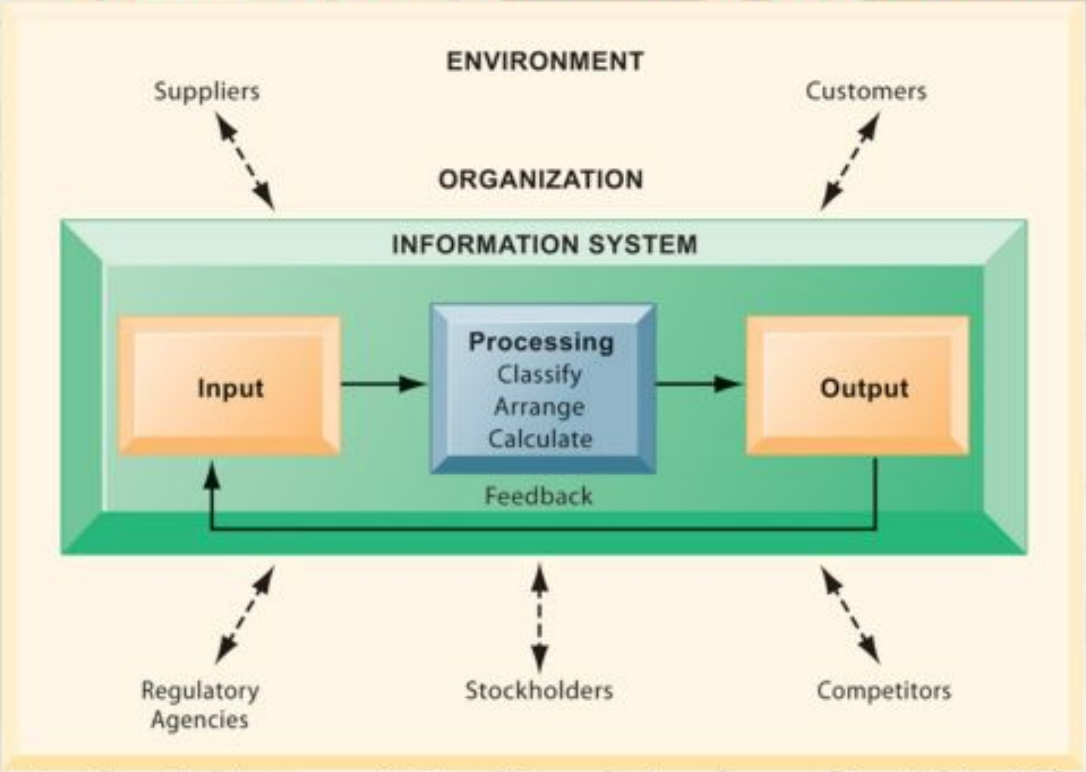
- **Information system:** Three activities produce information organizations need
  - **Input**: Captures raw data from organization or external environment
  - **Processing**: Converts raw data into meaningful form
  - **Output**: Transfers processed information to people or activities that use it

Perspectives on Information Systems

- **Feedback**:
  - Output returned to appropriate members of organization to help evaluate or correct input stage
  - Thus, the study of information systems, focuses on why and how technology can be put into best use to serve the information flow within an organization

Perspectives on Information Systems

Functions of an Information System



An information system contains information about an organization and its surrounding environment. Three basic activities—input, processing, and output—produce the information organizations need. Feedback is output returned to appropriate people or activities in the organization to evaluate and refine the input. Environmental actors, such as customers, suppliers, competitors, stockholders, and regulatory agencies, interact with the organization and its information systems.

Figure 1-4

Perspectives on Information Systems

- Information systems deal with the development, use and management of an organization's IT infrastructure.
- IT is a general term that describes any technology that helps to produce, manipulate, store, communicate, and/or disseminate information.
- IT is the hardware, telecommunications and software that make information systems possible.

Perspectives on Information Systems

Information Systems Are More Than Computers

Using information systems effectively requires an understanding of the organization, management, and information technology shaping the systems. An information system creates value for the firm as an organizational and management solution to challenges posed by the environment.

Figure 1-5

Perspectives on Information Systems

- **Organizational dimension of information systems.**
  - Separation of business functions
    - Sales and marketing
    - Human resources
    - Finance and accounting
    - Manufacturing and production
  - Unique business processes
  - Unique business culture
- **IT dept is the platform on which other depts stand to achieve their goals.**

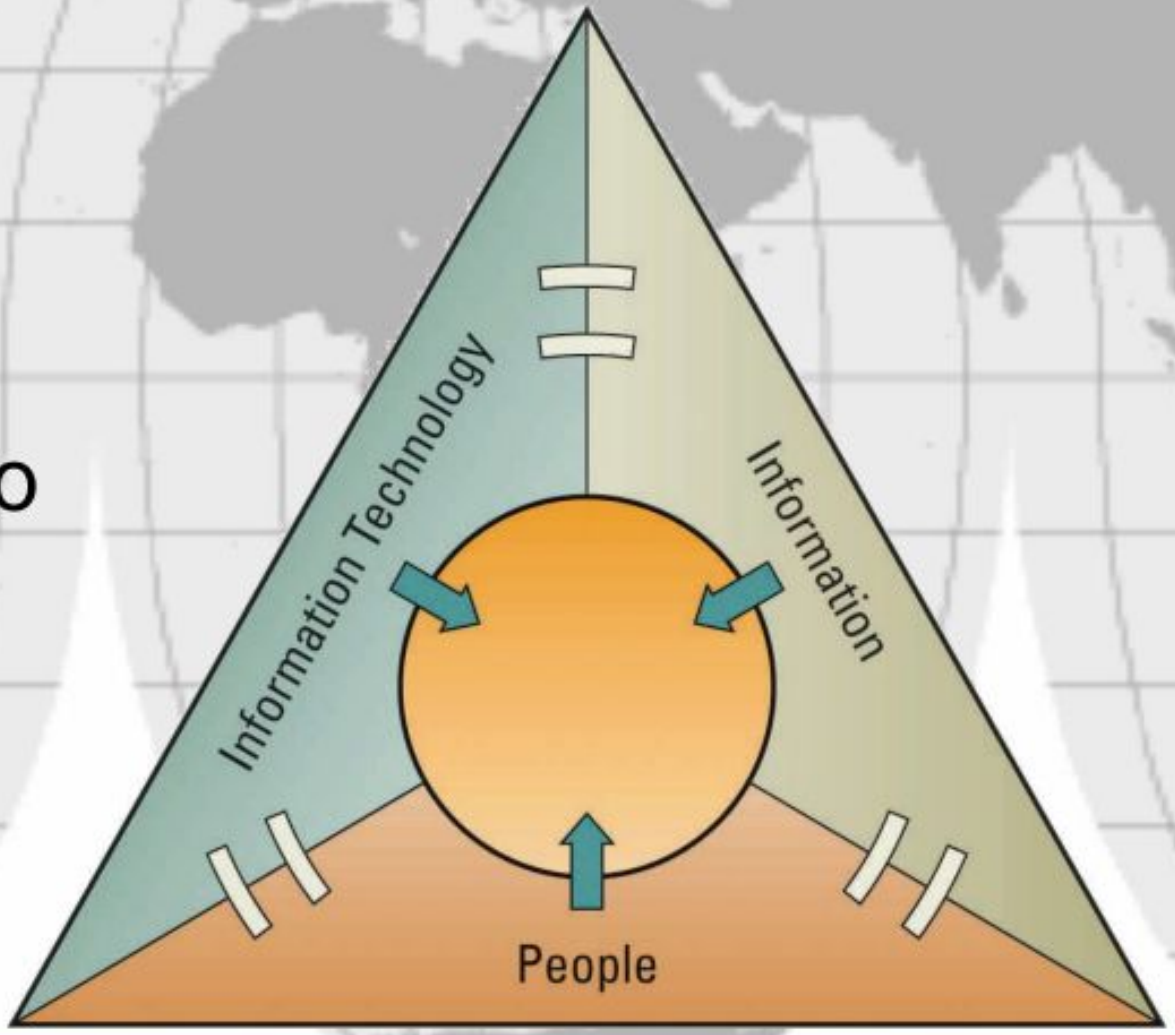
Perspectives on Information Systems

- **Technology dimension of information systems**
  - Computer hardware and software
  - Data management technology
  - Networking and telecommunications technology
    - Networks, the Internet, intranets and extranets, World Wide Web
  - IT infrastructure: provides platform that system is built on

IT Resources

Perspectives on Information Systems

- *People* use
- *Information technology* to work with
- *Information*



Perspectives on Information Systems

- **Business perspective on information systems:**
  - Information system is an instrument for creating value
  - Investments in information technology will result in superior returns:
    - Productivity increases
    - Revenue increases
    - Superior long-term strategic positioning

Perspectives on Information Systems

- **Business information value chain**
  - Raw data acquired and transformed through stages that add value to that information
  - Value of information system determined in part by extent to which it leads to better decisions, greater efficiency, and higher profits

- **Business perspective**:
  - Calls attention to organizational and managerial nature of information systems

Perspectives on Information Systems

- Investing in information technology does not guarantee good returns
- Considerable variation in the returns firms receive from systems investments
- Factors:
  - Adopting the right business model
  - Investing in complementary assets (organizational and management capital)

Perspectives on Information Systems

- **Complementary assets:**
  - Assets required to derive value from a primary investment
  - Firms supporting technology investments with investment in complementary assets receive superior returns
  - E.g.: invest in technology and the people to make it work properly

Perspectives on Information Systems

- **Complementary assets include:**
  - Organizational investments, e.g.
    - Appropriate business model
    - Efficient business processes
  - Managerial investments, e.g.
    - Incentives for management innovation
    - Teamwork and collaborative work environments
  - Social investments, e.g.
    - The Internet and telecommunications infrastructure
    - Technology standards

Contemporary Approaches to Information Systems

- **Management Information Systems**
  - Combines computer science, management science, operations research and practical orientation with behavioral issues
- **Four main actors**
  - Suppliers of hardware and software
  - Business firms
  - Managers and employees
  - Firm's environment (legal, social, cultural context)

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LESSON 02

Information Systems, Organizations, and Strategy

Chapter Outline

- Organizations and Information Systems
- How Information Systems Impact Organizations and Business Firms
- Using Information Systems to Achieve Competitive Advantage

Organizations and Information Systems

- Information technology and organizations influence one another
  - Complex relationship influenced by organization's structure, business processes, politics, culture, environment, and management decisions

Organizations and Information Systems

The Two-Way Relationship Between Organizations and Information Technology

This complex two-way relationship is mediated by many factors, not the least of which are the decisions made—or not made—by managers. Other factors mediating the relationship include the organizational culture, structure, politics, business processes, and environment.

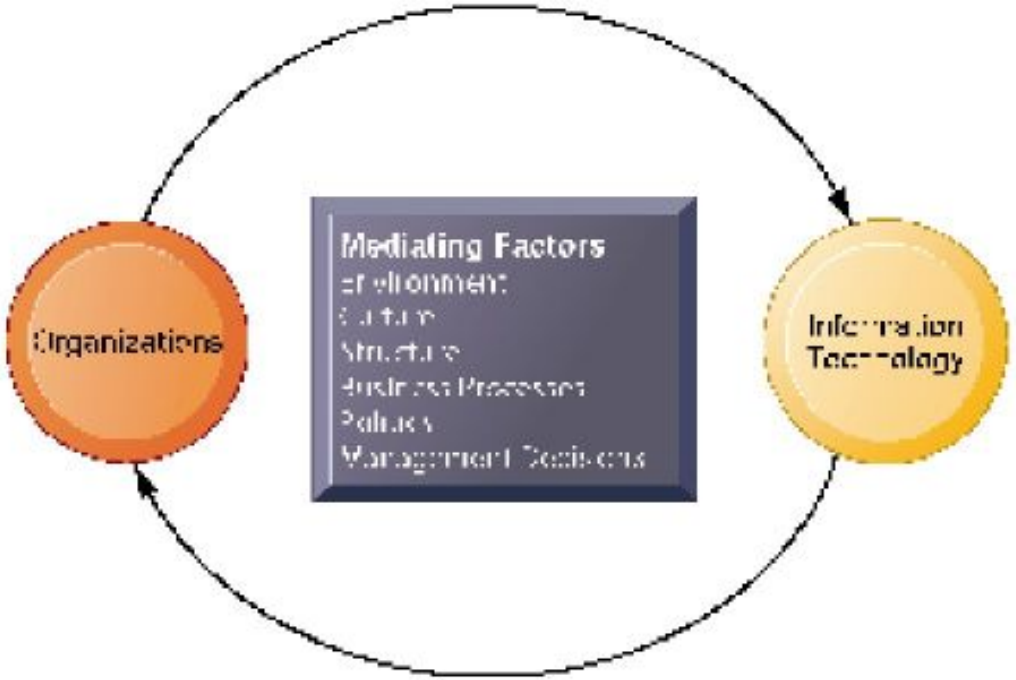


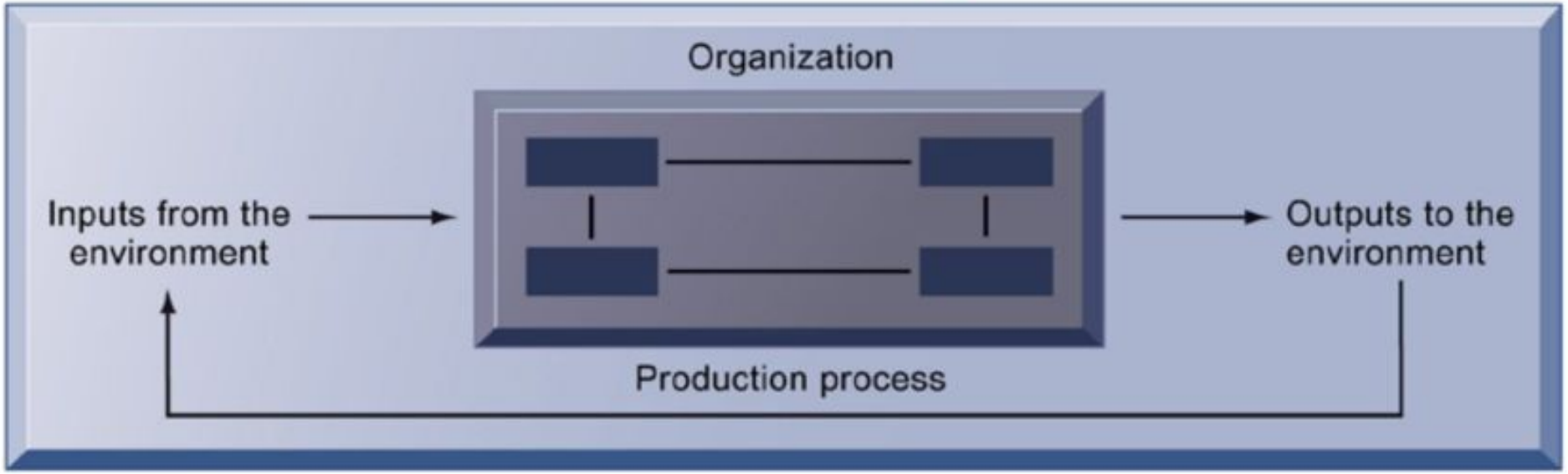
Figure 3-1

Organizations and Information Systems

- What is an organization?
  - Technical definition:
    - Stable, formal social structure that takes resources from environment and processes them to produce outputs
    - A formal legal entity with internal rules and procedures, as well as a social structure
  - Behavioral definition:
    - A collection of rights, privileges, obligations, and responsibilities that is delicately balanced over a period of time through conflict and conflict resolution

Organizations and Information Systems

The Technical Microeconomic Definition of the Organization

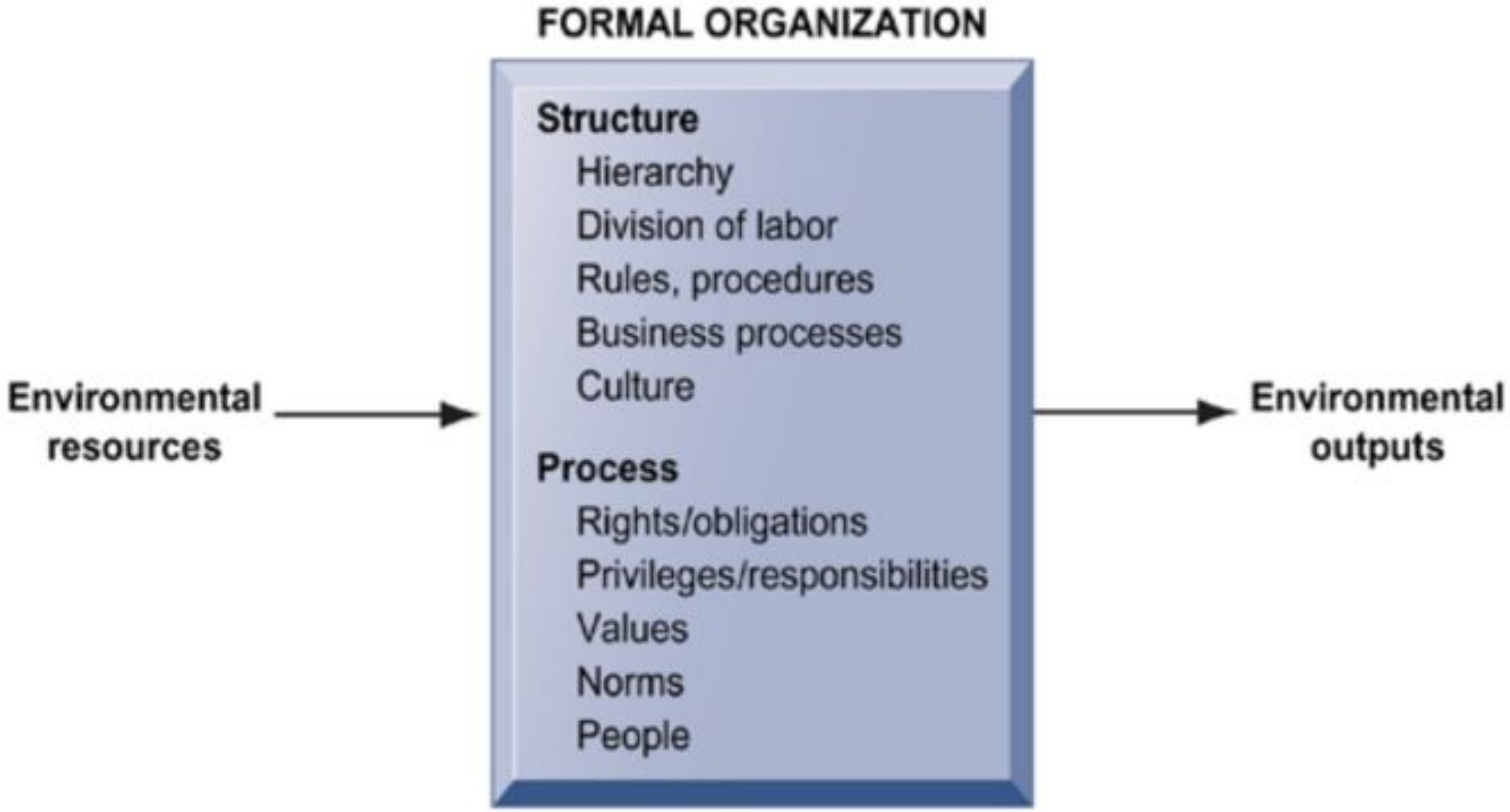


In the microeconomic definition of organizations, capital and labor (the primary production factors provided by the environment) are transformed by the firm through the production process into products and services (outputs to the environment). The products and services are consumed by the environment, which supplies additional capital and labor as inputs in the feedback loop.

Figure 3-2

Organizations and Information Systems

The Behavioral View of Organizations



The behavioral view of organizations emphasizes group relationships, values, and structures.

Figure 3-3

Organizations and Information Systems

- Features of organizations
  - All modern organizations share some characteristics, such as:
    - Use of hierarchical structure
    - explicit rules and procedures
    - technical qualifications for positions
    - Accountability, authority in system of impartial decision making
    - Adherence to principle of efficiency
    - Other features include: Routines and business processes and organizational politics, culture, environments and structures

Organizations and Information Systems

- Routines and business processes
  - Routines (standard operating procedures)
    - Precise rules, procedures, and practices developed to cope with virtually all expected situations
  - Business processes: Collections of routines
  - Business firm: Collection of business processes

Organizations and Information Systems

- Organizational politics
  - Divergent viewpoints lead to political struggle, competition, and conflict
  - Political resistance greatly hampers organizational change

Organizations and Information Systems

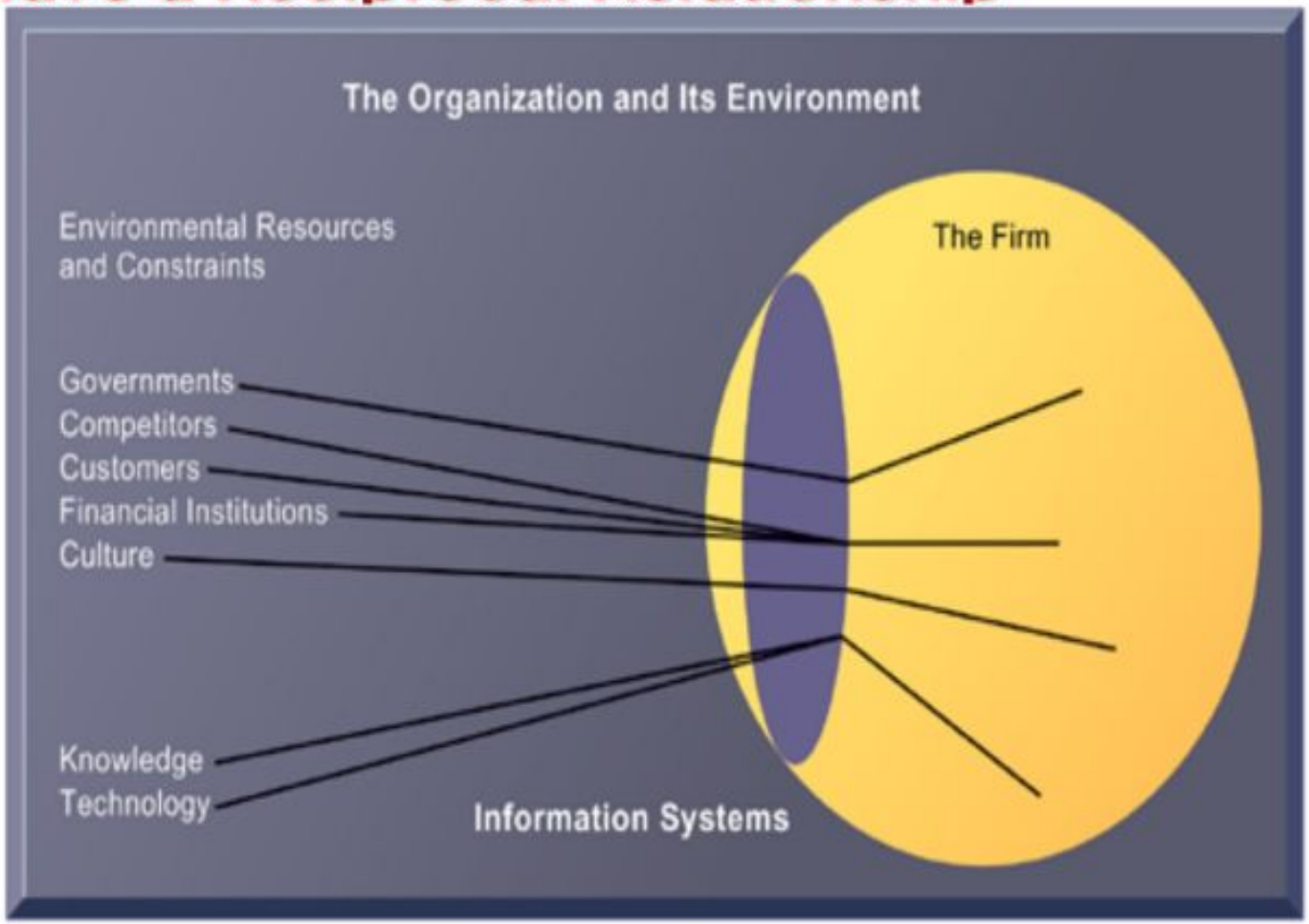
- Organizational culture:
  - Encompasses set of assumptions that define goal and product
    - What products the organization should produce
    - How and where it should be produced
    - For whom the products should be produced
  - May be powerful unifying force as well as restraint on change

Organizations and Information Systems

- **Organizational environments:**
  - Organizations and environments have a reciprocal relationship
  - Organizations are open to, and dependent on, the social and physical environment
  - Organizations can influence their environments
  - Environments generally change faster than organizations
  - Information systems can be instrument of environmental scanning, act as a lens

Environments and Organizations Have a Reciprocal Relationship

Environments shape what organizations can do, but organizations can influence their environments and decide to change environments altogether. Information technology plays a critical role in helping organizations perceive environmental change and in helping organizations act on their environment.



Organizations and Information Systems

• Organizations and Information Systems

- The organization's environment, culture, structure, standard operating procedures, politics and management decisions are mediating factors that influence the interaction between information technology and organizations.
- No two organizations are identical. Organizations have different structures, goals, constituencies, leadership styles, tasks, and surrounding environments. Differences in these characteristics will affect the type of information systems used by the organization.

Organizations and Information Systems

- Disruptive technologies
  - Technology that brings about sweeping change to businesses, industries, markets
  - Examples: personal computers, word processing software, the Internet, the PageRank algorithm
  - First movers and fast followers
    - First movers – inventors of disruptive technologies
    - Fast followers – firms with the size and resources to capitalize on that technology

Organizations and Information Systems

- Organizational structure
  - Five basic kinds of structure
    - Entrepreneurial: Small start-up business
    - Machine bureaucracy: Midsize manufacturing firm
    - Divisionalized bureaucracy: Fortune 500 firms
    - Professional bureaucracy: Law firms, school systems, hospitals
    - Adhocracy: Consulting firms

Organizations and Information Systems

- Other Organizational Features
  - Goals
  - Constituencies
  - Leadership styles
  - Tasks
  - Surrounding environments

How Information Systems Impact Organizations and Business Firms

- Economic impacts
  - IT changes relative costs of capital and the costs of information
  - Information systems technology is a factor of production, like capital and labor
  - IT affects the cost and quality of information and changes economics of information
    - Information technology helps firms contract in size because it can reduce transaction costs (the cost of participating in markets)
      - Outsourcing

How Information Systems Impact Organizations and Business Firms

- Transaction cost theory
  - Firms seek to economize on cost of participating in market (transaction costs)
  - IT lowers market transaction costs for firm, making it worthwhile for firms to transact with other firms rather than grow the number of employees

How Information Systems Impact Organizations and Business Firms

The Transaction Cost Theory of the Impact of Information Technology on the Organization

Firms traditionally grew in size to reduce transaction costs. IT potentially reduces transaction costs for a given size.

Figure 3-6

How Information Systems Impact Organizations and Business Firms

- **Agency theory:**
  - Firm is nexus of contracts among self-interested parties requiring supervision
  - Firms experience agency costs (the cost of managing and supervising) which rise as firm grows
  - IT can reduce agency costs, making it possible for firms to grow without adding to the costs of supervising, and without adding employees

How Information Systems Impact Organizations and Business Firms

The Agency Cost Theory of the Impact of Information Technology on the Organization

As firms grow in size and complexity, traditionally they experience rising agency costs.

Figure 3-7

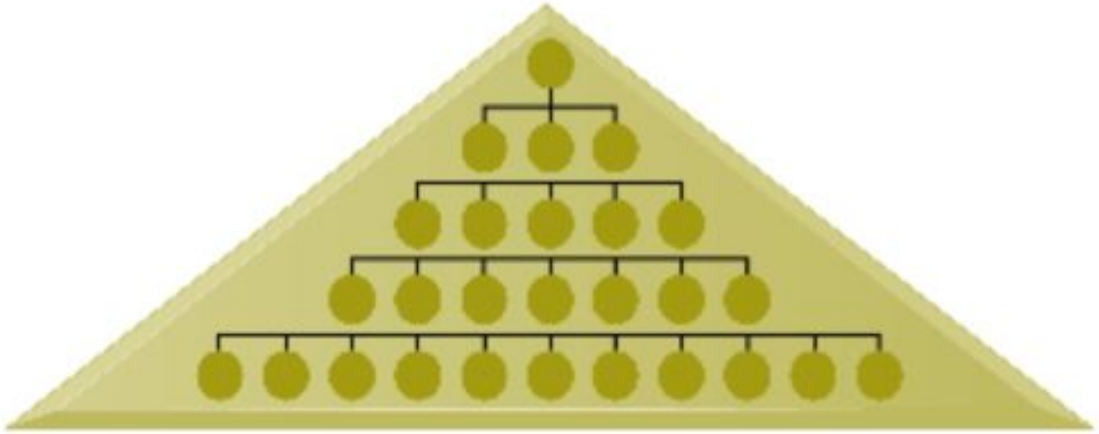
How Information Systems Impact Organizations and Business Firms

- **Organizational and behavioral impacts**
  - IT flattens organizations
    - Decision making pushed to lower levels
    - Fewer managers needed (IT enables faster decision making and increases span of control)
  - Postindustrial organizations
    - Organizations flatten because in postindustrial societies, authority increasingly relies on knowledge and competence rather than formal positions
    - With IT, competent workers will be able to accomplish more on their own than they would under a more concrete hierarchy

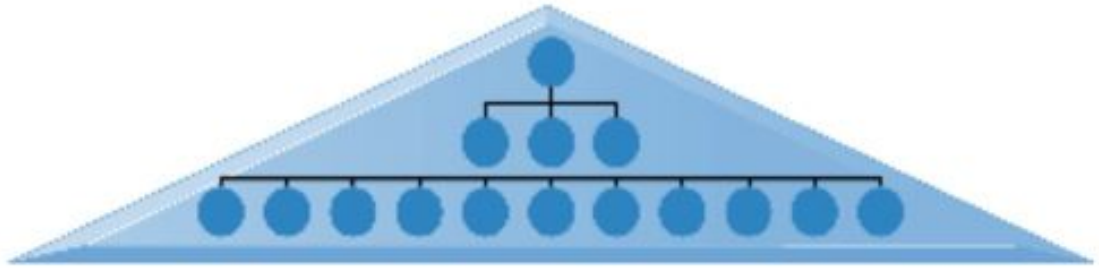
How Information Systems Impact Organizations and Business Firms

Flattening Organizations

Information systems can reduce the number of levels in an organization by providing managers with information to supervise larger numbers of workers and by giving lower-level employees more decision-making authority.



A traditional hierarchical organization with many levels of management



An organization that has been "flattened" by removing layers of management

How Information Systems Impact Organizations and Business Firms

- Organizational resistance to change
  - Information systems become bound up in organizational politics because they influence access to a key resource – information
  - Information systems potentially change an organization's structure, culture, politics, and work
  - Most common reason for failure of large projects is due to organizational and political resistance to change

How Information Systems Impact Organizations and Business Firms

- The Internet and organizations
  - The Internet increases the accessibility, storage, and distribution of information and knowledge for organizations
  - The Internet can greatly lower transaction and agency costs
    - Example: Large firm delivers internal manuals to employees via corporate Web site, saving millions of dollars in distribution costs

Using Information Systems to Achieve Competitive Advantage

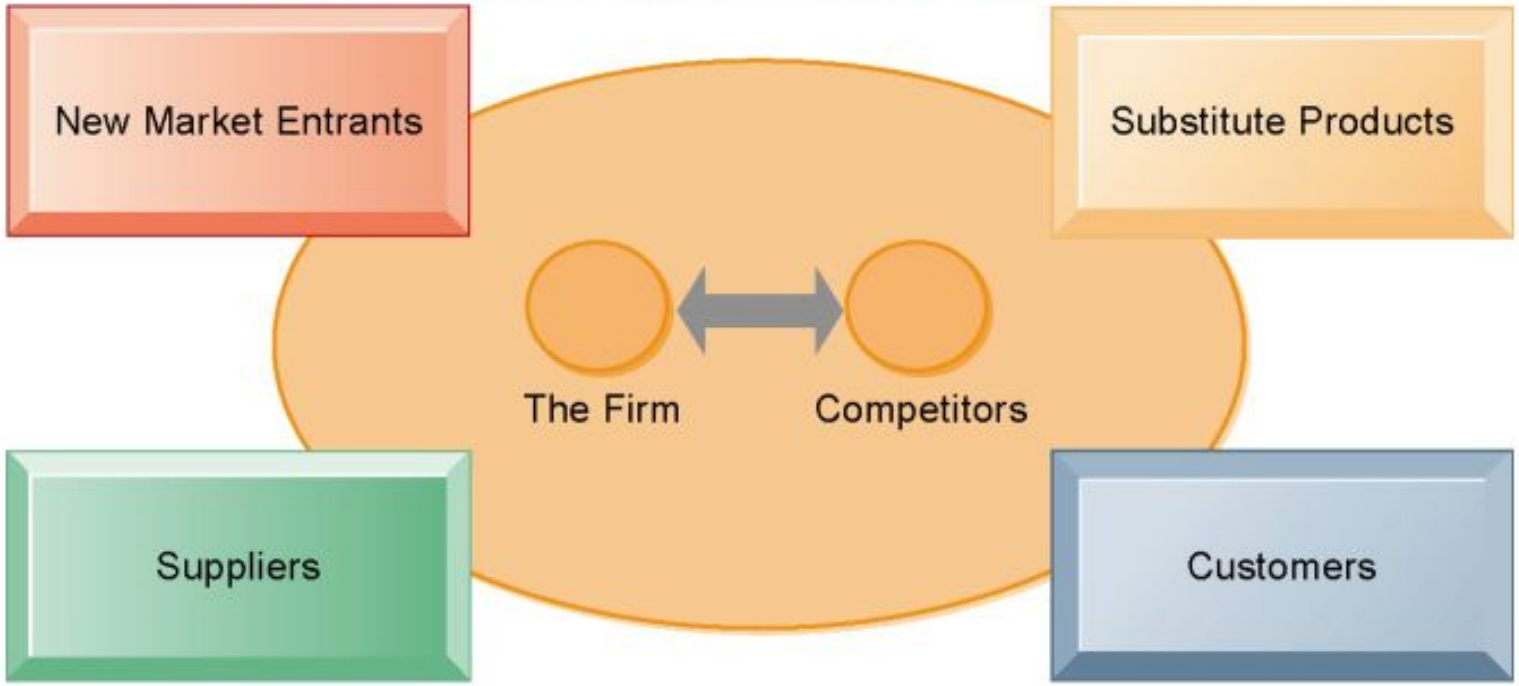
- Why do some firms become leaders within their industry?
- Michael Porter's competitive forces model
  - Provides general view of firm, its competitors, and environment
  - Five competitive forces shape fate of firm
    - Traditional competitors
    - New market entrants
    - Substitute products and services
    - Customers
    - Suppliers

Individual Class Assignment due next week 3rd February, 2020. Hand written

- What is the Internet of Things (IOT)? Give 3 examples of it.

Using Information Systems to Achieve Competitive Advantage

Porter's Competitive Forces Model



In Porter's competitive forces model, the strategic position of the firm and its strategies are determined not only by competition with its traditional direct competitors but also by four forces in the industry's environment: new market entrants, substitute products, customers, and suppliers.

Using Information Systems to Achieve Competitive Advantage

- Traditional competitors
  - All firms share market space with competitors who are continuously devising new products, services, efficiencies, switching costs
- New market entrants
  - Some industries have high barriers to entry, e. g. computer chip business
  - New companies have new equipment, younger workers, but little brand recognition

Using Information Systems to Achieve Competitive Advantage

- Substitute products and services
  - Substitutes customers might use if your prices become too high, e.g. iTunes substitutes for CDs
- Customers
  - Can customers easily switch to competitor's products? Can they force businesses to compete on price alone in transparent marketplace?
- Suppliers
  - Market power of suppliers when firm cannot raise prices as fast as suppliers

Using Information Systems to Achieve Competitive Advantage

- Four generic strategies for dealing with competitive forces, enabled by using IT
  - Low-cost leadership
  - Product differentiation
  - Focus on market niche
  - Strengthen customer and supplier intimacy

Using Information Systems to Achieve Competitive Advantage

- Low-cost leadership
  - produce products and services at a lower price than competitors while enhancing quality and level of service
  - Examples: Wal-Mart, Dell
- Product differentiation
  - Enable new products or services, greatly change customer convenience and experience
  - Examples: Google, Land's End, Apple iPhone

Using Information Systems to Achieve Competitive Advantage

- Focus on market niche
  - Use information systems to enable a focused strategy on a single market niche; specialize
  - Example: Hilton Hotels
- Strengthen customer and supplier intimacy
  - Use information systems to develop strong ties and loyalty with customers and suppliers; increase switching costs
  - Example: Chrysler, Amazon

Using Information Systems to Achieve Competitive Advantage

- The Internet's impact on competitive advantage
  - Transformation, destruction, threat to some industries
    - E.g. travel agency, printed encyclopedia, newspaper
  - Competitive forces still at work, but rivalry more intense
  - Universal standards allow new rivals, entrants to market
  - New opportunities for building brands and loyal customer bases

Using Information Systems to Achieve Competitive Advantage

- Business value chain model
  - Views firm as series of activities that add value to products or services
  - Highlights activities where competitive strategies can best be applied
    - Primary activities vs. support activities
  - At each stage, determine how information systems can improve operational efficiency and improve customer and supplier intimacy
  - Utilize benchmarking, industry best practices

Using Information Systems to Achieve Competitive Advantage

- Information systems can improve overall performance of business units by promoting synergies and core competencies
  - Synergies
    - When output of some units used as inputs to others, or organizations pool markets and expertise
    - Example: merger of Bank of NY and JPMorgan Chase
    - Purchase of YouTube by Google

Using Information Systems to Achieve Competitive Advantage

- Core competencies
  - Activity for which firm is world-class leader
  - Relies on knowledge, experience, and sharing this across business units
  - Example: Procter & Gamble's intranet and directory of subject matter experts

Using Systems for Competitive Advantage: Management Issues

- **Sustaining competitive advantage**
  - Because competitors can retaliate and copy strategic systems, competitive advantage is not always sustainable; systems may become tools for survival
- **Performing strategic systems analysis**
  - What is structure of industry?
  - What are value chains for this firm?
- **Managing strategic transitions**
  - Adopting strategic systems requires changes in business goals, relationships with customers and suppliers, and business processes

QUIZ 1

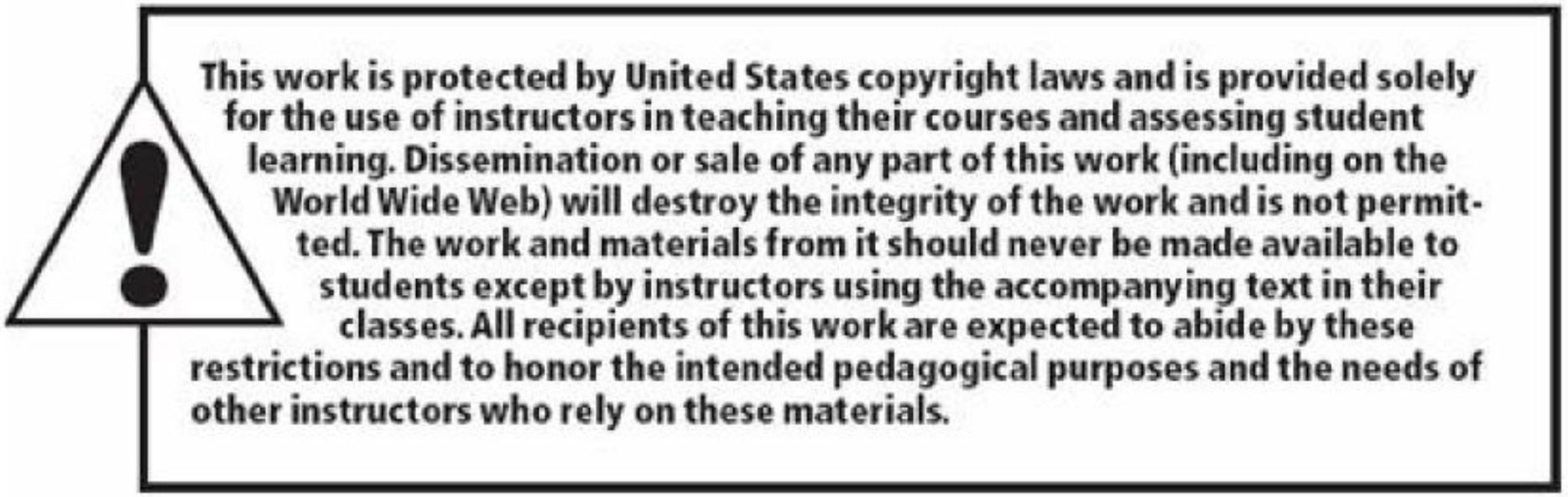
Please answer any 2 of the questions below:

1. What is a Business process?

2. What is are Disruptive technologies

3. Give five basic kinds of organizational structure

4. Give Four generic strategies for dealing with competitive forces, enabled by using IT



LESSON 03

IT Infrastructure and Emerging Technologies

LEARNING OBJECTIVES

- Define IT infrastructure and describe its components.
- Identify and describe the stages and technology drivers of IT infrastructure evolution.
- Assess contemporary computer hardware platform trends.
- Assess contemporary software platform trends.

IT Infrastructure

- **Defining IT infrastructure:**
  - Set of physical devices and software required to operate enterprise
  - Set of firmwide services including:
    - Computing platforms providing computing services
    - Telecommunications services
    - Data management services
    - Application software services
    - Physical facilities management services
    - IT management, standards, education, research and development services
  - "Service platform" perspective more accurate view of value of investments

Infrastructure Components

- **IT Infrastructure has 7 main components**
  - Computer hardware platforms
  - Operating system platforms
  - Enterprise software applications
  - Data management and storage
  - Networking/telecommunications platforms
  - Internet platforms
  - Consulting system integration services

Infrastructure Components

- **Computer hardware platforms**
  - Client machines
    - Desktop PCs, mobile computing devices – PDAs, laptops
  - Servers
    - Blade servers: ultrathin computers stored in racks
  - Mainframes:
    - IBM mainframe equivalent to thousands of blade servers
  - Top chip producers: AMD, Intel, IBM
  - Top firms: IBM, HP, Dell, Sun Microsystems

Infrastructure Components

- **Operating system platforms**
  - Operating systems
    - Client level: 95% run Microsoft Windows (XP, 2000, CE, etc.)
    - Server level: 85% run Unix or Linux
- **Enterprise software applications**
  - Enterprise software applications
    - Enterprise application providers: SAP and Oracle
    - Middleware providers: BEA

IT Infrastructure

Connection Between the Firm, IT Infrastructure, and Business Capabilities

The services a firm is capable of providing to its customers, suppliers, and employees are a direct function of its IT infrastructure. Ideally, this infrastructure should support the firm's business and information systems strategy. New information technologies have a powerful impact on business and IT strategies, as well as the services that can be provided to customers.

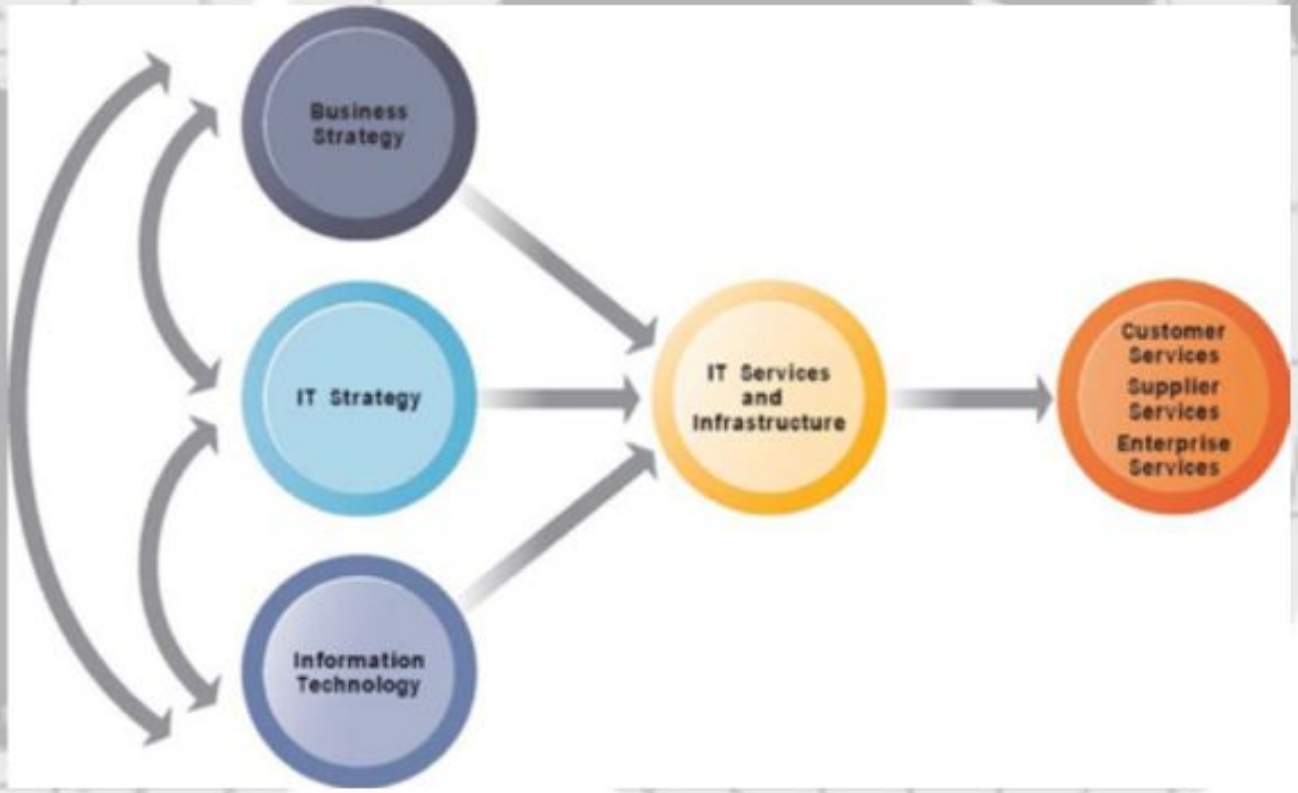


Figure 5-1

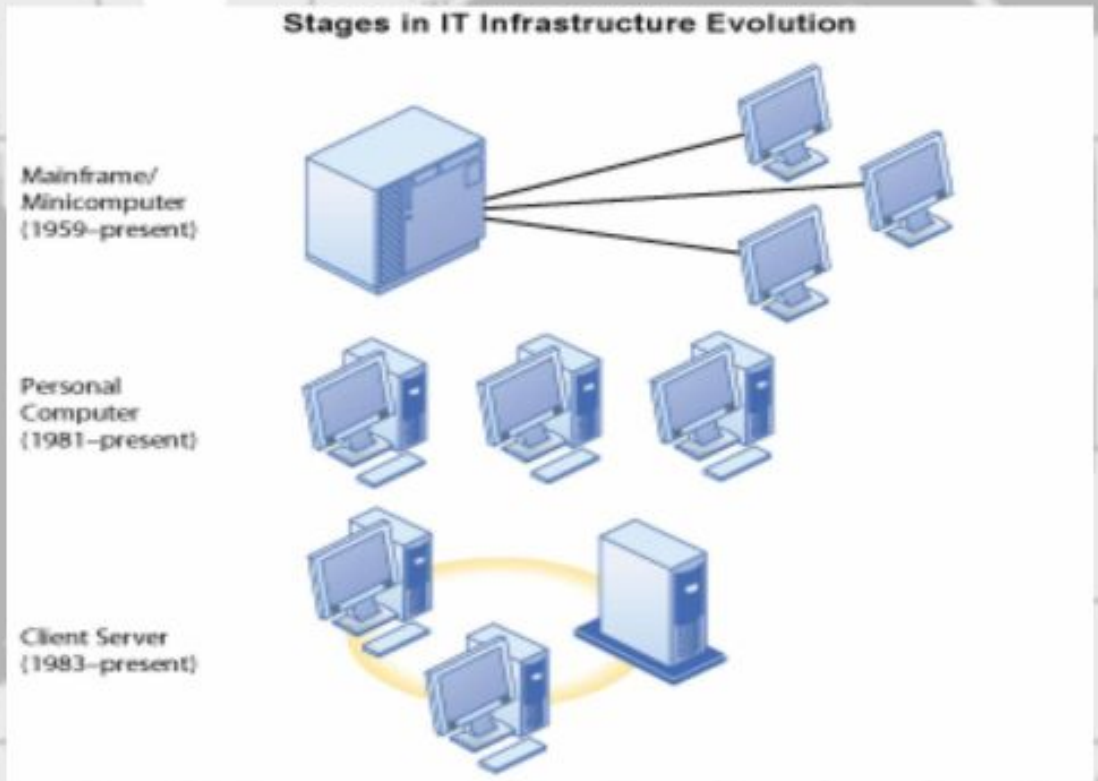
IT Infrastructure

Evolution of IT infrastructure

- **General-purpose mainframe and minicomputer era: 1959 to present**
  - 1958 IBM first mainframes introduced, eventually used to support thousands of online remote terminals
  - 1965 less expensive DEC minicomputers introduced, allowing decentralized computing
- **Personal computer era: 1981 to present**
  - 1981 Introduction of IBM PC
  - Proliferation in 80s, 90s resulted in growth of personal software
- **Client/server era: 1983 to present**
  - Desktop clients networked to servers, with processing work split between clients and servers
  - Network may be two-tiered or multitiered (N-tiered)
  - Various types of servers (network, application, Web)

IT Infrastructure

Eras in IT Infrastructure Evolution



Illustrated here are the typical computing configurations characterizing each of the five eras of IT infrastructure evolution.

Figure 5-2A

IT Infrastructure

- Evolution of IT infrastructure (cont.)
  - Enterprise Internet computing era: 1992 to present
    - Move toward integrating disparate networks, applications using Internet standards and enterprise applications
  - Cloud Computing: 2000 to present
    - Refers to a model of computing where firms and individuals obtain computing power and software applications over the Internet
    - Fastest growing form of computing

IT Infrastructure

Eras in IT Infrastructure Evolution (cont.)

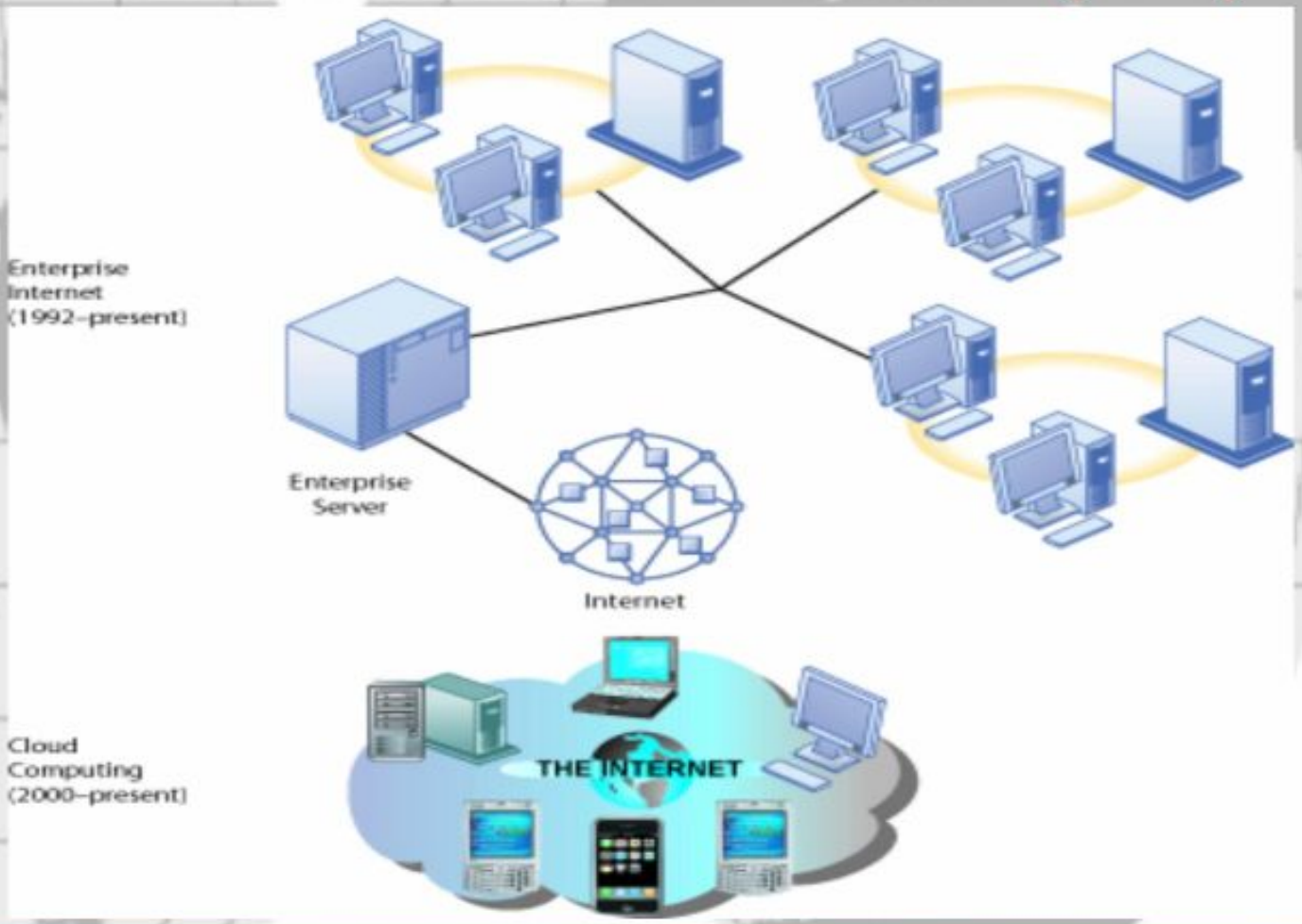
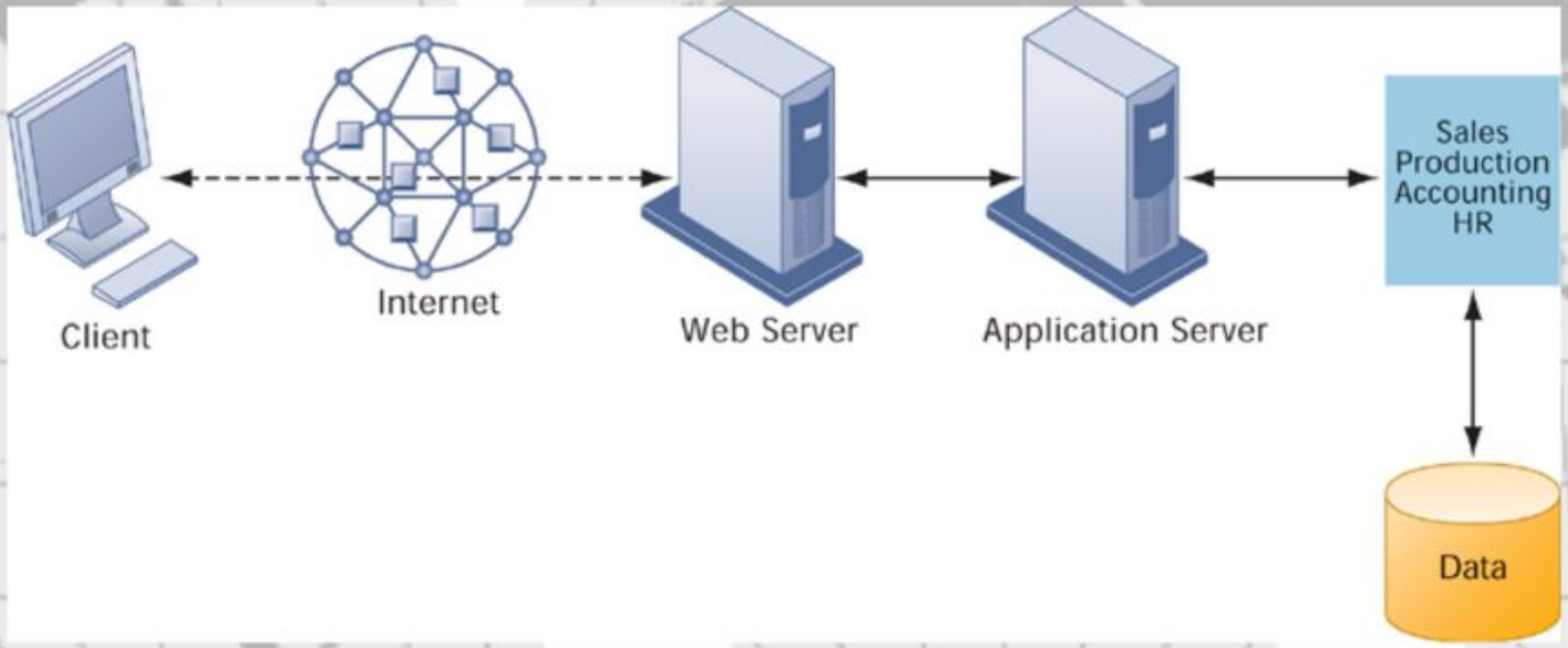


Figure 5-2B

IT Infrastructure

A Multitiered Client/Server Network (N-Tier)



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

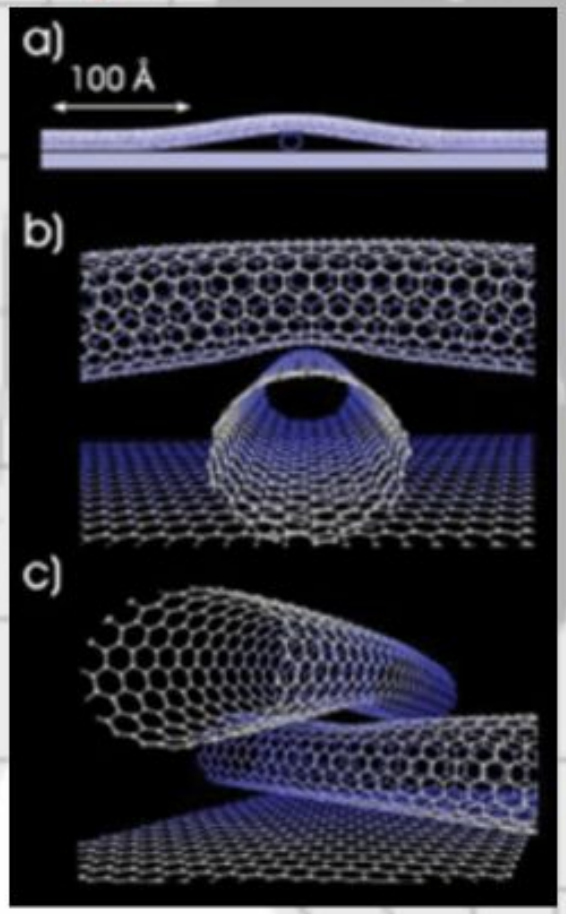
Figure 5-3

IT Infrastructure

- Technology drivers of infrastructure evolution
  - Moore's law and microprocessing power
    - Computing power doubles every 18 months
    - Nanotechnology: May shrink size of transistors to width of several atoms
    - Contrary factors: Heat dissipation needs, power consumption concerns
  - Law of Mass Digital Storage
    - The amount of data being stored each year doubles

IT Infrastructure

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. Discovered in 1991 by researchers at NEC, they have the potential uses as minuscule wires or in ultrasmall electronic devices and are very powerful conductors of electrical current.

Figure 5-6

IT Infrastructure

Falling Cost of Chips

An Intel® processor today can contain as many as 1 billion transistors, run at 3.2 GHz and higher, deliver over 10,000 MIPS, and can be manufactured in high volumes with transistors that cost less than 1/10,000th of a cent. That's a little less than the cost of one printed character in this book.

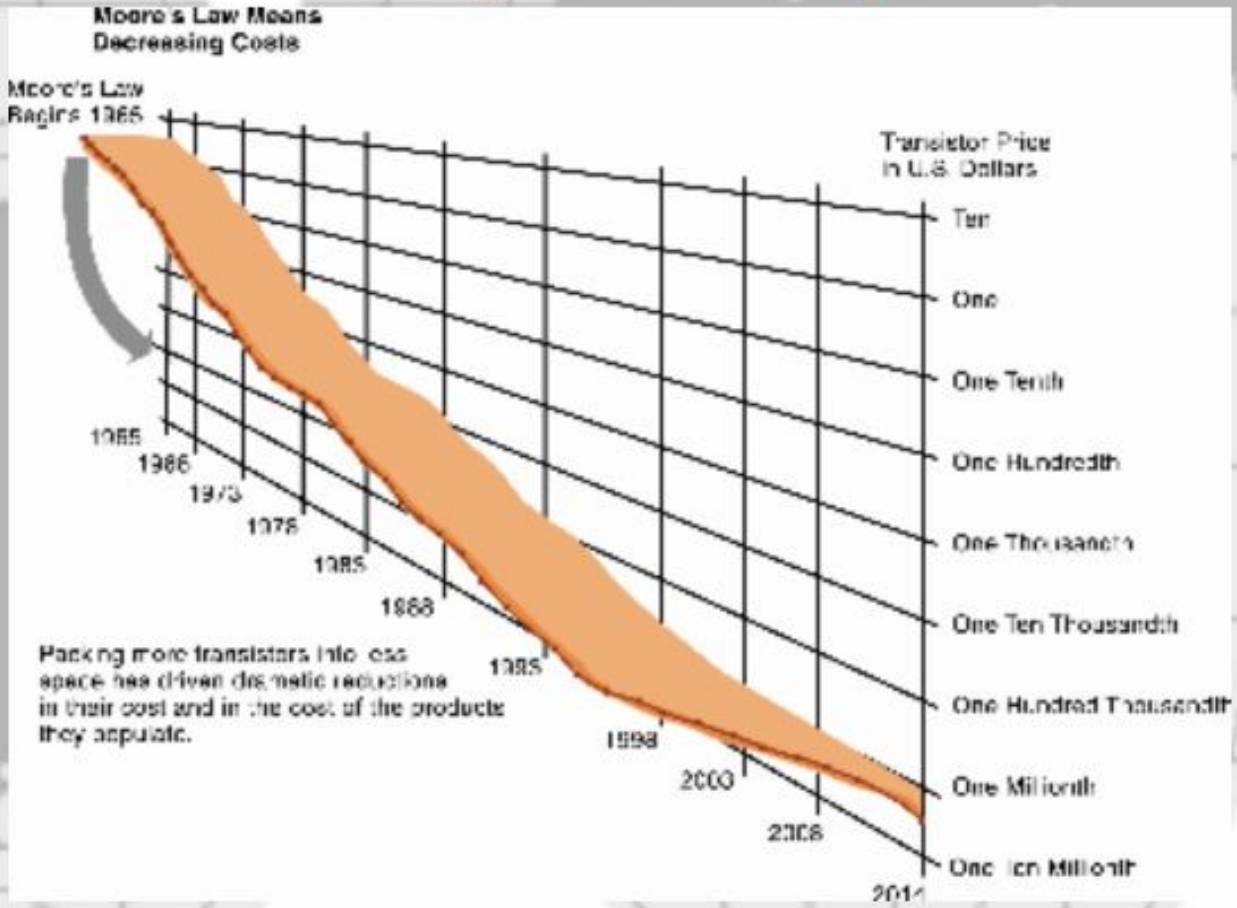


Figure 5-5

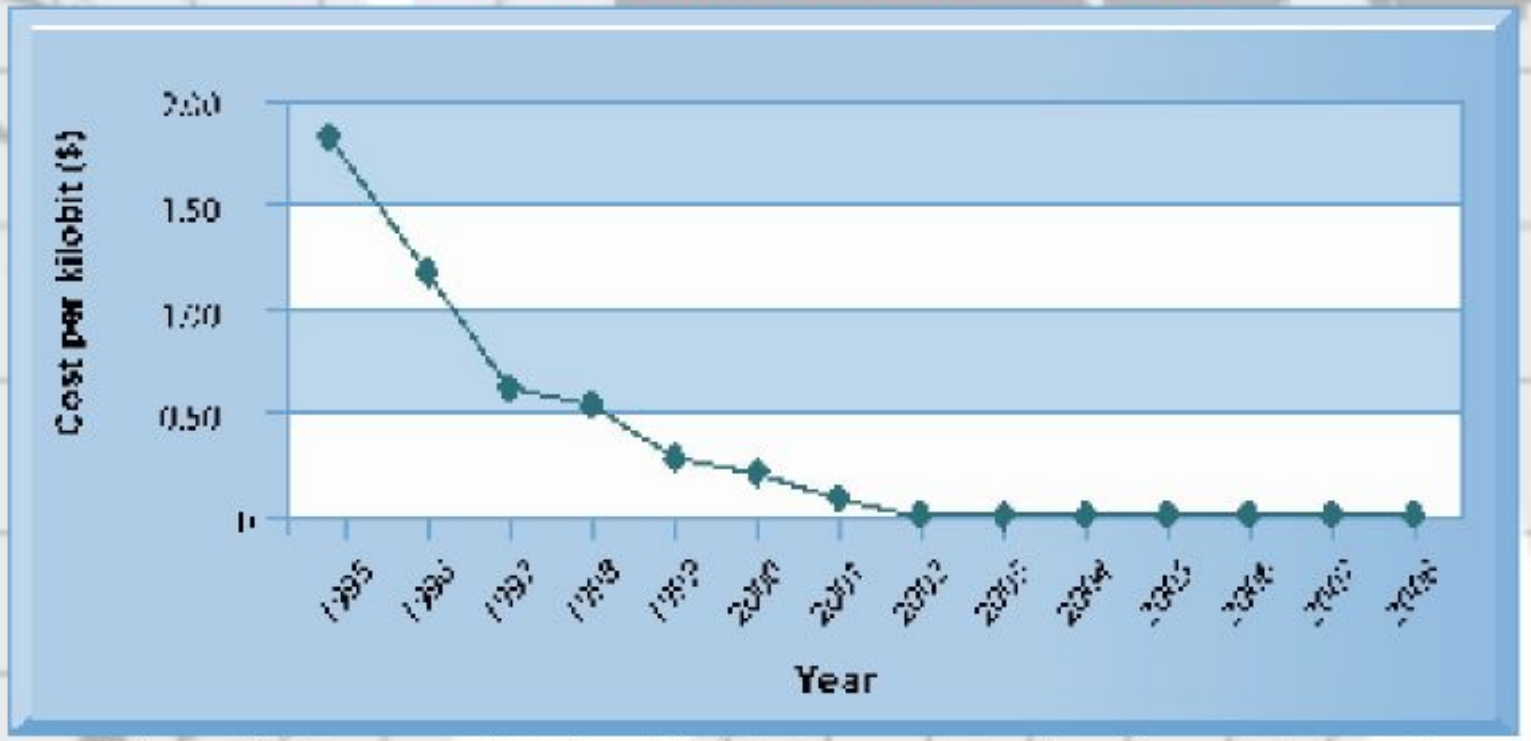
- Technology drivers of infrastructure evolution (cont.)
  - Metcalfe's Law and network economics
    - Value or power of a network grows exponentially as a function of the number of network members
    - As network members increase, more people want to use it (demand for network access increases)

Declining communication costs and the Internet

- An estimated 1.5 billion people worldwide have Internet access
- As communication costs fall toward a very small number and approach 0, utilization of communication and computing facilities explodes

IT Infrastructure

Exponential Declines in Internet Communication Costs



One reason for the growth in the Internet population is the rapid decline in Internet connection and overall communication costs. The cost per kilobit of Internet access has fallen exponentially since 1995. Digital Subscriber Line (DSL) and cable modems now deliver a kilobit of communication for a retail price of less than 2 cents.

Figure 5-9

- Technology drivers of infrastructure evolution (cont.)
  - Standards and network effects
    - Technology standards:
      - Specifications that establish the compatibility of products and the ability to communicate in a network
      - Unleash powerful economies of scale and result in price declines as manufacturers focus on the products built to a single standard

Infrastructure Components

- **Data management and storage**
  - Database software: IBM (DB2), Oracle, Microsoft (SQL Server), Sybase (Adaptive Server Enterprise), MySQL
  - Physical data storage: EMC Corp (large-scale systems), Seagate, Maxtor, Western Digital
  - Storage area networks: connect multiple storage devices on dedicated network

Infrastructure Components

- **Networking/telecommunications platforms**
  - Telecommunication services
    - Telecommunications, cable, telephone company charges for voice lines and Internet access
    - Vodafone
  - Network operating systems:
    - Windows Server, Novell, Linux, Unix
  - Network hardware providers: Cisco, Lucent, Nortel, Juniper Networks

Infrastructure Components

- **Internet platforms**
  - Hardware, software, management services to support company Web sites, (including Web hosting services) intranets, extranets
  - Internet hardware server market: Dell, HP/Compaq, IBM
  - Web development tools/suites: Microsoft (FrontPage, .NET) IBM (WebSphere) Sun (Java), independent software developers: Macromedia/Adobe, RealMedia

Infrastructure Components

- **Consulting and system integration services**
  - Even large firms do not have resources for full range of support for new, complex infrastructure
  - Software integration: ensuring new infrastructure works with legacy systems
  - Legacy systems: older TPS created for mainframes that would be too costly to replace or redesign
  - Accenture, IBM Global Services, EDS, Infosys, Wipro

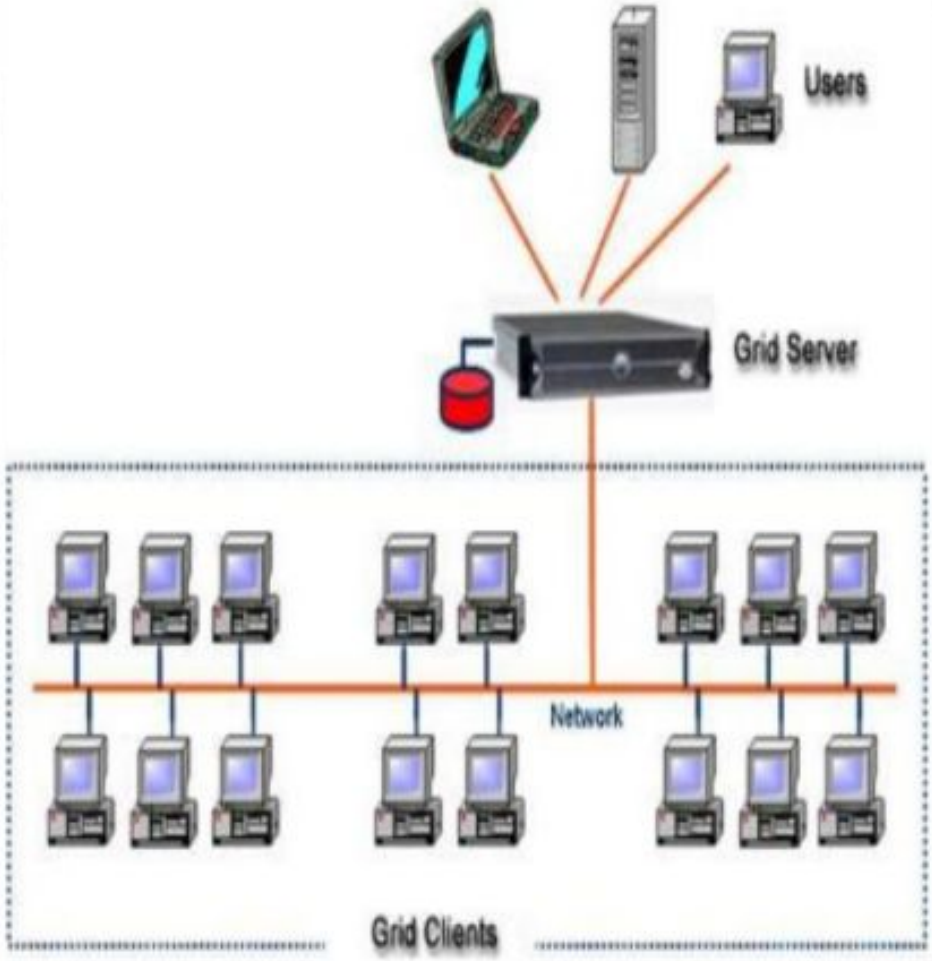
Contemporary Hardware Platform Trends

- **While cost of computing is lower, infrastructure costs have expanded**
  - More computing, more sophisticated computing, increased consumer expectations, need for security
- **The emerging mobile digital platform**
  - Cell phones, smartphones (BlackBerry, iPhone) have assumed data transmission, Web surfing, e-mail and IM duties
  - Netbooks: small, low-cost lightweight notebooks optimized for wireless communication and core computing tasks

Contemporary Hardware Platform Trends

- **Grid computing**
  - Connects geographically remote computers into a single network to combine processing power and create virtual supercomputer
  - Provides cost savings, speed, agility
- **Cloud computing (utility computing)**
  - Data permanently stored in remote servers, accessed and updated over the Internet by users
  - Organizations using cloud computing need only pay for the computing power they actually use (on-demand or utility computing)

How Grid computing works ?



In general, a grid computing system requires:

- **At least one computer, usually a server, which handles all the administrative duties for the System**
- **A network of computers running special grid computing network software.**
- **A collection of computer software called middleware**

Management Issues

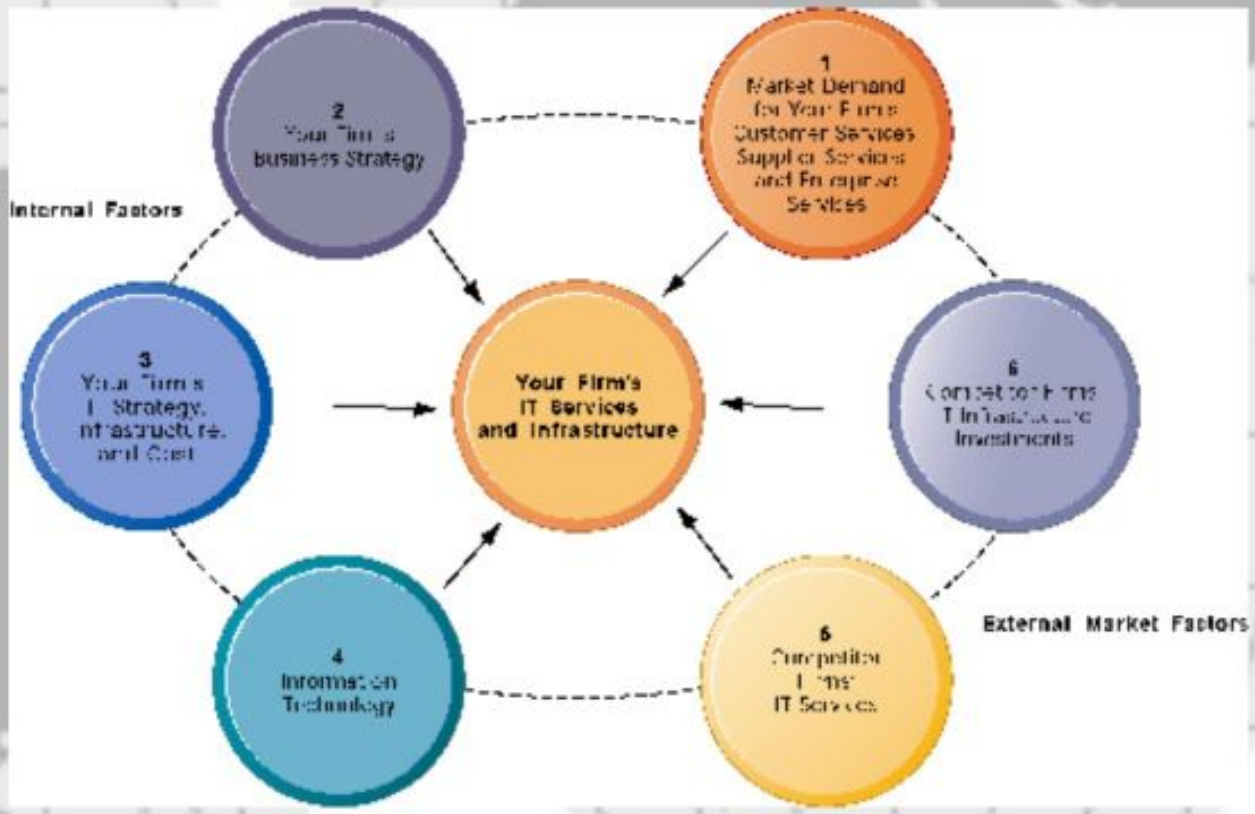
- **Management and governance**
  - Who controls IT infrastructure
  - Centralized/decentralized
  - How are costs allocated between divisions, departments?

Management Issues

- **Making wise infrastructure investments**
  - Amount to spend on IT is complex question
    - Rent vs. buy, outsourcing
- **Competitive forces model for IT infrastructure investment**
  - Market demand for firm's services
  - Firm's business strategy
  - Firm's IT strategy, infrastructure, and cost
  - Information technology assessment
  - Competitor firm services
  - Competitor firm IT infrastructure investments

Management Issues

Competitive Forces Model for IT Infrastructure



There are six factors you can use to answer the question, "How much should our firm spend on IT infrastructure?"

Figure 5-13

Management Issues

- **Total Cost of Ownership of Technology Assets**
  - **TCO model:** Used to analyze direct and indirect costs of systems
    - Hardware, software account for only about 20% of TCO
    - Other costs include: Installation, training, support, maintenance, infrastructure, downtime, space and energy
  - TCO can be reduced through greater centralization and standardization of hardware and software resources

LESSON 04

Foundations of Business Intelligence: Databases and Information Management

LEARNING OBJECTIVES

- Describe how the problems of managing data resources in a traditional file environment are solved by a database management system
- Describe the capabilities and value of a database management system
- Apply important database design principles
- Evaluate tools and technologies for accessing information from databases to improve business performance and decision making
- Assess the role of information policy, data administration, and data quality assurance in the management of firm's data resources

UNDERSTANDING INFORMATION

- Data is a valuable organizational resource & should be managed
- Its usefulness depends to a large extent on how it is stored, organized, and accessed/retrieved
- Employees must be able to obtain and analyze the many different levels, formats, and granularities of organizational information to make decisions

Information Quality

- Business decisions are only as good as the quality of the information used to make the decisions

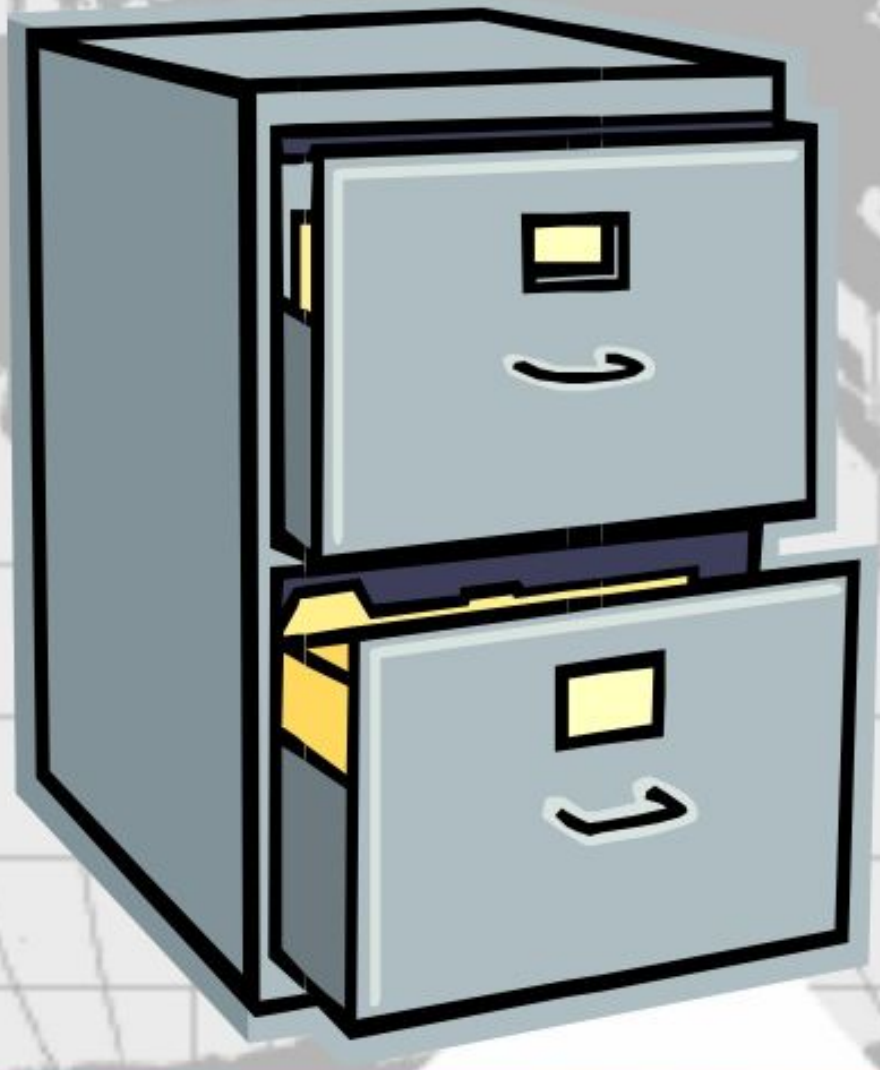
- Characteristics of high quality information include:
  - Accuracy
  - Completeness
  - Consistency
  - Uniqueness
  - Timeliness

- **File organization concepts**
  - **Computer system organizes data in a hierarchy**
    - **Field:** Group of characters as word(s) or number
    - **Record:** Group of related fields
    - **File:** Group of records of same type
    - **Database:** Group of related files
  - **Record**: Describes an entity
  - **Entity**: Person, place, thing on which we store information
    - Attribute: Each characteristic, or quality, describing entity
      - E.g., Attributes **Date** or **Grade** belong to entity **COURSE**

DATABASE FUNDAMENTALS

Database

- A database is comprised of one or more tables. Each database also contains a unique name.
- Microsoft Access is an example of a database program that allows you to store, retrieve, and manipulate data.



DATABASE FUNDAMENTALS

- The use of a traditional approach to file processing encourages each functional area in a corporation to develop specialized applications and files.
- Each application requires a unique data file that is likely to be a subset of the master file.
- These subsets of the master file lead to data redundancy and inconsistency, processing inflexibility, and wasted storage resources.

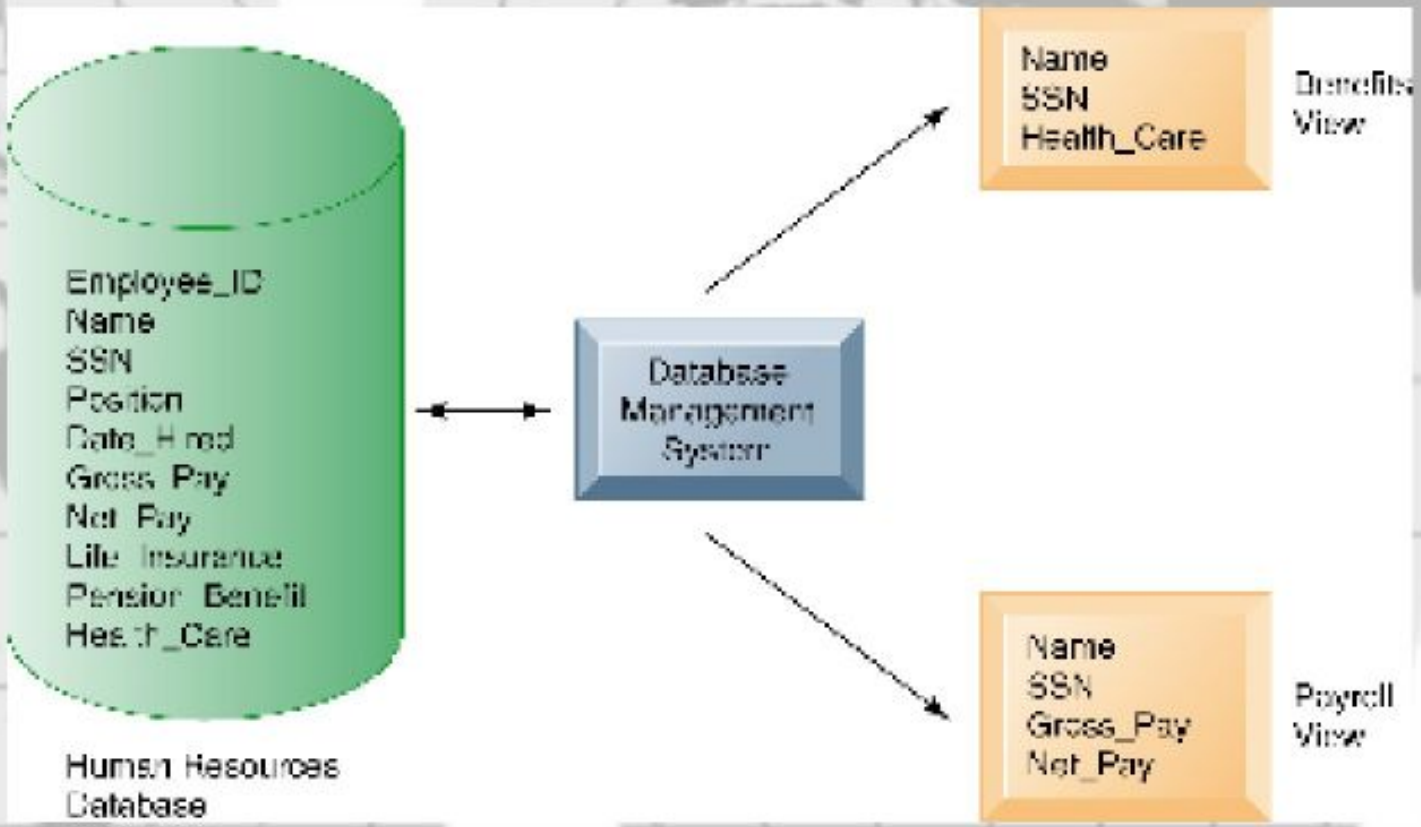
- Problems with the traditional file environment (files maintained separately by different departments)
  - Data redundancy and inconsistency
    - **Data redundancy:** Presence of duplicate data in multiple files
    - **Data inconsistency:** Same attribute has different values
  - Program-data dependence:
    - When changes in program requires changes to data accessed by program
  - Lack of flexibility
  - Poor security
  - Lack of data sharing and availability

- **Database**
  - Collection of data organized to serve many applications by centralizing data and controlling redundant data
- **Database management system**
  - Interfaces between application programs and physical data files
  - Separates logical and physical views of data
  - Solves problems of traditional file environment
    - Controls redundancy
    - Eliminates inconsistency
    - Uncouples programs and data
    - Enables organization to central manage data and data security

DATABASE FUNDAMENTALS

- Database models include:
  - ***Hierarchical database model*** – information is organized into a tree-like structure (using parent/child relationships) in such a way that it cannot have too many relationships
  - ***Network database model*** – a flexible way of representing objects and their relationships
  - ***Relational database model*** – stores information in the form of logically related two-dimensional tables

Human Resources Database with Multiple Views

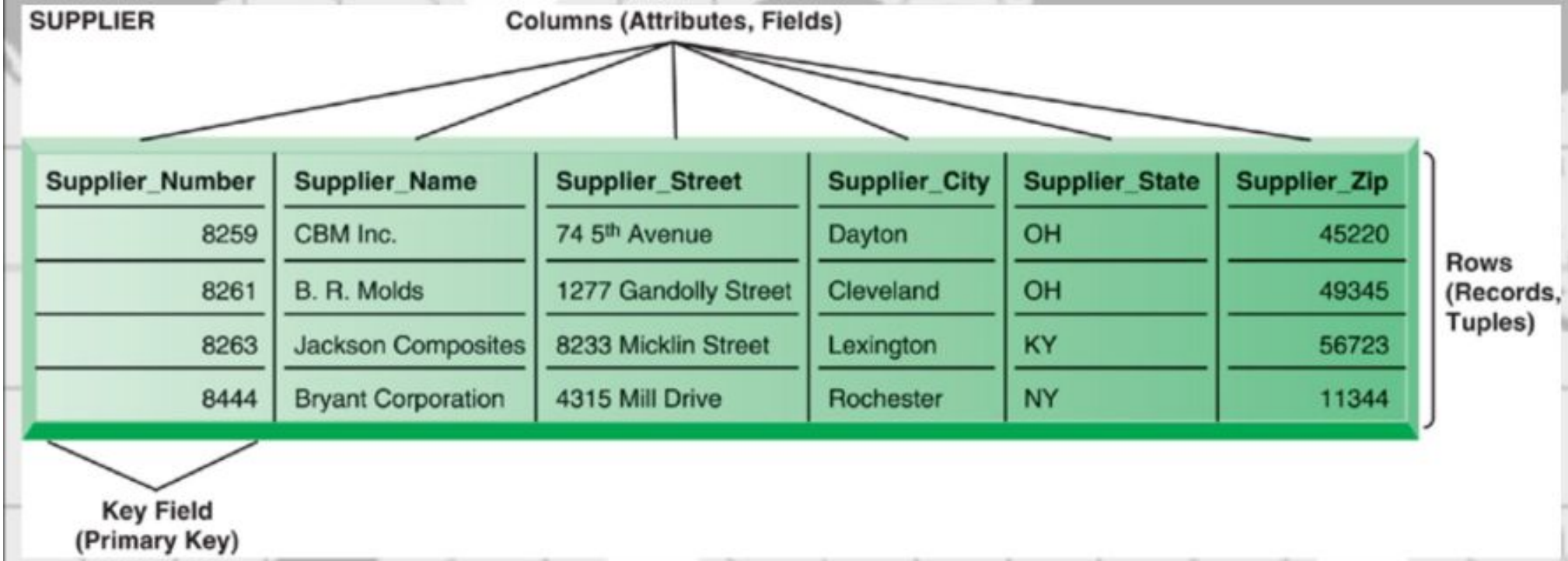


A single human resources database provides many different views of data, depending on the information requirements of the user. Illustrated here are two possible views, one of interest to a benefits specialist and one of interest to a member of the company's payroll department.

Figure 6-3

- **Relational DBMS**
  - Represent data as two-dimensional tables called relations or files
  - Each table contains data on entity and attributes
- **Table**: grid of columns and rows
  - **Rows (tuples):** Records for different entities
  - **Fields (columns):** Represents attribute for entity
  - **Key field**: Field used to uniquely identify each record
  - **Primary key**: Field in table used for key fields
  - **Foreign key**: Primary key used in second table as look-up field to identify records from original table

Relational Database Tables



Supplier_Number	Supplier_Name	Supplier_Street	Supplier_City	Supplier_State	Supplier_Zip
8259	CBM Inc.	74 5th Avenue	Dayton	OH	45220
8261	B. R. Molds	1277 Gandolly Street	Cleveland	OH	49345
8263	Jackson Composites	8233 Micklin Street	Lexington	KY	56723
8444	Bryant Corporation	4315 Mill Drive	Rochester	NY	11344

A relational database organizes data in the form of two-dimensional tables. Illustrated here are tables for the entities SUPPLIER and PART showing how they represent each entity and its attributes. Supplier_Number is a primary key for the SUPPLIER table and a foreign key for the PART table.

Figure 6-4A

Relational Database Tables (cont.)

PART

Part_Number	Part_Name	Unit_Price	Supplier_Number
137	Door latch	22.00	8259
145	Side mirror	12.00	8444
150	Door molding	6.00	8263
152	Door lock	31.00	8259
155	Compressor	54.00	8261
178	Door handle	10.00	8259

Primary Key

Foreign Key

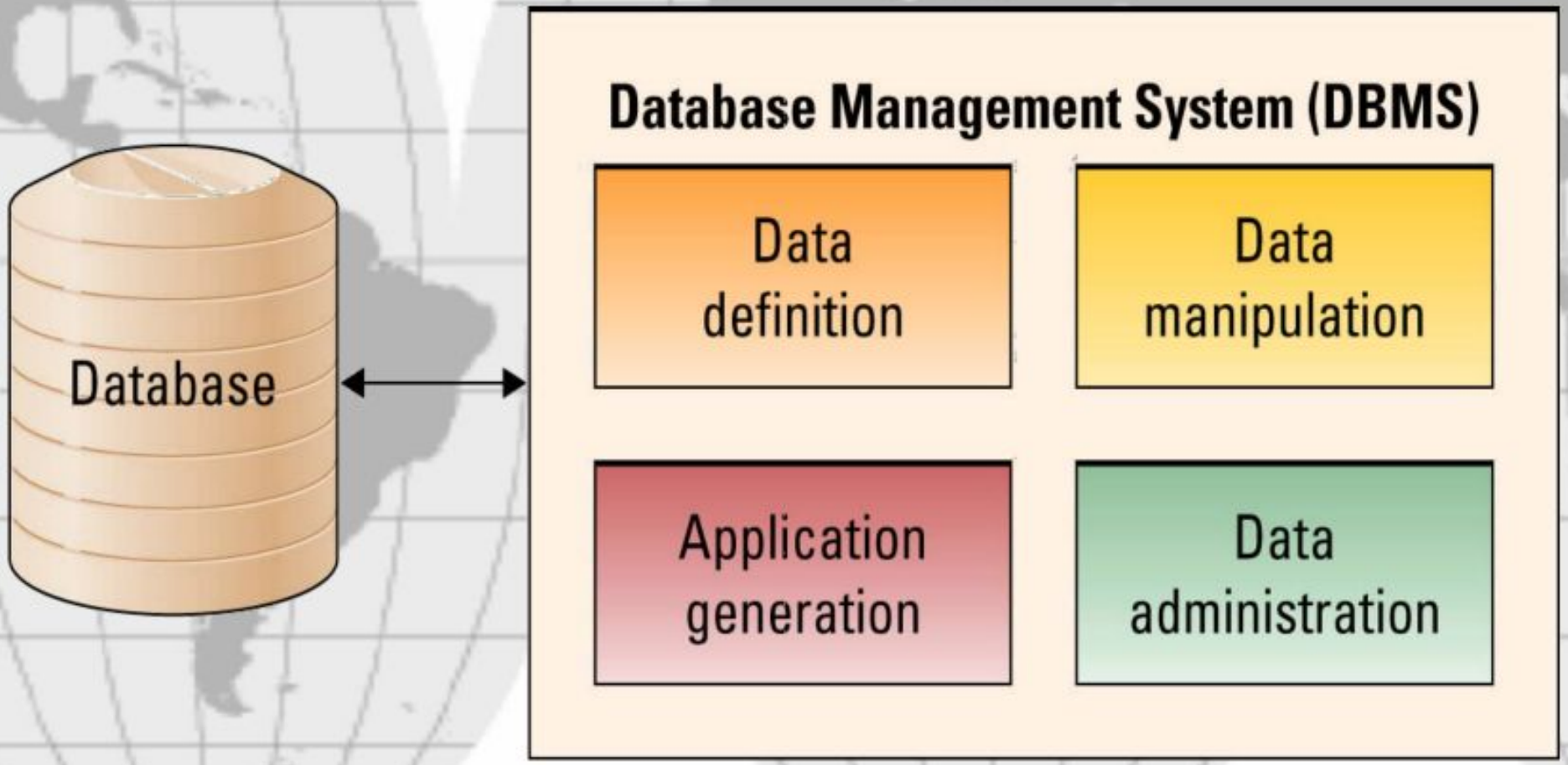
Figure 6-4B

- **Object-Oriented DBMS (OODBMS)**
  - Stores data and procedures as objects
  - Capable of managing graphics, multimedia, Java applets
  - Relatively slow compared with relational DBMS for processing large numbers of transactions
  - **Hybrid object-relational DBMS:** Provide capabilities of both OODBMS and relational DBMS

- **Capabilities of Database Management Systems**
  - **Data definition capability:** Specifies structure of database content, used to create tables and define characteristics of fields
  - **Data dictionary:** Automated or manual file storing definitions of data elements and their characteristics
  - **Data manipulation language:** Used to add, change, delete, retrieve data from database
    - Structured Query Language (SQL)
    - Microsoft Access user tools for generation SQL
  - Many DBMS have **report generation capabilities** for creating polished reports (Crystal Reports)

DATABASE MANAGEMENT SYSTEMS

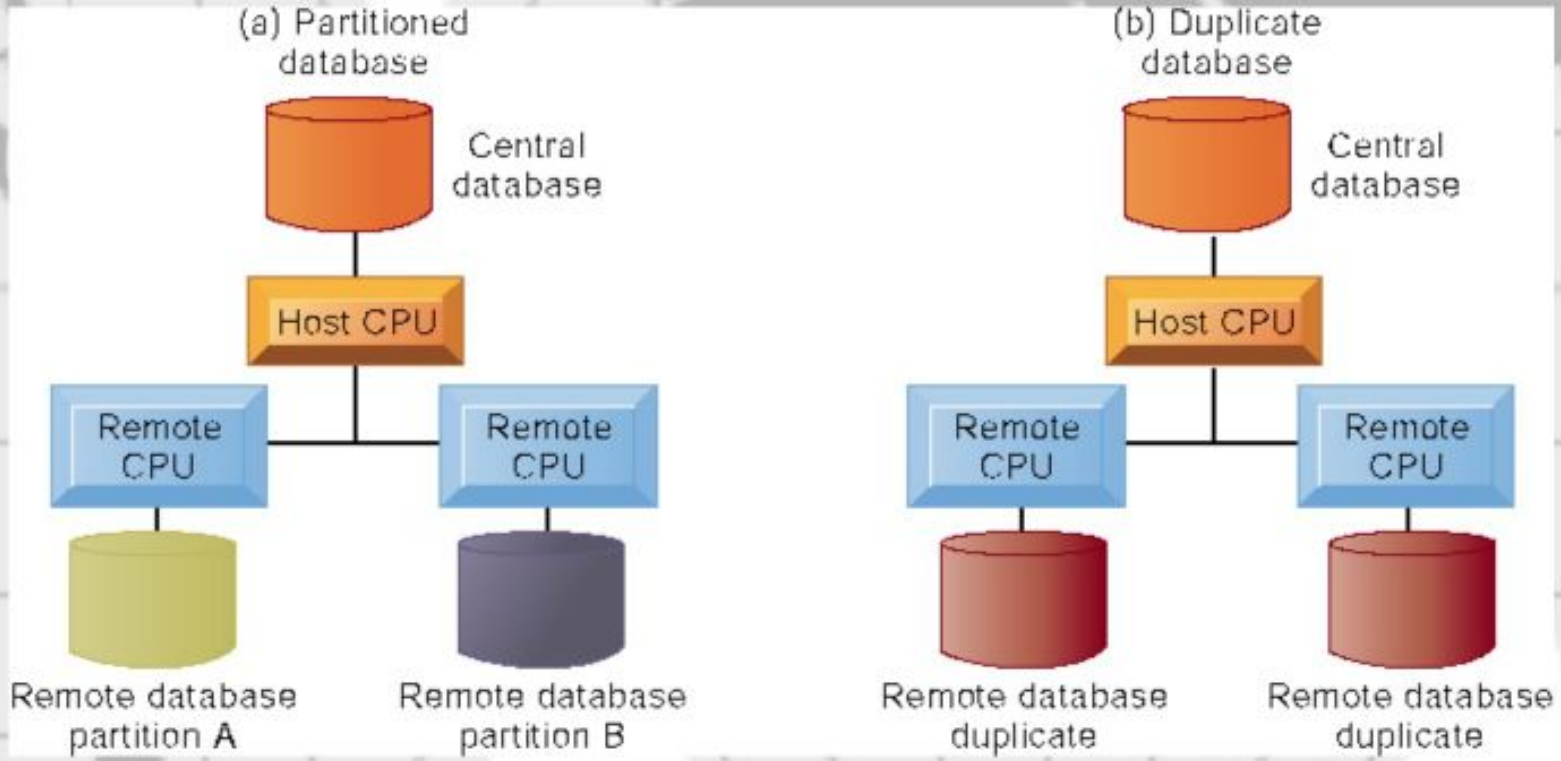
- Four components of a DBMS



- **Distributing databases**: Storing database in more than one place
  - **Partitioned**: Separate locations store different parts of database
  - **Replicated**: Central database duplicated in entirety at different locations

- **Distributing databases**
  - Two main methods of distributing a database
    - **Partitioned**: Separate locations store different parts of database
    - **Replicated**: Central database duplicated in entirety at different locations
  - Advantages
    - Reduced vulnerability
    - Increased responsiveness
  - Drawbacks
    - Departures from using standard definitions
    - Security problems

Distributed Databases



There are alternative ways of distributing a database. The central database can be partitioned (a) so that each remote processor has the necessary data to serve its own local needs. The central database also can be replicated (b) at all remote locations.

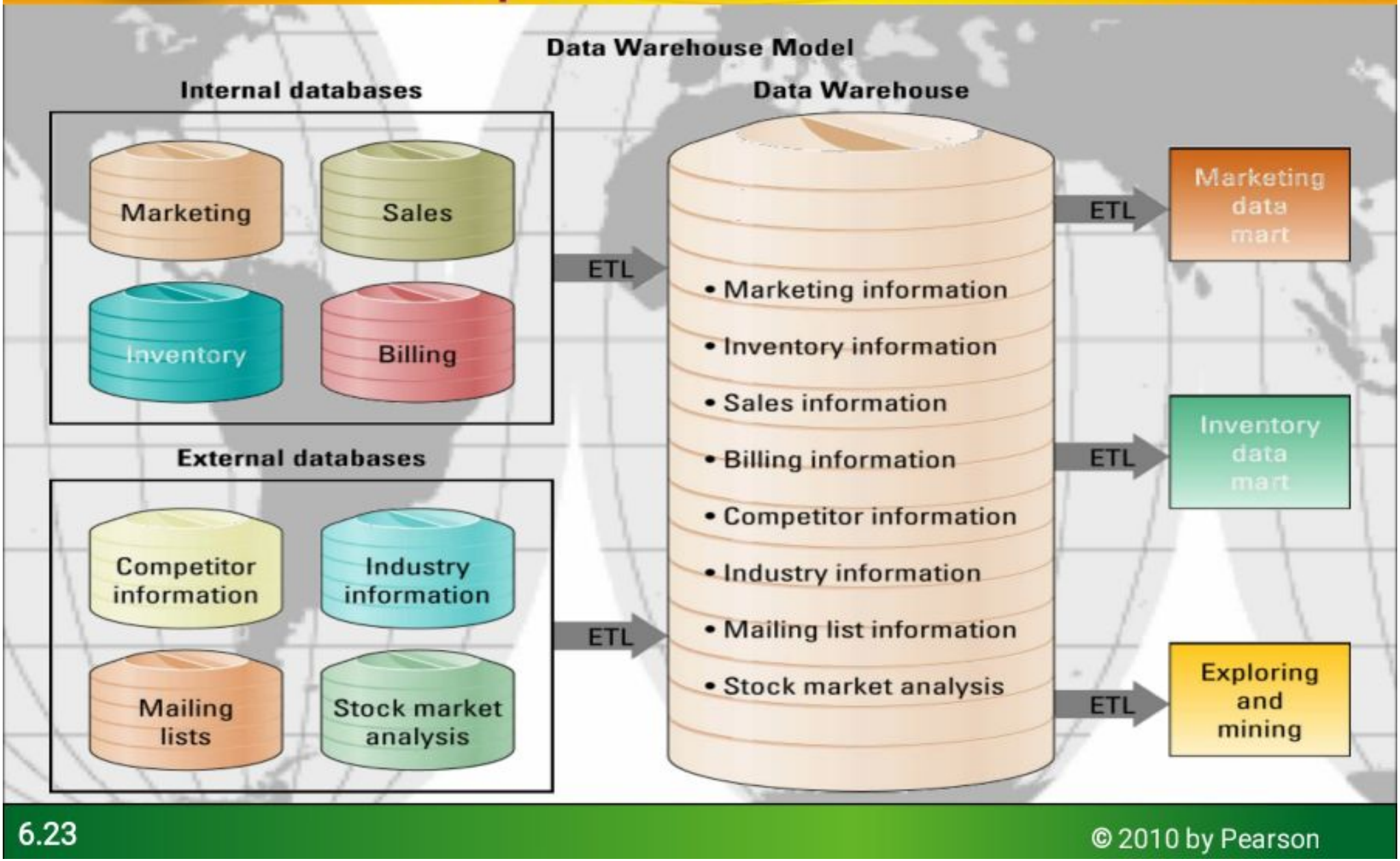
Figure 6-12

- Very large databases and systems require special capabilities, tools
  - To analyze large quantities of data
  - To access data from multiple systems
- Three key techniques
  - Data warehousing
  - Data mining
  - Tools for accessing internal databases through the Web

- **Data warehouse:**
  - Stores current and historical data from many core operational transaction systems
  - Consolidates and standardizes information for use across enterprise, but data cannot be altered
  - Data warehouse system will provide query, analysis, and reporting tools
- **Data marts:**
  - Subset of data warehouse
  - Summarized or highly focused portion of firm's data for use by specific population of users
  - Typically focuses on single subject or line of business

DATA WAREHOUSE

Components of a Data Warehouse



- **Business Intelligence:**
  - Tools for consolidating, analyzing, and providing access to vast amounts of data to help users make better business decisions
  - E.g., Harrah's Entertainment analyzes customers to develop gambling profiles and identify most profitable customers
  - Principle tools include:
    - Software for database query and reporting
    - Online analytical processing (OLAP)
    - Data mining

Business Intelligence

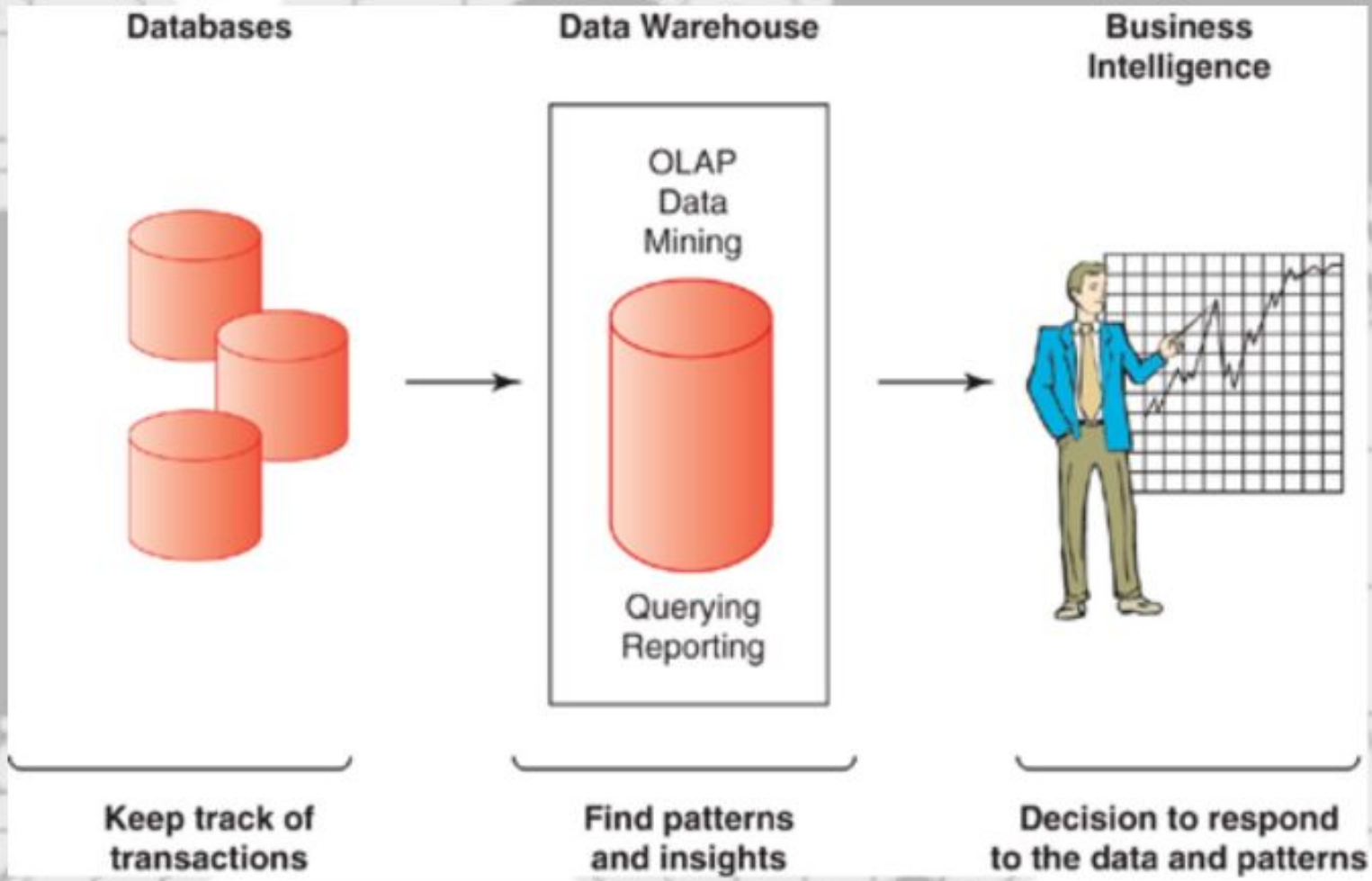


Figure 6-14

A series of analytical tools works with data stored in databases to find patterns and insights for helping managers and employees make better decisions to improve organizational performance.

- **Online analytical processing (OLAP)**
  - Supports multidimensional data analysis
    - Viewing data using multiple dimensions
    - Each aspect of information (product, pricing, cost, region, time period) is different dimension
    - E.g., how many washers sold in East in June compared with other regions?
  - OLAP enables rapid, online answers to ad hoc queries
  - Online analytical processing, one of the three principle tools for gathering business intelligence.

- **Data mining:**
  - More discovery driven than OLAP
  - Finds hidden patterns, relationships in large databases and infers rules to predict future behavior
  - E.g., Finding patterns in customer data for one-to-one marketing campaigns or to identify profitable customers.
  - Types of information obtainable from data mining
    - **Associations:** Occurrences linked to single event
    - **Sequences:** Events linked over time
    - **Classification:** Recognizes patterns that describe group to which item belongs
    - **Clustering:** Similar to classification when no groups have been defined; finds groupings within data
    - **Forecasting:** Uses series of existing values to forecast what other values will be

- **Predictive analysis**
  - Uses data mining techniques, historical data, and assumptions about future conditions to predict outcomes of events
  - E.g., Probability a customer will respond to an offer or purchase a specific product
- **Text mining**
  - Extracts key elements from large unstructured data sets (e.g., stored e-mails)

- **Establishing an information policy**
  - Firm's rules, procedures, roles for sharing, managing, standardizing data
    - E.g., What employees are responsible for updating sensitive employee information
  - **Data administration**: Firm function responsible for specific policies and procedures to manage data
  - **Data governance:** Policies and processes for managing availability, usability, integrity, and security of enterprise data, especially as it relates to government regulations
  - **Database administration** : Defining, organizing, implementing, maintaining database; performed by database design and management group

- **Ensuring data quality**
  - More than 25% of critical data in Fortune 1000 company databases are inaccurate or incomplete
  - Most data quality problems stem from faulty input
  - Before new database in place, need to:
    - Identify and correct faulty data
    - Establish better routines for editing data once database in operation

- **Data quality audit:**
  - Structured survey of the accuracy and level of completeness of the data in an information system
    - Survey samples from data files, or
    - Survey end users for perceptions of quality
- **Data cleansing**
  - Software to detect and correct data that are incorrect, incomplete, improperly formatted, or redundant
  - Enforces consistency among different sets of data from separate information systems

LESSON 06

Achieving Operational Excellence and Customer Intimacy: Enterprise Applications

LEARNING OBJECTIVES

- Evaluate how enterprise systems help businesses achieve operational excellence.
- Describe how supply chain management systems coordinate planning, production, and logistics with suppliers.
- Explain how customers relationship management systems help firms achieve customer intimacy.
- Identify the challenges posed by enterprise applications.
- Describe how enterprise applications are used in platforms for new cross-functional services.

- Enterprise Systems

- Enterprise resource planning (ERP) is a cross-functional enterprise system that comprises a broad set of an organization's activities supported by multi-module application software packages that help the organization manage its resources, share its information across departments and integrate its multiple business operations to meet the complex needs of customers
- Essentially, the ERP system designed for a client–server environment can facilitate the complete integration of business information flow across functional units in an organization by means of a single and unified database and access via a unified interface across the entire organization

- Enterprise Systems
  - Aka enterprise resource planning (ERP) systems
  - Suite of integrated software modules and a common central database
  - Collects data from many divisions of firm for use in nearly all of firm's internal business activities
  - Information entered in one process is immediately available for other processes

- **Enterprise Software**
  - **Built around thousands of predefined business processes that reflect best practices**
    - **Finance/accounting:** General ledger, accounts payable, etc.
    - **Human resources:** Personnel administration, payroll, etc.
    - **Manufacturing/production:** Purchasing, shipping, etc.
    - **Sales/marketing**: Order processing, billing, sales planning, etc.
  - **To implement, firms:**
    - Select functions of system they wish to use
    - Map business processes to software processes
      - Use software's configuration tables for customizing

How Enterprise Systems Work

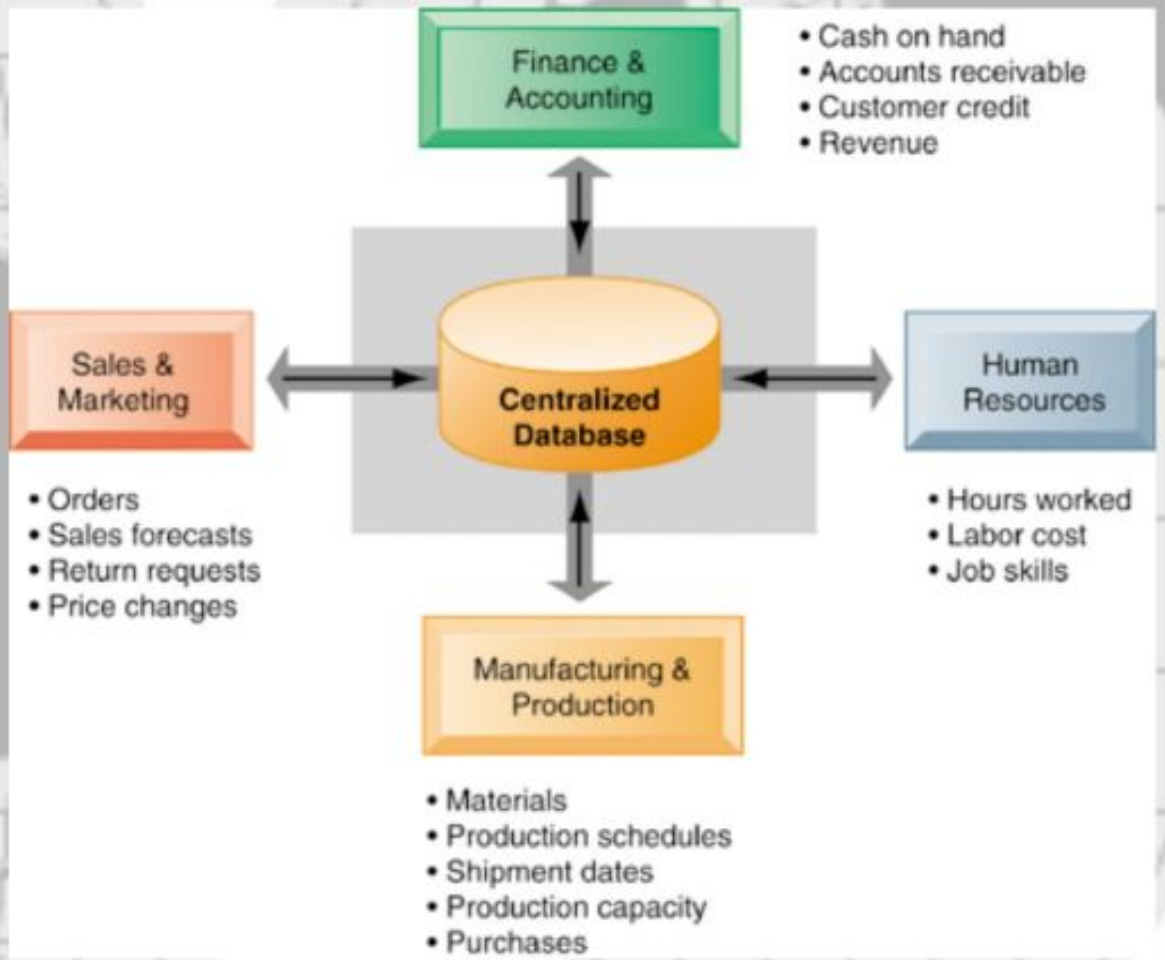


Figure 9-1

Enterprise systems feature a set of integrated software modules and a central database that enables data to be shared by many different business processes and functional areas throughout the enterprise

- Business Value of Enterprise Systems
  - Increase operational efficiency
  - Provide firmwide information to support decision making
  - Enable rapid responses to customer requests for information or products
  - Include analytical tools to evaluate overall organizational performance

- **The supply chain**
- Supply chain management refers to the coordination of activities and involved in making and moving a product.
- The supply chain is the network of businesses and business processes involved in the creation and selling of a product, from suppliers that procure raw materials through retail outlets and customers.
- The manufacturer also has internal supply chain processes for transforming the materials and services furnished by suppliers into finished goods and for managing materials and inventory
- **Upstream supply chain:**
  - Firm's suppliers, suppliers' suppliers, processes for managing relationships with them
- **Downstream supply chain:**
  - Organizations and processes responsible for delivering products to customers

Nike's Supply Chain

This figure illustrates the major entities in Nike's supply chain and the flow of information upstream and downstream to coordinate the activities involved in buying, making, and moving a product. Shown here is a simplified supply chain, with the upstream portion focusing only on the suppliers for sneakers and sneaker soles.

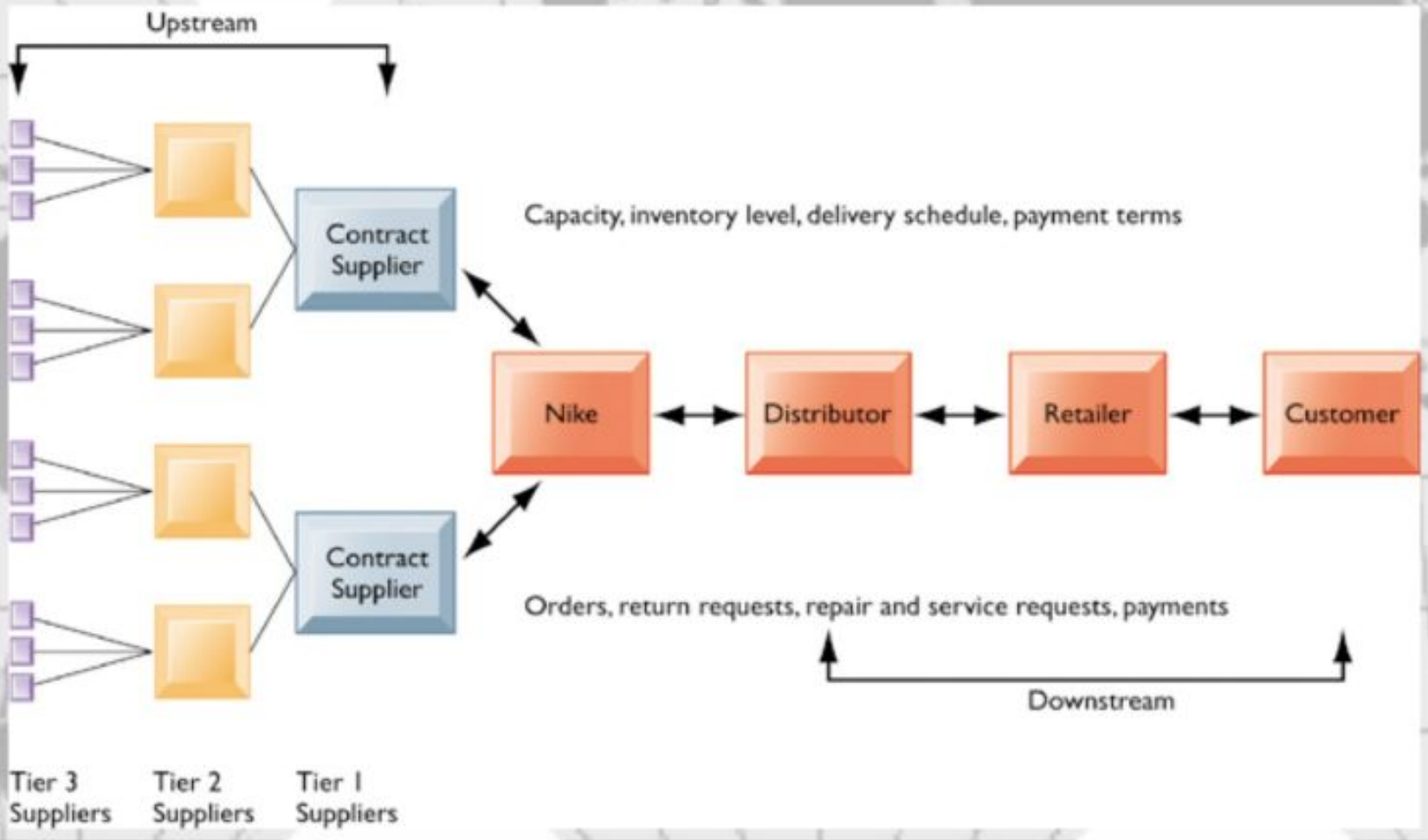


Figure 9-2

- **Information and supply chain management**
  - **Inefficiencies cut into a company's operating costs**
    - Inefficiencies in the supply chain, such as parts shortages, underutilized plant capacity, excessive inventory, or runaway transportation costs, are caused by inaccurate or untimely information and can waste as much as 25% of operating costs
    - **Just-in-time strategy:**
    - Components arrive as they are needed
    - Finished goods shipped after leaving assembly line
  - **Safety stock**
    - Buffer for lack of flexibility in supply chain
  - **Bullwhip effect**
    - Information about product demand gets distorted as it passes from one entity to next across supply chain

The Bullwhip Effect

Inaccurate information can cause minor fluctuations in demand for a product to be amplified as one moves further back in the supply chain. Minor fluctuations in retail sales for a product can create excess inventory for distributors, manufacturers, and suppliers.

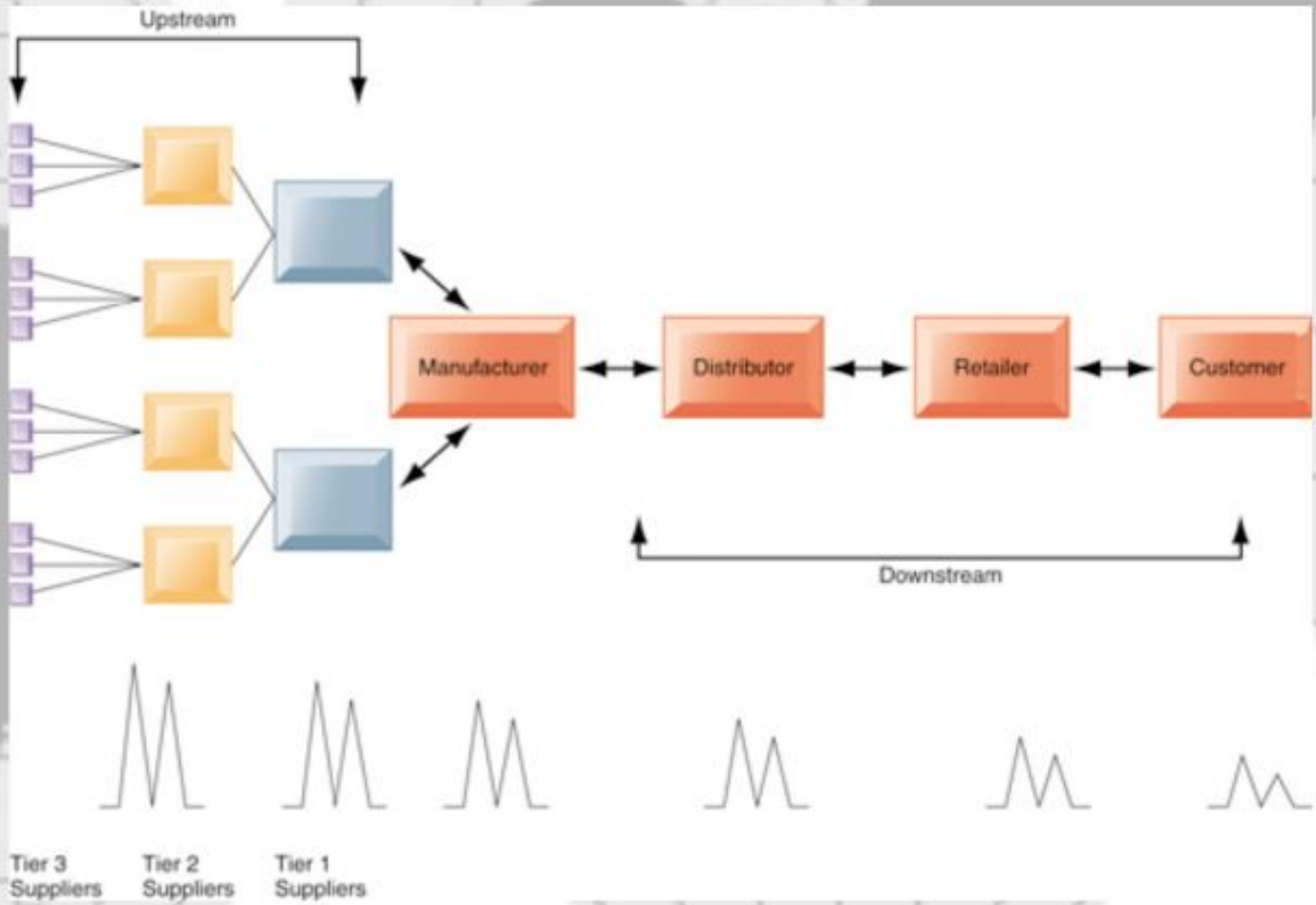


Figure 9-3

- **Supply chain management systems**
  - **Supply chain planning systems**
    - enable the firm to generate demand forecasts for a product,
    - develop sourcing and manufacturing plans for that product,
    - make adjustments to production and distribution plans, and
    - share that information with relevant supply chain members.
    - Model existing supply chain
    - Demand planning, which determines how much product a business needs to make to satisfy all of its customers' demands.
  - **Supply chain execution systems**
    - Manage flow of products through distribution centers and warehouses to ensure that products are delivered to the right locations in the most efficient manner

- **Global supply chains and the Internet**
  - Before Internet, supply chain coordination hampered by difficulties of using disparate internal supply chain systems
  - Enterprise systems supply some integration of internal supply chain processes but not designed to deal with external supply chain processes
  - Internet technology has changed supply chains, allowing integration with external supply chains, using intranets and extranets
  - The Internet provides a standard set of tools that are used by companies all over the world to coordinate global supply chains that include participants from many countries

- **Global supply chains and the Internet**
  - Today, using intranets and extranets, all members of the supply chain can instantly communicate with each other, using up-to-date information to adjust purchasing, logistics, manufacturing, packaging, and schedules.
  - **Intranets and Extranets**
    - **Intranets:** To improve coordination among internal supply chain processes.
    - Intranets integrate information from isolated business processes within the firm to help manage its internal supply chain.
    - **Extranets:** To coordinate supply chain processes shared with their business partners.
    - Access to these private intranets can also be extended to authorized suppliers, distributors, logistics services, and, sometimes, to retail customers to improve coordination of external supply chain processes

Intranets and Extranets for Supply Chain Management

Intranets integrate information from isolated business processes within the firm to help manage its internal supply chain. Access to these private intranets can also be extended to authorized suppliers, distributors, logistics services, and, sometimes, to retail customers to improve coordination of external supply chain processes.

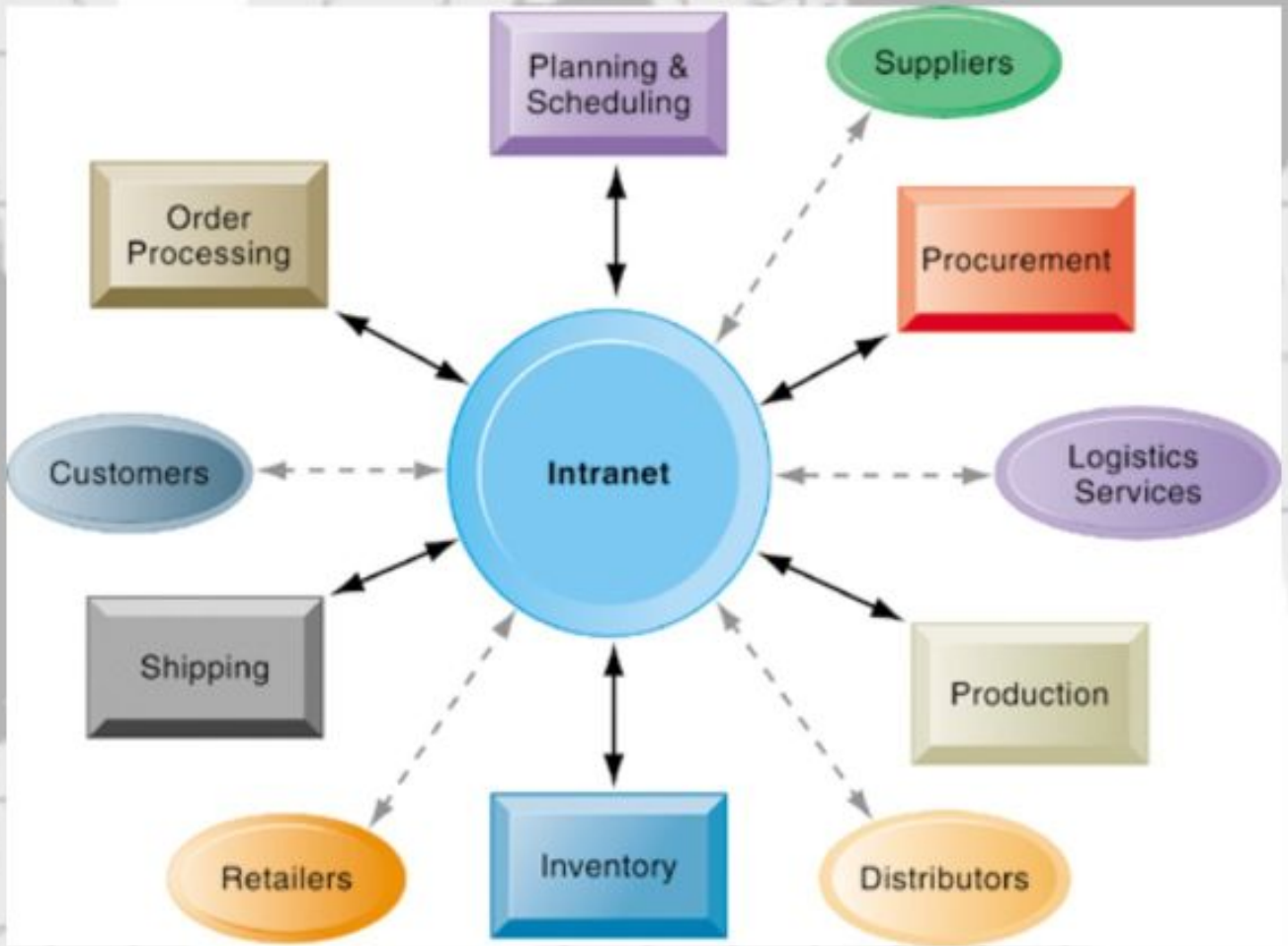
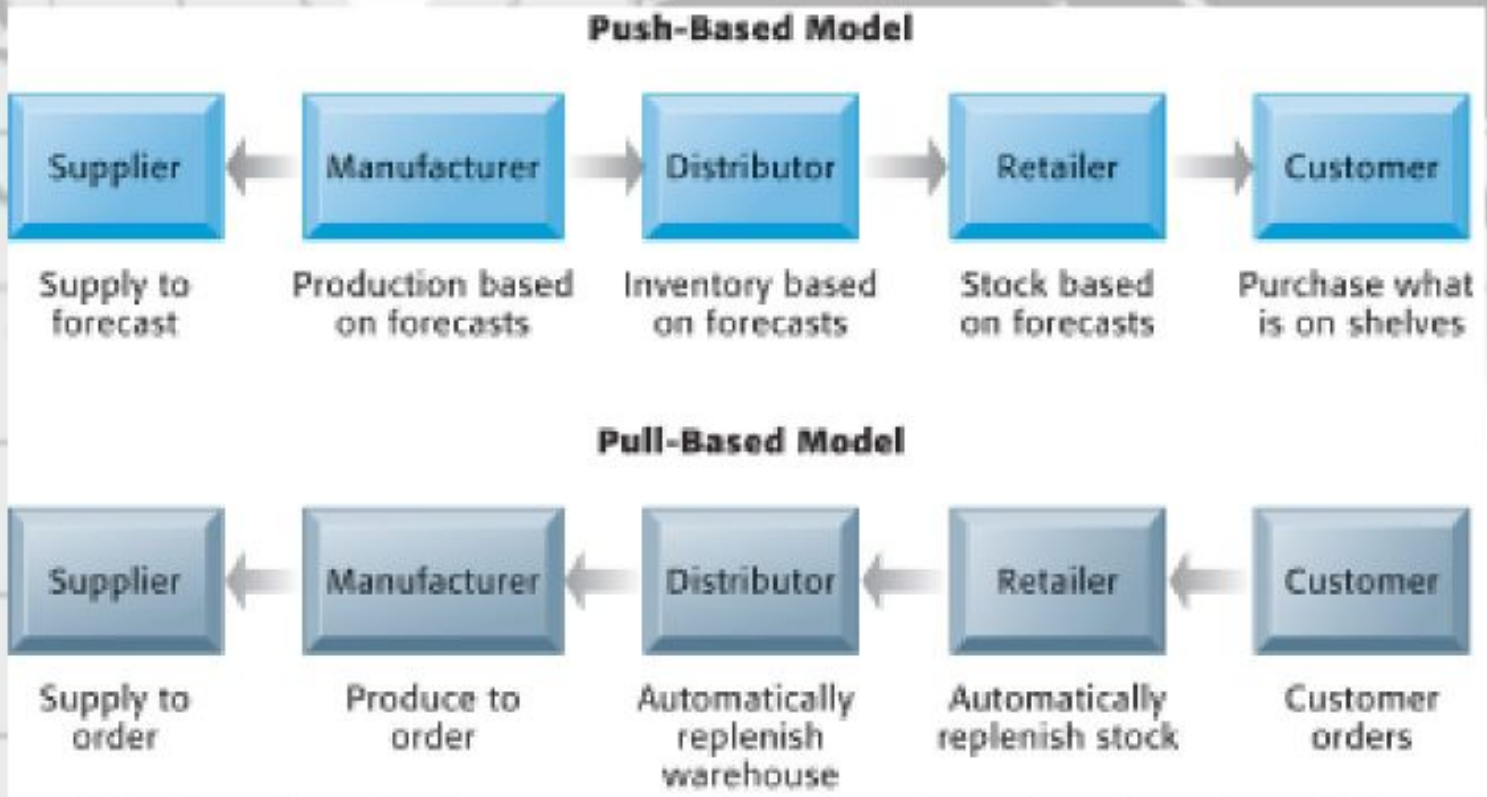


Figure 9-4

- **Global supply chain issues**
  - Global supply chains typically span greater geographic distances and time differences
  - More complex pricing issues (local taxes, transportation, etc.)
  - Foreign government regulations
- **Internet helps companies manage many aspects of global supply chains**
  - Sourcing, transportation, communications, international finance

- **Demand-driven supply chains**
  - **Push-based model (build-to-stock)**
    - Schedules based on best guesses of demand
  - **Pull-based model (demand-driven)**
    - Customer orders trigger events in supply chain
  - **Sequential supply chains**
    - Information and materials flow sequentially from company to company
  - **Concurrent supply chains**
    - Information flows in many directions simultaneously among members of a supply chain network

Push- Versus Pull-Based Supply Chain Models



The difference between push- and pull-based models is summarized by the slogan "Make what we sell, not sell what we make."

Figure 9-5

Business Value of Supply Chain Management Systems

- Match supply to demand
- Reduce inventory levels
- Improve delivery service
- Speed product time to market
- Use assets more effectively
- Reduced supply chain costs
- Increased sales

- What is customer relationship management?
  - Knowing the customer
    - In large businesses, too many customers and too many ways customers interact with firm
  - Customer relationship management (CRM) systems
    - Capture and integrate customer data from all over the organization
    - Consolidate and analyze customer data
    - Distribute customer information to various systems and customer touch points across enterprise
    - Provide single enterprise view of customers

Customer Relationship Management (CRM)

Figure 9-7

CRM systems examine customers from a multifaceted perspective. These systems use a set of integrated applications to address all aspects of the customer relationship, including customer service, sales, and marketing.

Customer Loyalty Management Process Map

This process map shows how a best practice for promoting customer loyalty through customer service would be modeled by customer relationship management software. The CRM software helps firms identify high-value customers for preferential treatment.

Figure 9-10

- **Operational CRM:**
  - Customer-facing applications such as sales force automation, call center and customer service support, and marketing automation
- **Analytical CRM:**
  - Analyze customer data output from operational CRM applications
  - Based on data warehouses populated by operational CRM systems and customer touch points
  - Customer lifetime value (CLTV)

- **Business value of customer relationship management**
  - Increased customer satisfaction
  - Reduced direct-marketing costs
  - More effective marketing
  - Lower costs for customer acquisition/retention
  - Increased sales revenue
  - Reduced churn rate
    - **Churn rate:**
      - Number of customers who stop using or purchasing products or services from a company.
      - Indicator of growth or decline of firm's customer base

- **Enterprise application challenges**
  - Highly expensive to purchase and implement enterprise applications – total cost may be 4 to 5 times the price of software
  - Requires fundamental changes
    - Technology changes
    - Business processes changes
    - Organizational changes
  - Incurs switching costs, dependence on software vendors
  - Requires data standardization, management, cleansing

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Chapter 8

Enhancing Decision Making

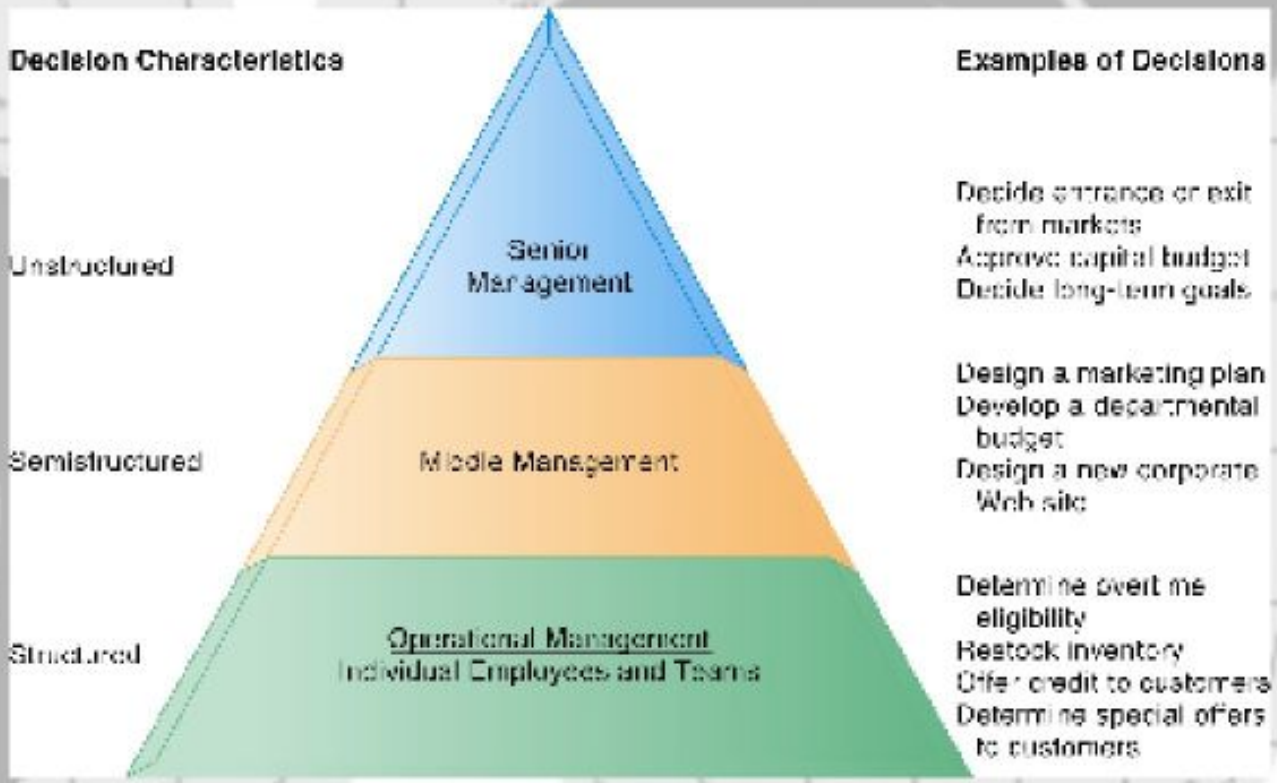
LEARNING OBJECTIVES

- Describe different types of decisions and the decision-making process.
- Assess how information systems support the activities of managers and management decision making.
- Demonstrate how decision-support systems (DSS) differ from MIS and how they provide value to the business.
- Demonstrate how executive support systems (ESS) help senior managers make better decisions.
- Evaluate the role of information systems in helping people working in a group make decisions more efficiently.

- **Business value of improved decision making**
  - Improving hundreds of thousands of "small" decisions adds up to large annual value for the business
- **Types of decisions:**
  - **Unstructured:** Decision maker must provide judgment, evaluation, and insight to solve problem
  - **Structured:** Repetitive and routine; involve definite procedure for handling so they do not have to be treated each time as new
  - **Semistructured:** Only part of problem has clear-cut answer provided by accepted procedure

- **Senior managers:**
  - Make many unstructured decisions
  - E.g., Should we enter a new market?
- **Middle managers:**
  - Make more structured decisions but these may include unstructured components
  - E.g., Why is order fulfillment report showing decline in Minneapolis?
- **Operational managers, rank and file employees**
  - Make more structured decisions
  - E.g., Does customer meet criteria for credit?

Information Requirements of Key Decision-Making Groups in a Firm



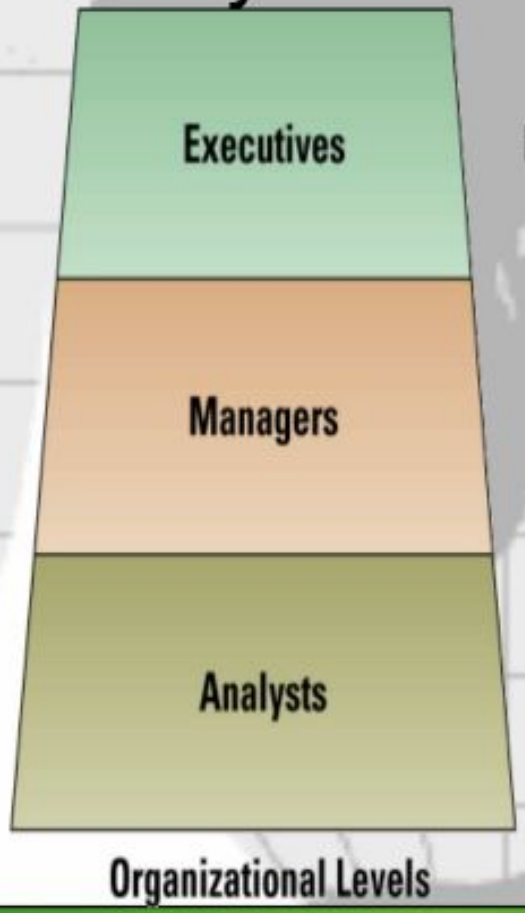
Senior managers, middle managers, operational managers, and employees have different types of decisions and information requirements.

Figure 12-1

DECISION MAKING

- ***Model*** – a simplified representation or abstraction of reality

- IT systems in an enterprise



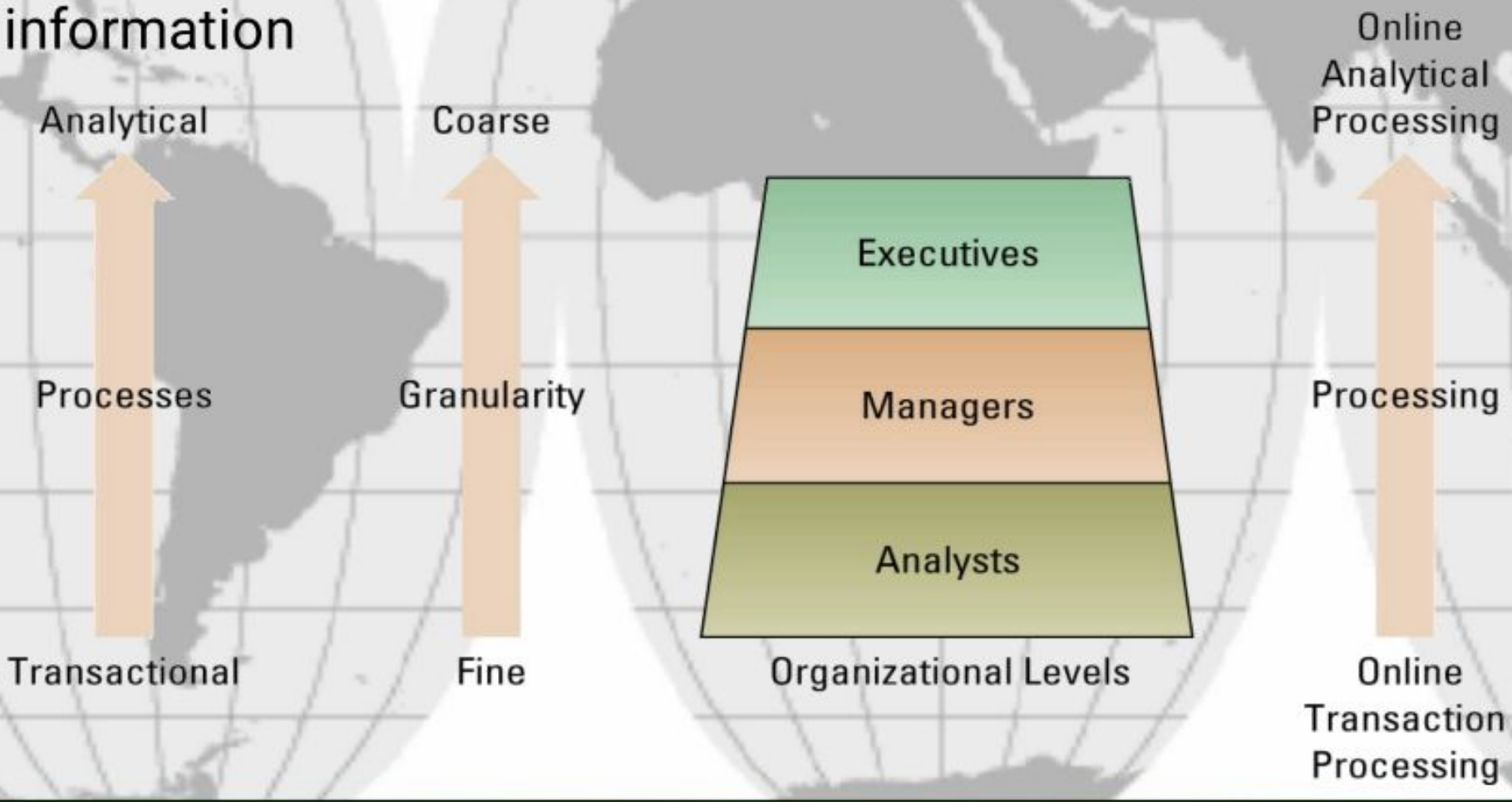
Executive Information Systems (EIS)

Decision Support Systems (DSS)

Transaction Processing Systems (TPS)

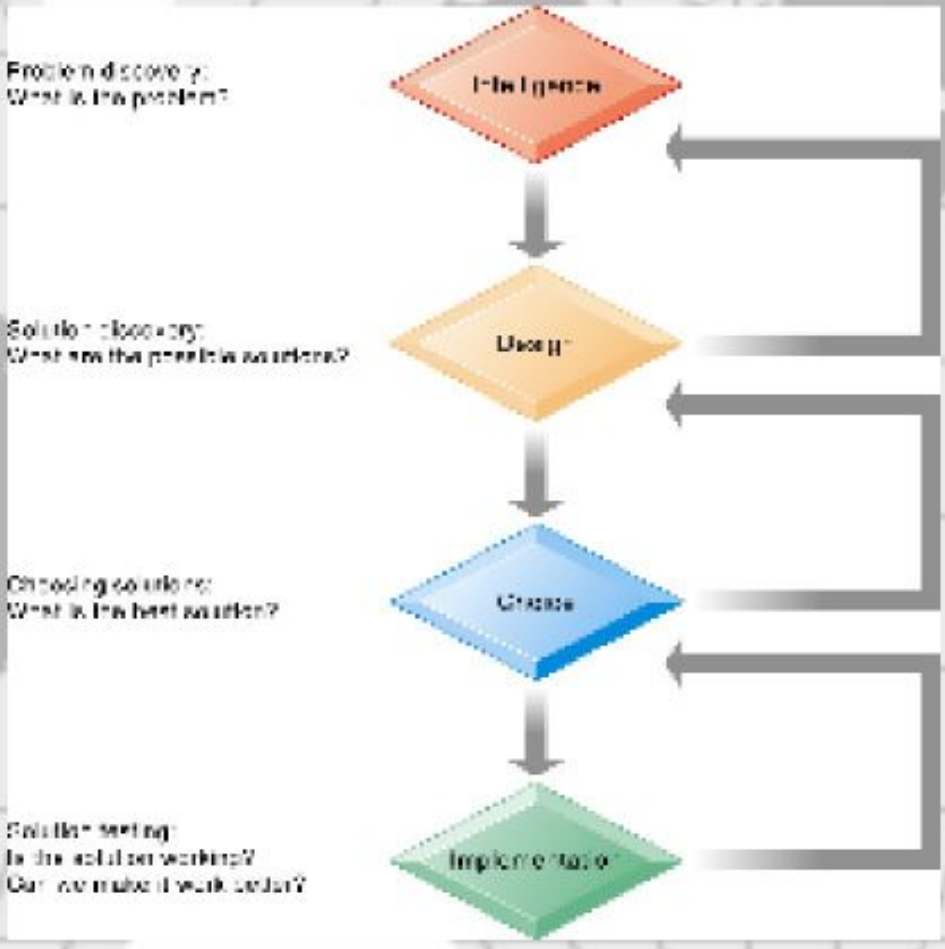
TRANSACTION PROCESSING SYSTEMS

- Moving up through the organizational pyramid users move from requiring transactional information to analytical information



- **Four stages of decision making**
  1. **Intelligence**
     - Discovering, identifying, and understanding the problems occurring in the organization
  2. **Design**
     - Identifying and exploring solutions to the problem
  3. **Choice**
     - Choosing among solution alternatives
  4. **Implementation**
     - Making chosen alternative work and continuing to monitor how well solution is working

Stages in Decision Making



The decision-making process is broken down into four stages.

Figure 12-2

- **Information systems can only assist in some of the roles played by managers**
- **Classical model of management**
  - Five functions of managers
    - Planning, organizing, coordinating, deciding, and controlling
- **More contemporary behavioral models**
  - Actual behavior of managers appears to be less systematic, more informal, less reflective, more reactive, and less well organized than in classical model
  - Mintzberg's behavioral model of managers defines 10 managerial roles falling into 3 categories

- **Mintzberg's 10 managerial roles**
  - **Interpersonal roles:** Figurehead
    Leader
    Liaison
  - **Informational roles:** Nerve center
    Disseminator
    Spokesperson
  - **Decisional roles:** Entrepreneur
    Disturbance handler
    Resource allocator
    Negotiator

- **Three main reasons why investments in information technology do not always produce positive results**

1. **Information quality**
   - High-quality decisions require high-quality information
2. **Management filters**
   - Managers have selective attention and have variety of biases that reject information that does not conform to prior conceptions
3. **Organizational culture**
   - Strong forces within organizations resist making decisions calling for major change

TRANSACTION PROCESSING SYSTEMS

- *Transactional information*
  - all of the information contained within a single business process or unit of work; purpose is to support daily operational work
- *Transaction processing system (TPS)*
  - - the basic business system that serves the operational level (analysts) in an organization; designed to process business events and transactions

TRANSACTION PROCESSING SYSTEMS

- **Processing** – the capturing of transaction & event information using technology to
  1) Process the information according to defined business rules,
  2) Store the information,
  3) Update existing information to reflect the new information

- Processing can be either:
  - **Batch** – grouped and processed together at a later time
  - **Online (real-time)** – processed individually in real-time

- Four kinds of systems for decision support
  - Management information systems (MIS)
  - Decision support systems (DSS)
  - Executive support systems (ESS)
  - Group decision support systems (GDSS)

- **Management information systems (MIS)**
  - Help managers monitor and control business by providing information on firm's performance and address structured problems
  - Typically produce fixed, regularly scheduled reports based on data from TPS
    - E.g., **exception reports**: Highlighting exceptional conditions, such as sales quotas below anticipated level
  - E.g., **California Pizza Kitchen MIS**
    - For each restaurant, compares amount of ingredients used per ordered menu item to predefined portion measurements and identifies restaurants with out-of-line portions

- **Decision-support systems (DSS)**
  - Support unstructured and semistructured decisions
  - **Model-driven DSS**
    - Earliest DSS were heavily model-driven
    - E.g., voyage-estimating DSS (Chapter 2)
  - **Data-driven DSS**
    - Some contemporary DSS are data-driven
    - Use OLAP and data mining to analyze large pools of data
    - E.g., business intelligence applications (Chapter 6)

- **Components of DSS**
  - **Database**
    - Used for query and analysis
    - Current or historical data from number of applications or groups
    - May be small database or large data warehouse
  - **User interface**
    - Often a Web interface
  - **Software system**
    - With models, data mining, other analytical tools

DECISION SUPPORT SYSTEMS

Three quantitative models used by DSSs include:

- ***What-if analysis*** – checks the impact of a change in an assumption on the proposed solution; making a hypothetical change to problem data and observing the impact on the results; "what will happen?"
- ***Sensitivity analysis*** – the study of the impact that changes in one (or more) parts of the model have on other parts of the model (repeated changes)
- ***Goal-seeking analysis*** – finds the inputs necessary to achieve a goal such as a desired level of output; determining the data required for a given result; setting a target value or goal to achieve, then determining "how to get it"

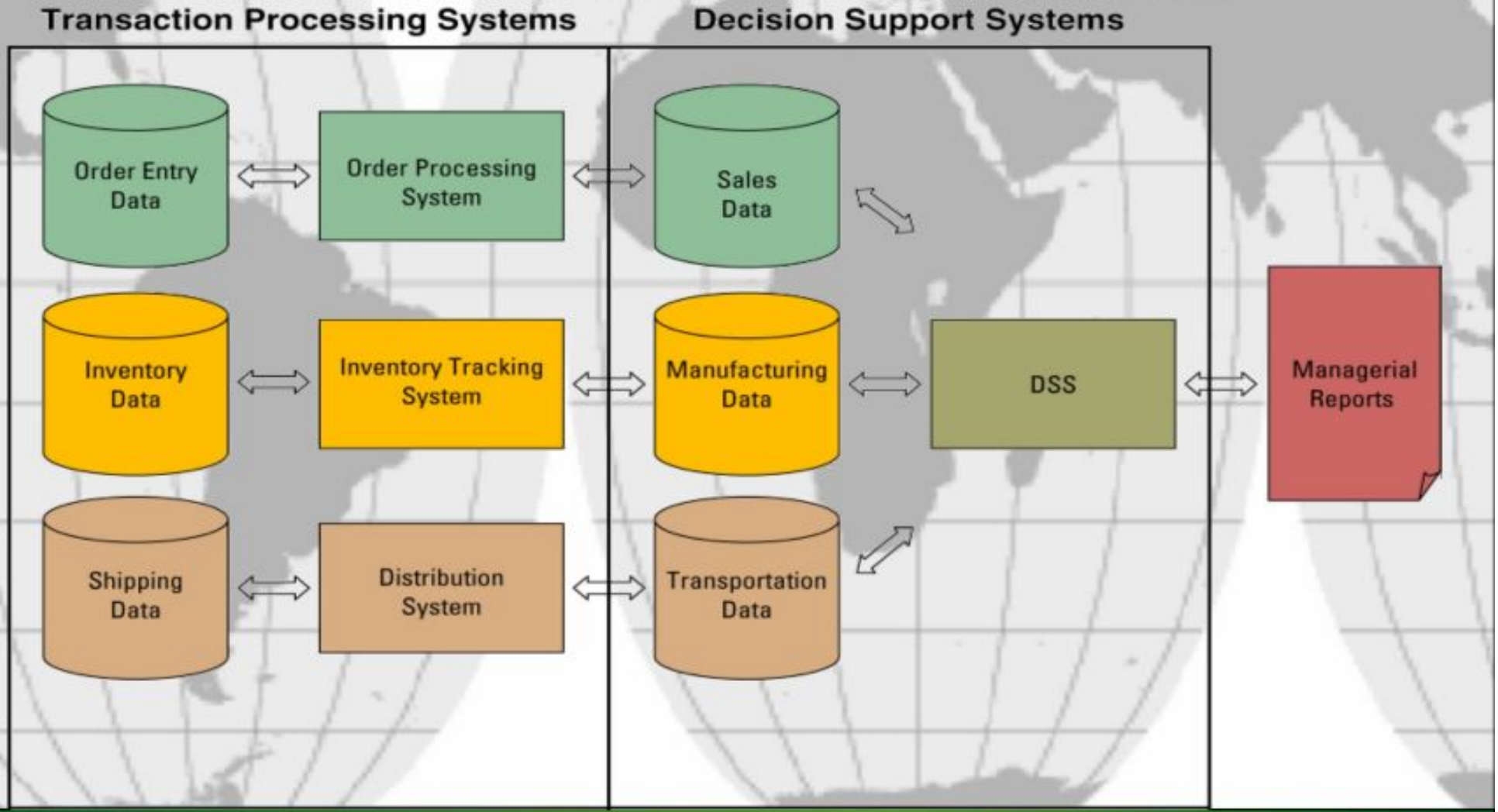
Overview of a Decision-Support System

The main components of the DSS are the DSS database, the user interface, and the DSS software system. The DSS database may be a small database residing on a PC or a large data warehouse.

Figure 12-3

DECISION SUPPORT SYSTEMS

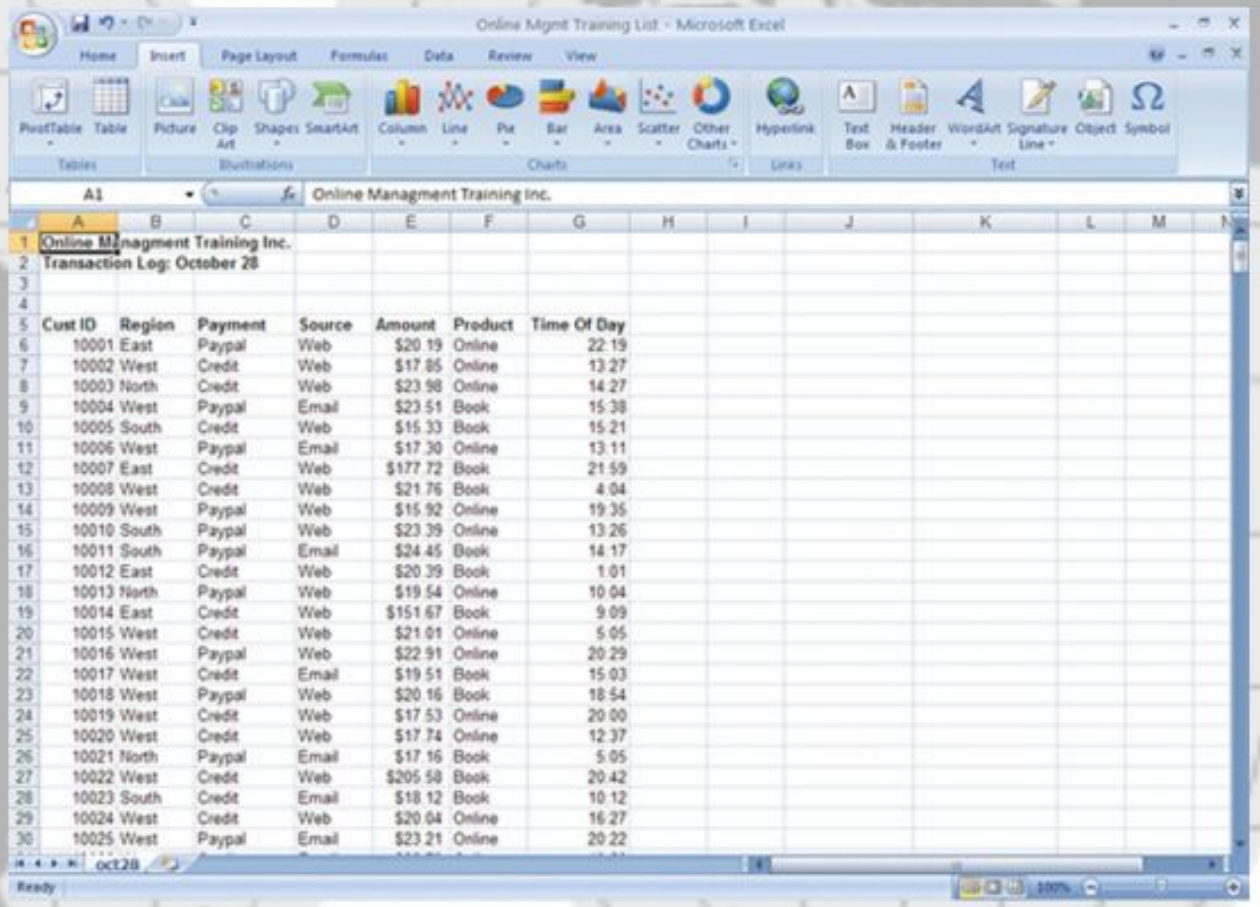
- Interaction between a TPS and a DSS



- **Model:**
  - Abstract representation that illustrates components or relationships of phenomenon; may be physical, mathematical, or verbal model
  - **Statistical models**
  - **Optimization models**
  - **Forecasting models**
  - **Sensitivity analysis models**

- **Using spreadsheet pivot tables to support decision making**
  - Records of online transactions can be analyzed using Excel
    - Where do most customers come from?
    - Where are average purchases higher?
    - What time of day do people buy?
    - What kinds of ads work best?
  - **Pivot table**:
    - Categorizes and summarizes data very quickly
    - Displays two or more dimensions of data in a convenient format

Sample List of Transactions for Online Management Training



Online Mgmt Training List - Microsoft Excel

A1: Online Managment Training Inc.

	A	B	C	D	E	F	G
1	Online Management Training Inc.						
2	Transaction Log: October 28						
3							
4							
5	Cust ID	Region	Payment	Source	Amount	Product	Time Of Day
6	10001	East	Paypal	Web	$20.19	Online	22:19
7	10002	West	Credit	Web	$17.85	Online	13:27
8	10003	North	Credit	Web	$23.98	Online	14:27
9	10004	West	Paypal	Email	$23.51	Book	15:38
10	10005	South	Credit	Web	$15.33	Book	15:21
11	10006	West	Paypal	Email	$17.30	Online	13:11
12	10007	East	Credit	Web	$177.72	Book	21:59
13	10008	West	Credit	Web	$21.76	Book	4:04
14	10009	West	Paypal	Web	$15.92	Online	19:35
15	10010	South	Paypal	Web	$23.39	Online	13:26
16	10011	South	Paypal	Email	$24.45	Book	14:17
17	10012	East	Credit	Web	$20.39	Book	1:01
18	10013	North	Paypal	Web	$19.54	Online	10:04
19	10014	East	Credit	Web	$151.67	Book	9:09
20	10015	West	Credit	Web	$21.01	Online	5:05
21	10016	West	Paypal	Web	$22.91	Online	20:29
22	10017	West	Credit	Email	$19.51	Book	15:03
23	10018	West	Paypal	Web	$20.16	Book	18:54
24	10019	West	Credit	Web	$17.53	Online	20:00
25	10020	West	Credit	Web	$17.74	Online	12:37
26	10021	North	Paypal	Email	$17.16	Book	5:05
27	10022	West	Credit	Web	$205.58	Book	20:42
28	10023	South	Credit	Email	$18.12	Book	10:12
29	10024	West	Credit	Web	$20.04	Online	16:27
30	10025	West	Paypal	Email	$23.21	Online	20:22

This list shows a portion of the order transactions for Online Management Training Inc. (OMT Inc.) on October 28, 2008.

Figure 12-5

- **Data visualization tools:**
  - Help users see patterns and relationships in large amounts of data that would be difficult to discern if data were presented as traditional lists of text
- **Geographic information systems (GIS):**
  - Category of DSS that use data visualization technology to analyze and display data in form of digitized maps
  - Used for decisions that require knowledge about geographic distribution of people or other resources, e.g.:
    - Helping local governments calculate emergency response times to natural disasters
    - Help retail chains identify profitable new store locations

- **Web-based customer decision-support systems (CDSS):**
  - Support decision-making process of existing or potential customer
  - Use Web information resources and capabilities for interactivity and personalization to help users select products and services
    - E.g., search engines, intelligent agents, online catalogs, Web directories, newsgroup discussions, other tools
  - Automobile companies that use CDSS to allow Web site visitors to configure desired car
  - Financial services companies with Web-based asset-management tools for customers

- **Group decision support systems (GDSS)**
  - Interactive system to facilitate solution of unstructured problems by group of decision makers
  - Hardware – computer and networking hardware, overhead projectors, display screens
  - GDSS software collects, documents, ranks, edits and stores participant ideas, responses
  - May require facilitator and staff
  - Enables increasing meeting size and increasing productivity
  - Promotes collaborative atmosphere, guaranteeing anonymity
  - Follow structured methods for organizing and evaluating ideas and preserving meeting results

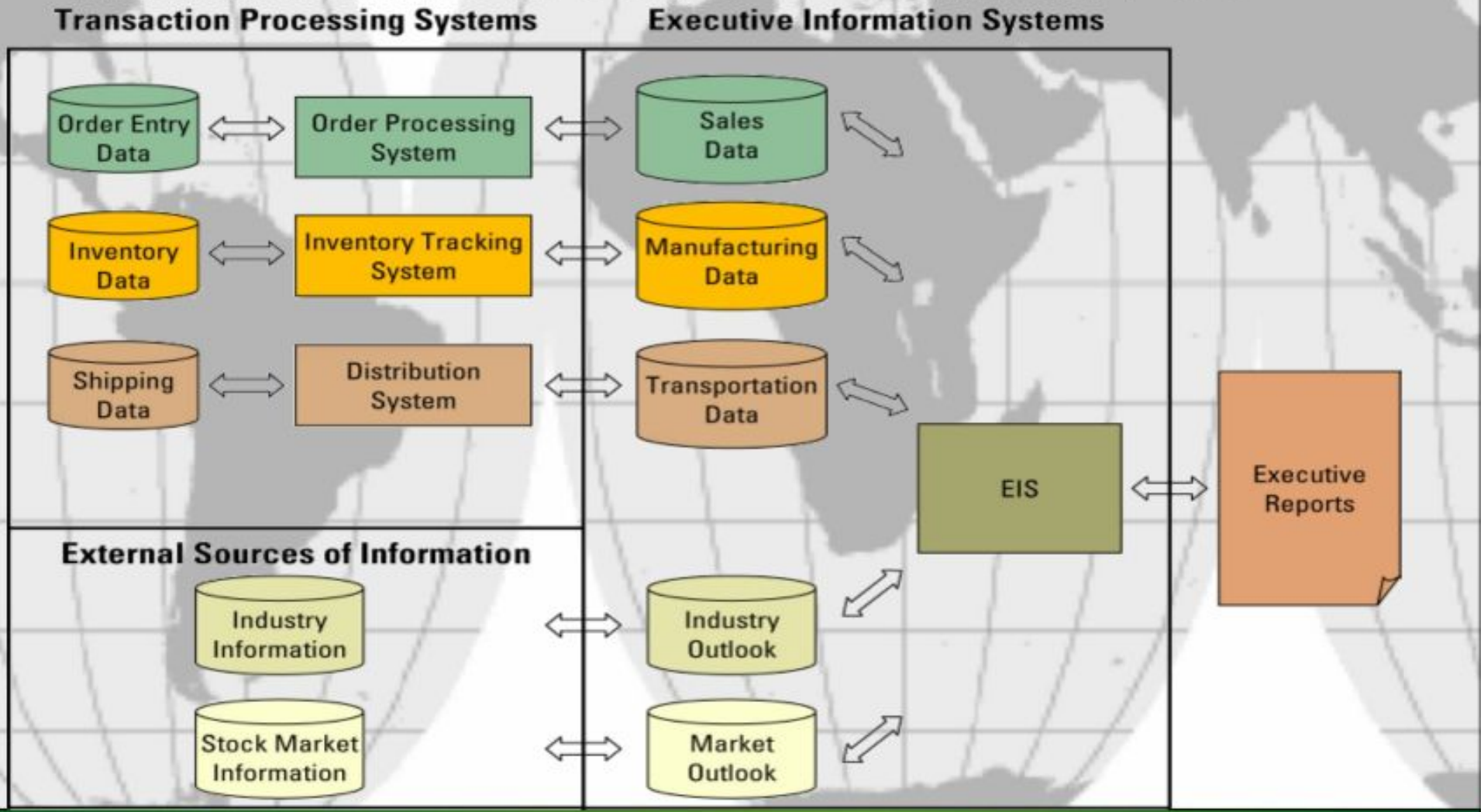
- **Executive support systems (ESS)**
  - Designed to help executives focus on important performance indications
  - Balanced scorecard method:
    - Measures outcomes on four dimensions:
      - Financial
      - Business process
      - Customer
      - Learning & growth
    - Key performance indicators (KPIs) measure each dimension
  - In developing an ESS, first concern is for senior executives and consultants to develop scorecard and then to automate flow of information for each KPI

Executive Support Systems (ESS)

- **Role of ESS in the firm**
  - Used by both executives and subordinates
  - Drill-down capability: Ability to move from summary information to finer levels of detail
  - Integrate data from different functional systems for firmwide view
  - Incorporate external data, e.g. stock market news, competitor information, industry trends, legislative action
  - Include tools for modeling and analysis
    - Primarily for status, comparison information about performance

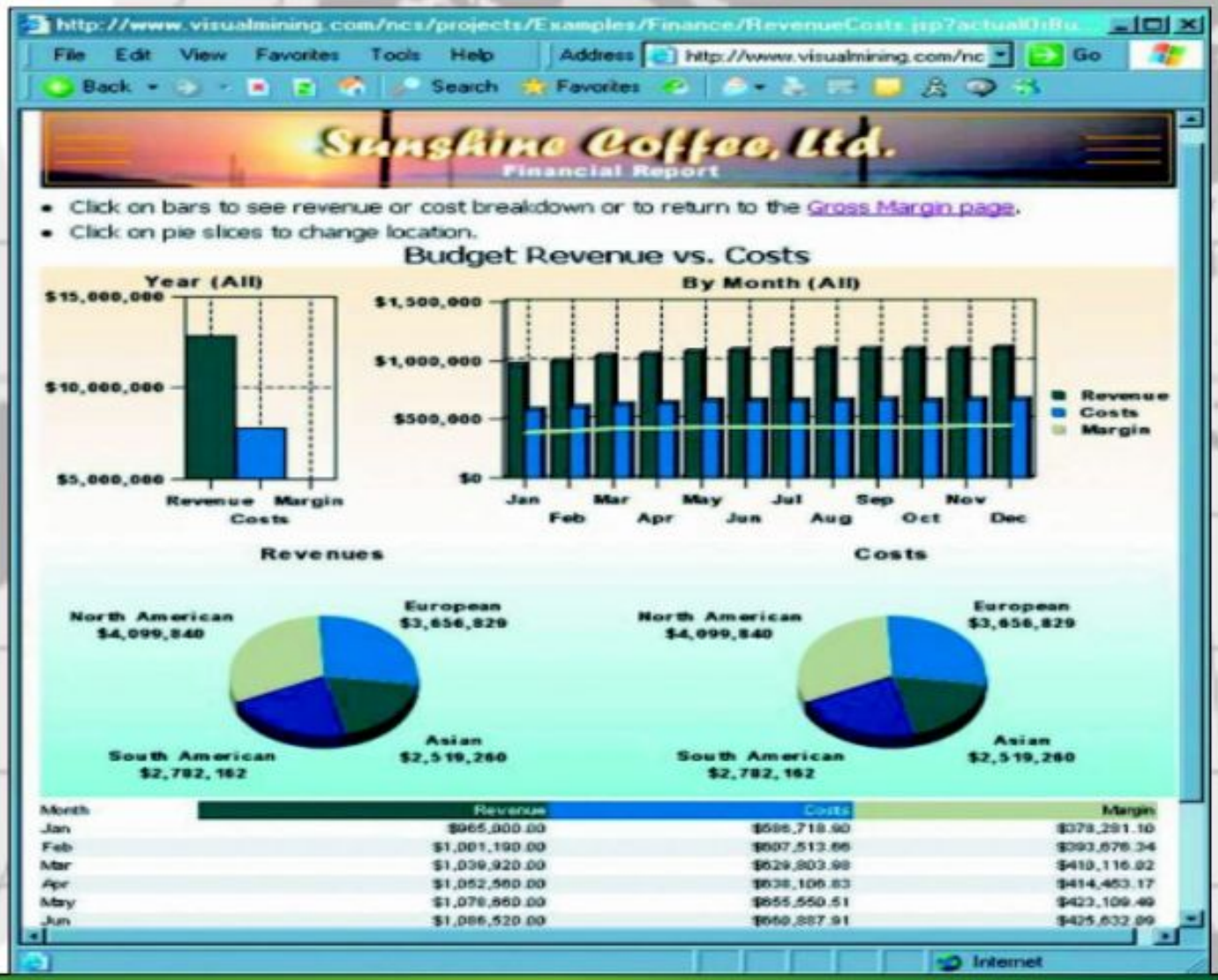
EXECUTIVE INFORMATION SYSTEMS

- Interaction between a TPS and an ESS



Digital Dashboards

- ***Digital dashboard*** – integrates information from multiple components and presents it in a unified display



Digital Dashboards

- **Business value of executive support systems**
  - Enables executive to review more data in less time with greater clarity than paper-based systems
    - Needed actions identified and carried out earlier
  - Improves management performance
  - Increases upper management's span of control
    - Also enables decision making to be decentralized and take place at lower operating levels
  - Increases executives' ability to monitor activities of lower units reporting to them

- **National Life**
  - Markets life insurance, health insurance, and retirement/ investment products executive information system
  - Executive information system:
    - Allows senior managers to access corporate databases through Web interface
    - Shows premium dollars by salesperson
    - Authorized users can drill down into these data to see product, agent, and client for each sale
    - Data can be examined by region, by product, and by broker, and accessed for monthly, quarterly, and annual time periods

Chapter 4

Ethical and Social Issues in Information Systems

LEARNING OBJECTIVES

- Identify the ethical, social, and political issues that are raised by information systems.
- Identify the principles for conduct that can be used to guide ethical decisions.
- Evaluate the impact of contemporary information systems and the Internet on the protection of individual privacy and intellectual property.
- Assess how information systems have affected everyday life.

Understanding Ethical and Social Issues Related to Systems

- **Ethics**
  - Principles of right and wrong that individuals, acting as free moral agents, use to make choices to guide their behavior
- **Information systems and ethics**
  - Information systems raise new ethical questions because they create opportunities for:
    - Intense social change, threatening existing distributions of power, money, rights, and obligations
    - New kinds of crime

Understanding Ethical and Social Issues Related to Systems

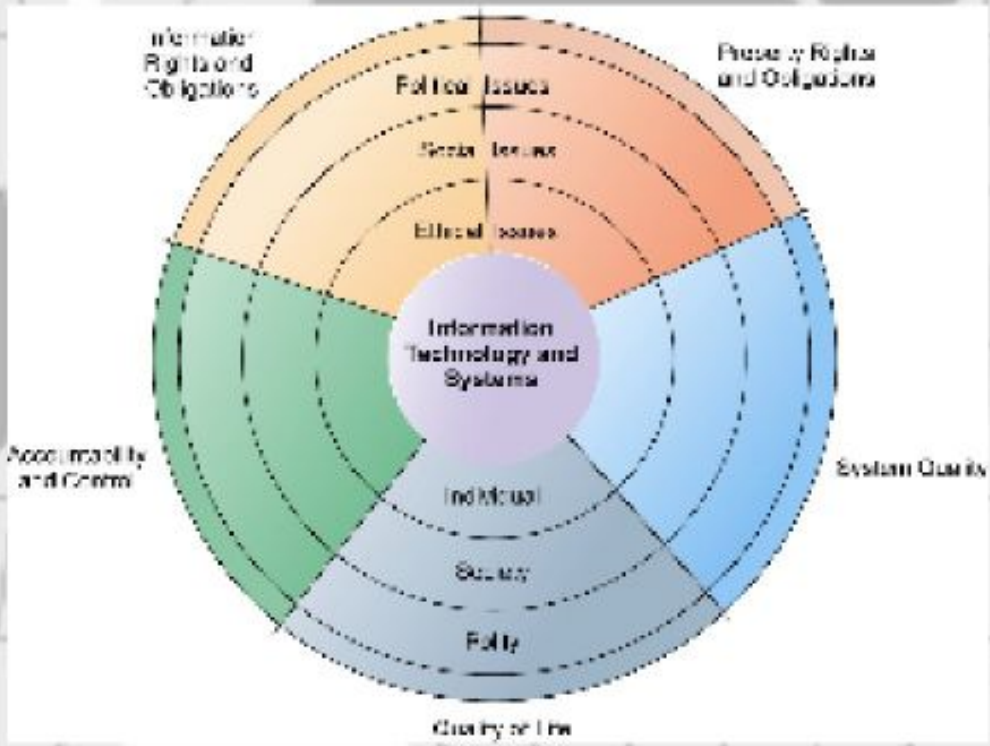
- **A model for thinking about ethical, social, and political issues**
  - Society as a calm pond
  - IT as a rock dropped in pond, creating ripples of new situations not covered by old rules
  - Social and political institutions cannot respond overnight to these ripples — it may take years to develop etiquette, expectations, laws
  - Requires understanding of ethics to make choices in legally gray areas

Understanding Ethical and Social Issues Related to Systems

- **A model for thinking about ethical, social, and political issues**
  - Ethical, social, and political issues are closely linked.
  - Introduction of new technology has a ripple effect in the current equilibrium, creating new ethical, social, and political issues that must be dealt with on individual, social, and political levels.
  - Both social and political institutions require time before developing new behaviours, rules, and laws.

Understanding Ethical and Social Issues Related to Systems

The Relationship Between Ethical, Social, and Political Issues in an Information Society



The introduction of new information technology has a ripple effect, raising new ethical, social, and political issues that must be dealt with on the individual, social, and political levels. These issues have five moral dimensions: information rights and obligations, property rights and obligations, system quality, quality of life, and accountability and control.

Figure 4-1

Understanding Ethical and Social Issues Related to Systems

- Five moral dimensions of information age
  - Major issues raised by information systems include:
    - Information rights and obligations
    - Property rights and obligations
    - Accountability and control
    - System quality
    - Quality of life

Understanding Ethical and Social Issues Related to Systems

- **Four key technology trends that raise ethical issues**
  - **Computing power doubles every 18 months**
    - allowing growing numbers of organizations to use information systems in their core business processes. This growing dependence on critical systems increases vulnerability to system errors and poor data quality.
  - **Data storage costs rapidly declining**
    - have enabled for the multiplying databases on individuals maintained by private and public organizations - making the violation of individual **privacy** both cheap and effective.

Understanding Ethical and Social Issues Related to Systems

- **Four key technology trends that raise ethical issues**
  - **Data analysis advances**
    - enable companies and government agencies use **profiling** to determine detailed information about individual's habits and tastes and create dossiers of detailed information.
      - **Nonobvious relationship awareness (NORA)** is a new data analysis technology that can take data about people from many sources and correlate relationships to find hidden connections to identify potential criminals and terrorists
  - **Networking advances and the Internet**
    - Enables moving and accessing large quantities of personal data

Understanding Ethical and Social Issues Related to Systems

Nonobvious Relationship Awareness (NORA)

NORA technology can take information about people from disparate sources and find obscure, nonobvious relationships. It might discover, for example, that an applicant for a job at a casino shares a telephone number with a known criminal and issue an alert to the hiring manager.

Figure 4-2

Ethics in an Information Society

- **Basic concepts form the underpinning of an ethical analysis of information systems and those who manage them**
  - **Responsibility:** Accepting the potential costs, duties, and obligations for decisions
  - **Accountability:** Mechanisms for identifying responsible parties
  - **Liability:** Permits individuals (and firms) to recover damages done to them
  - **Due process:** Laws are well known and understood, with an ability to appeal to higher authorities

Ethics in an Information Society

- **Ethical analysis: A five-step process**

1. Identify and clearly describe the facts
2. Define the conflict or dilemma and identify the higher-order values involved
3. Identify the stakeholders
4. Identify the options that you can reasonably take
5. Identify the potential consequences of your options

Ethics in an Information Society

- **Candidate Ethical Principles**
  - **Golden Rule**
    - Do unto others as you would have them do unto you
  - **Immanuel Kant's Categorical Imperative**
    - If an action is not right for everyone to take, it is not right for anyone
  - **Descartes' rule of change**
    - If an action cannot be taken repeatedly, it is not right to take at all

Ethics in an Information Society

- **Candidate Ethical Principles (cont.)**
  - **Utilitarian Principle**
    - Take the action that achieves the higher or greater value
  - **Risk Aversion Principle**
    - Take the action that produces the least harm or least potential cost
  - **Ethical "no free lunch" rule**
    - Assume that virtually all tangible and intangible objects are owned by someone unless there is a specific declaration otherwise

Ethics in an Information Society

- **Professional codes of conduct**
  - Promulgated by associations of professionals
    - E.g. AMA, ABA, AITP, ACM
  - Promises by professions to regulate themselves in the general interest of society
- **Real-world ethical dilemmas**
  - One set of interests pitted against another
  - E.g., Right of company to maximize productivity of workers vs. workers right to use Internet for short personal tasks

The Moral Dimensions of Information Systems

- **Information rights and obligations**
  - **Privacy**
    - Claim of individuals to be left alone, free from surveillance or interference from other individuals, organizations, or the state.
    - Ability to control information about yourself
  - In U.S., privacy protected by:
    - First Amendment (freedom of speech)
    - Fourth Amendment (unreasonable search and seizure)
    - Additional federal statues
      - Privacy Act of 1974

The Moral Dimensions of Information Systems

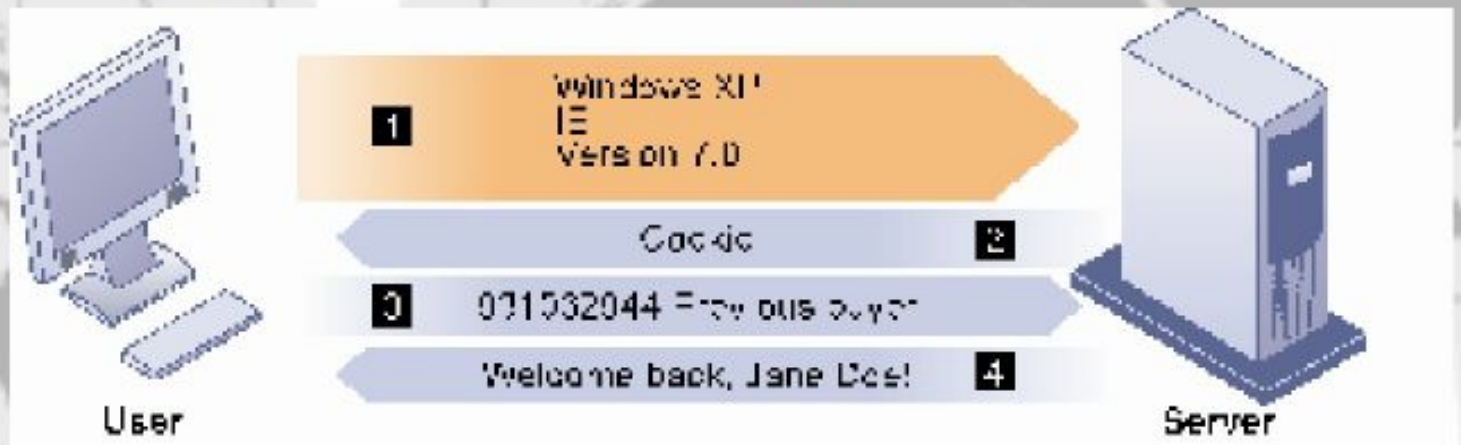
- **FTC FIP principles:**
  - **Notice/awareness (core principle):** Web sites must disclose practices before collecting data
  - **Choice/consent (core principle):** Consumers must be able to choose how information is used for secondary purposes
  - **Access/participation**: Consumers must be able to review, contest accuracy of personal data
  - **Security**: Data collectors must take steps to ensure accuracy, security of personal data
  - **Enforcement**: Must be mechanism to enforce FIP principles

The Moral Dimensions of Information Systems

- **Internet Challenges to Privacy:**
  - **Cookies**
    - Tiny files downloaded by Web site to visitor's hard drive
    - Identify visitor's browser and track visits to site
    - Allow Web sites to develop profiles on visitors
  - **Web bugs**
    - Tiny graphics embedded in e-mail messages and Web pages
    - Designed to monitor who is reading a message and transmitting that information to another computer on the Internet
  - **Spyware**
    - Surreptitiously installed on user's computer
    - May transmit user's keystrokes or display unwanted ads

The Moral Dimensions of Information Systems

How Cookies Identify Web Visitors



1. The Web server reads the user's Web browser and determines the operating system, browser name, version number, Internet address, and other information.
2. The server transmits a tiny text file with user identification information called a cookie, which the user's browser receives and stores on the user's computer hard drive.
3. When the user returns to the Web site, the server requests the contents of any cookie it deposited previously in the user's computer.
4. The Web server reads the cookie, identifies the visitor, and calls up data on the user

Cookies are written by a Web site on a visitor's hard drive. When the visitor returns to that Web site, the Web server requests the ID number from the cookie and uses it to access the data stored by that server on that visitor. The Web site can then use these data to display personalized information.

Figure 4-3

The Moral Dimensions of Information Systems

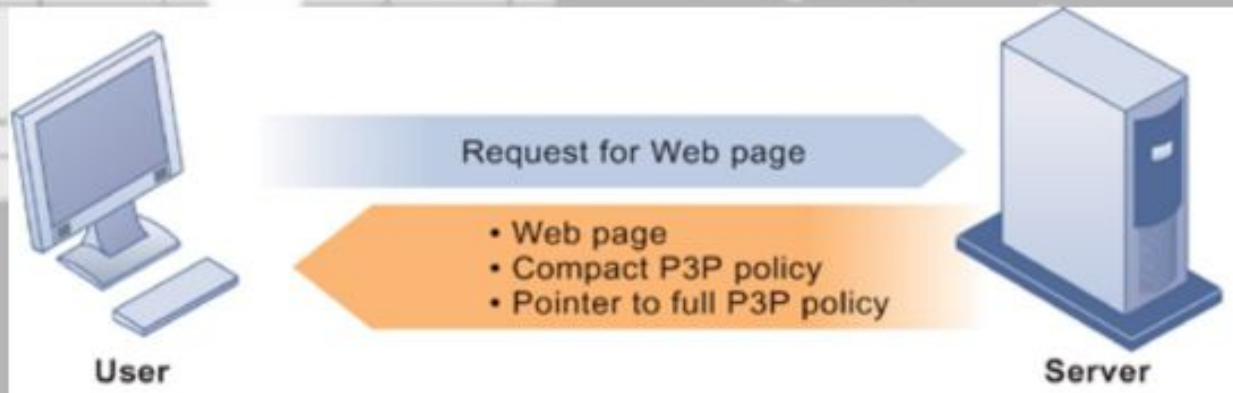
- U.S. allows businesses to gather transaction information and use this for other marketing purposes
- Online industry promotes self-regulation over privacy legislation
- Self regulation has proven highly variable
  - Statements of information use are quite different
  - Some firms offer opt-out selection boxes
  - Online "seals" of privacy principles
- Most Web sites do not have any privacy policies
- Many online privacy policies do not protect customer privacy, but rather protect the firm from lawsuits

The Moral Dimensions of Information Systems

- Technical solutions
  - The Platform for Privacy Preferences (P3P)
    - Allows Web sites to communicate privacy policies to visitor's Web browser – user
    - User specifies privacy levels desired in browser settings
    - E.g., "medium" level accepts cookies from first-party host sites that have opt-in or opt-out policies but rejects third-party cookies that use personally identifiable information without an opt-in policy.

The Moral Dimensions of Information Systems

The P3P Standard



1. The user with P3P Web browsing software requests a Web page.
2. The Web server returns the Web page along with a compact version of the Web site's policy and a pointer to the full P3P policy. If the Web site is not P3P compliant, no P3P data are returned.
3. The user's Web browsing software compares the response from the Web site with the user's privacy preferences. If the Web site does not have a P3P policy or the policy does not match the privacy levels established by the user, it warns the user or rejects the cookies from the Web site. Otherwise, the Web page loads normally.

P3P enables Web sites to translate their privacy policies into a standard format that can be read by the user's Web browser software. The user's Web browser software evaluates the Web site's privacy policy to determine whether it is compatible with the user's privacy preferences.

Figure 4-4

The Moral Dimensions of Information Systems

- **Property Rights: Intellectual Property**
  - **Intellectual property:** Intangible property of any kind created by individuals or corporations
  - Three ways that intellectual property is protected
    - **Trade secret**: Intellectual work or product belonging to business, not in the public domain
    - **Copyright**: Statutory grant protecting intellectual property from being copied for the life of the author, plus 70 years
    - **Patents**: Grants creator of invention an exclusive monopoly on ideas behind invention for 20 years

The Moral Dimensions of Information Systems

- **Challenges to Intellectual Property Rights**
  - Digital media different from physical media (e.g. books)
    - Ease of replication
    - Ease of transmission (networks, Internet)
    - Difficulty in classifying software
    - Compactness
    - Difficulties in establishing uniqueness
- **Digital Millenium Copyright Act (DMCA)**
  - Makes it illegal to circumvent technology-based protections of copyrighted materials

The Moral Dimensions of Information Systems

- **Accountability, Liability, Control**
  - Computer-related liability problems
    - If software fails, who is responsible?
      - If seen as a part of a machine that injures or harms, software producer and operator may be liable
      - If seen as similar to a book, difficult to hold software author/publisher responsible
      - What should liability be if software is seen as service? Would this be similar to telephone systems not being liable for transmitted messages (so-called "common carriers")

The Moral Dimensions of Information Systems

- **System Quality: Data Quality and System Errors**
  - What is an acceptable, technologically feasible level of system quality?
    - Flawless software is economically unfeasible
  - Three principal sources of poor system performance:
    - Software bugs, errors
    - Hardware or facility failures
    - Poor input data quality (most common source of business system failure)

The Moral Dimensions of Information Systems

- **Quality of Life:** Negative social consequences of systems
  - **Balancing power**: Although computing power is decentralizing, key decision-making power remains centralized
  - **Rapidity of change**: Businesses may not have enough time to respond to global competition
  - **Maintaining boundaries**: Computing and Internet use lengthens the work-day, infringes on family, personal time
  - **Dependence and vulnerability**: Public and private organizations ever more dependent on computer systems

The Moral Dimensions of Information Systems

- **Computer crime and abuse**
  - **Computer crime**: Commission of illegal acts through use of compute or against a computer system – computer may be object or instrument of crime
  - **Computer abuse**: Unethical acts, not illegal
    - **Spam**: High costs for businesses in dealing with spam
- **Employment:** Reengineering work resulting in lost jobs
- **Equity and access – the digital divide**: Certain ethnic and income groups in the United States less likely to have computers or Internet access

The Moral Dimensions of Information Systems

- **Health risks:**
  - Repetitive stress injury (RSI)
    - Largest source is computer keyboards
    - Carpal Tunnel Syndrome (CTS)
  - Computer vision syndrome (CVS)
  - Technostress
  - Role of radiation, screen emissions, low-level electromagnetic fields

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Chapter 8

Securing Information Systems

LEARNING OBJECTIVES

- Explain why information systems are vulnerable to destruction, error, and abuse.
- Assess the business value of security and control.
- Identify the components of an organizational framework for security and control.
- Evaluate the most important tools and technologies for safeguarding information resources.

System Vulnerability and Abuse

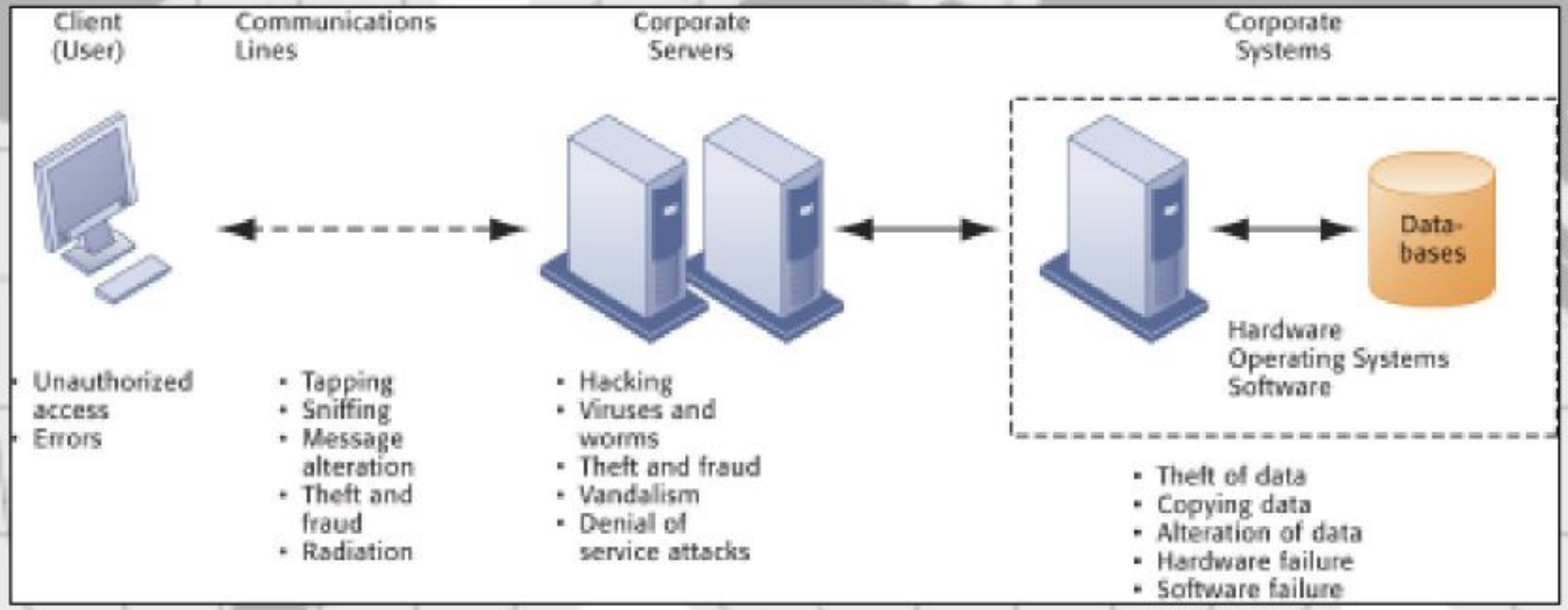
- **Security:**
  - Policies, procedures and technical measures used to prevent unauthorized access, alteration, theft, or physical damage to information systems
- **Controls:**
  - Methods, policies, and organizational procedures that ensure safety of organization's assets; accuracy and reliability of its accounting records; and operational adherence to management standards

System Vulnerability and Abuse

- Threats to Computerized Information Systems
  - Hardware problems
    - Breakdowns, configuration errors, damage from improper use or crime
  - Software problems
    - Programming errors, installation errors, unauthorized changes)
  - Disasters
    - Power failures, flood, fires, etc.
  - Use of networks and computers outside of firm's control
    - E.g., with domestic or offshore outsourcing vendors

System Vulnerability and Abuse

Contemporary Security Challenges and Vulnerabilities



The architecture of a Web-based application typically includes a Web client, a server, and corporate information systems linked to databases. Each of these components presents security challenges and vulnerabilities. Floods, fires, power failures, and other electrical problems can cause disruptions at any point in the network.

Figure 8-1

System Vulnerability and Abuse

- Internet vulnerabilities
  - Network open to anyone
  - Size of Internet means abuses can have wide impact
  - Use of fixed Internet addresses with permanent connections to Internet eases identification by hackers
  - E-mail attachments
  - E-mail used for transmitting trade secrets
  - IM messages lack security, can be easily intercepted

System Vulnerability and Abuse

- **Wireless security challenges**
  - **Radio frequency bands easy to scan**
  - **SSIDs (service set identifiers)**
    - Identify access points
    - Broadcast multiple times
  - **War driving**
    - Eavesdroppers drive by buildings and try to intercept network traffic
    - When hacker gains access to SSID, has access to network's resources
  - **WEP (Wired Equivalent Privacy)**
    - Security standard for 802.11
    - Basic specification uses shared password for both users and access point
    - Users often fail to use security features

Wi-Fi Security Challenges

Many Wi-Fi networks can be penetrated easily by intruders using sniffer programs to obtain an address to access the resources of a network without authorization.

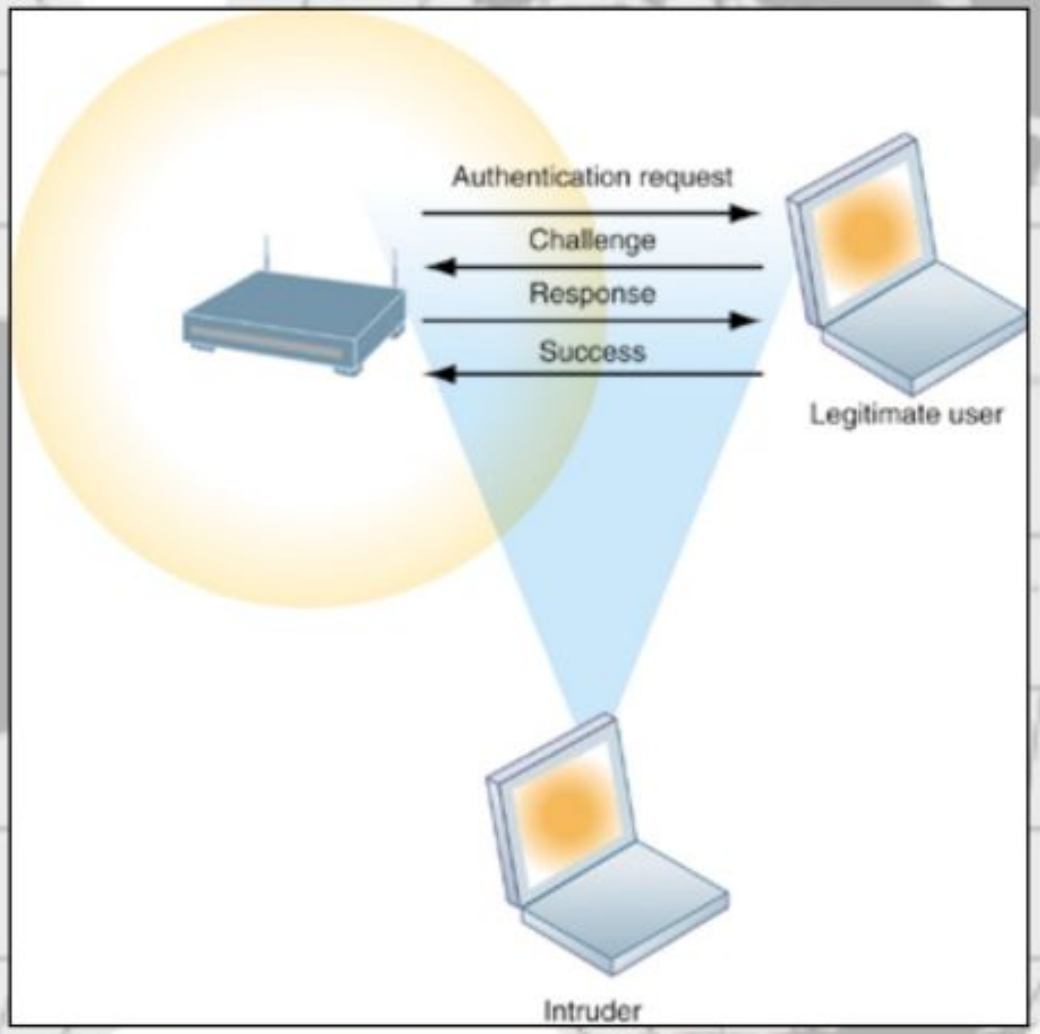


Figure 8-2

System Vulnerability and Abuse

- **Malicious software (malware)**
  - **Viruses:** Rogue software program that attaches itself to other software programs or data files in order to be executed
  - **Worms:** Independent computer programs that copy themselves from one computer to other computers over a network
  - **Trojan horses:** Software program that appears to be benign but then does something other than expected
  - **Spyware:** Small programs install themselves surreptitiously on computers to monitor user Web surfing activity and serve up advertising
    - **Key loggers:** Record every keystroke on computer to steal serial numbers, passwords, launch Internet attacks

System Vulnerability and Abuse

- Hackers and computer crime
  - Hackers vs. crackers
  - Activities include
    - System intrusion
    - Theft of goods and information
    - System damage
    - Cybervandalism
      - Intentional disruption, defacement, destruction of Web site or corporate information system

System Vulnerability and Abuse

- **Spoofing**
  - Misrepresenting oneself by using fake e-mail addresses or masquerading as someone else
  - Redirecting Web link to address different from intended one, with site masquerading as intended destination
- **Sniffer:** Eavesdropping program that monitors information traveling over network
- **Denial-of-service attacks (DoS):** Flooding server with thousands of false requests to crash the network
- **Distributed denial-of-service attacks (DDoS):** Use of numerous computers to launch a DoS
  - **Botnets:** Networks of "zombie" PCs infiltrated by bot malware

System Vulnerability and Abuse

- **Computer crime**
  - Defined as "any violations of criminal law that involve a knowledge of computer technology for their perpetration, investigation, or prosecution"
  - **Computer may be target of crime, e.g.:**
    - Breaching confidentiality of protected computerized data
    - Accessing a computer system without authority
  - **Computer may be instrument of crime, e.g.:**
    - Theft of trade secrets
    - Using e-mail for threats or harassment

System Vulnerability and Abuse

- **Identity theft:** Theft of personal Information (social security id, driver's license or credit card numbers) to impersonate someone else
- **Phishing:** Setting up fake Web sites or sending e-mail messages that look like legitimate businesses to ask users for confidential personal data.
- **Evil twins:** Wireless networks that pretend to offer trustworthy Wi-Fi connections to the Internet
- **Pharming:** Redirects users to a bogus Web page, even when individual types correct Web page address into his or her browser

System Vulnerability and Abuse

- **Click fraud**
  - Individual or computer program clicks online ad without any intention of learning more or making a purchase
- **Global threats - Cyberterrorism and cyberwarfare**
  - Concern that Internet vulnerabilities and other networks make digital networks easy targets for digital attacks by terrorists, foreign intelligence services, or other groups

System Vulnerability and Abuse

- Internal threats – Employees
  - Security threats often originate inside an organization
    - Inside knowledge
    - Sloppy security procedures
      - User lack of knowledge
    - Social engineering:
      - Tricking employees into revealing their passwords by pretending to be legitimate members of the company in need of information

System Vulnerability and Abuse

- Software vulnerability
  - Commercial software contains flaws that create security vulnerabilities
    - Hidden bugs (program code defects)
      - Zero defects cannot be achieved because complete testing is not possible with large programs
    - Flaws can open networks to intruders
  - Patches
    - Vendors release small pieces of software to repair flaws
    - However, amount of software in use can mean exploits created faster than patches be released and implemented

Business Value of Security and Control

- Lack of security, control can lead to
  - Loss of revenue
    - Failed computer systems can lead to significant or total loss of business function
  - Lowered market value:
    - Information assets can have tremendous value
    - A security breach may cut into firm's market value almost immediately
  - Legal liability
  - Lowered employee productivity
  - Higher operational costs

- Information systems controls
  - General controls
    - Govern design, security, and use of computer programs and data throughout organization's IT infrastructure
    - Combination of hardware, software, and manual procedures to create overall control environment
    - Types of general controls
      - Software controls
      - Hardware controls
      - Computer operations controls
      - Data security controls
      - Implementation controls
      - Administrative controls

- **Application controls**
  - Specific controls unique to each computerized application, such as payroll or order processing
  - Include both automated and manual procedures
  - Ensure that only authorized data are completely and accurately processed by that application
  - Types of application controls:
    - **Input controls**
    - **Processing controls**
    - **Output controls**

Establishing a Framework for Security and Control

- **Security policy**
  - Ranks information risks, identifies acceptable security goals, and identifies mechanisms for achieving these goals
  - Drives other policies
    - **Acceptable use policy (AUP):** Defines acceptable uses of firm's information resources and computing equipment
    - **Authorization policies:** Determine differing levels of user access to information assets
- **Authorization management systems**
  - Allow each user access only to those portions of system that person is permitted to enter, based on information established by set of access rules, profile

Establishing a Framework for Security and Control

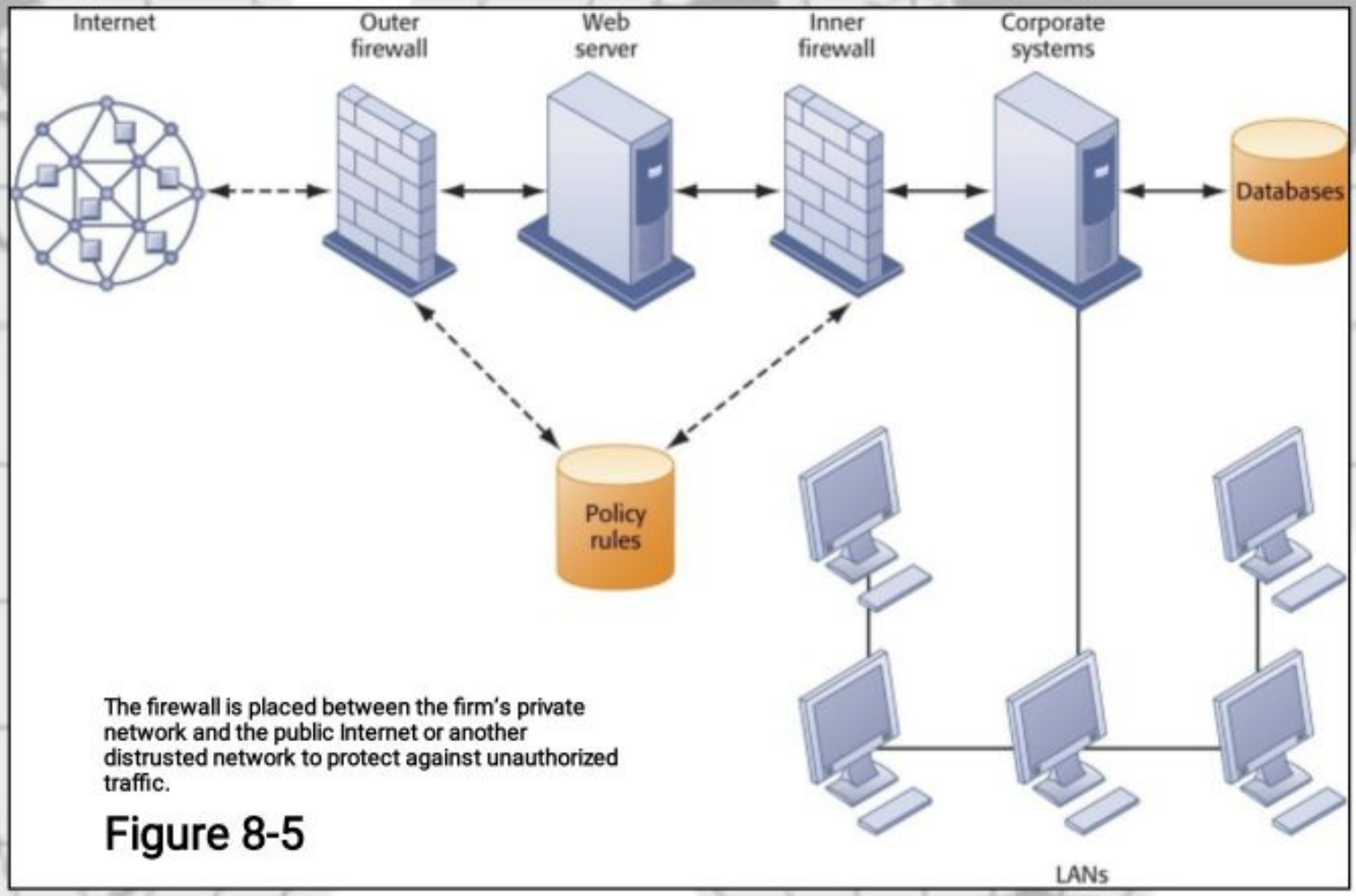
- **Disaster recovery planning:** Devises plans for restoration of disrupted services
- **Business continuity planning:** Focuses on restoring business operations after disaster
- Both types of plans needed to identify firm's most critical systems and business processes
  - Business impact analysis to determine impact of an outage
  - Management must determine
    - Maximum time systems can be down
    - Which systems must be restored first

- **MIS audit**
  - Examines firm's overall security environment as well as controls governing individual information systems
  - Reviews technologies, procedures, documentation, training, and personnel
  - May even simulate disaster to test response of technology, IS staff, other employees
  - Lists and ranks all control weaknesses and estimates probability of their occurrence
  - Assesses financial and organizational impact of each threat

- Access control: Policies and procedures to prevent improper access to systems by unauthorized insiders and outsiders
  - Authorization
  - Authentication
    - Password systems
    - Tokens
    - Smart cards
    - Biometric authentication

- **Firewall:** Hardware and/or software to prevent unauthorized access to private networks
  - Screening technologies
    - Packet filtering
    - Stateful inspection
    - Network address translation (NAT)
    - Application proxy filtering
- **Intrusion detection systems:** Monitor vulnerable points on networks to detect and deter intruders
  - Examines events as they are happening to discover attacks in progress
  - Scans network to find patterns indicative of attacks

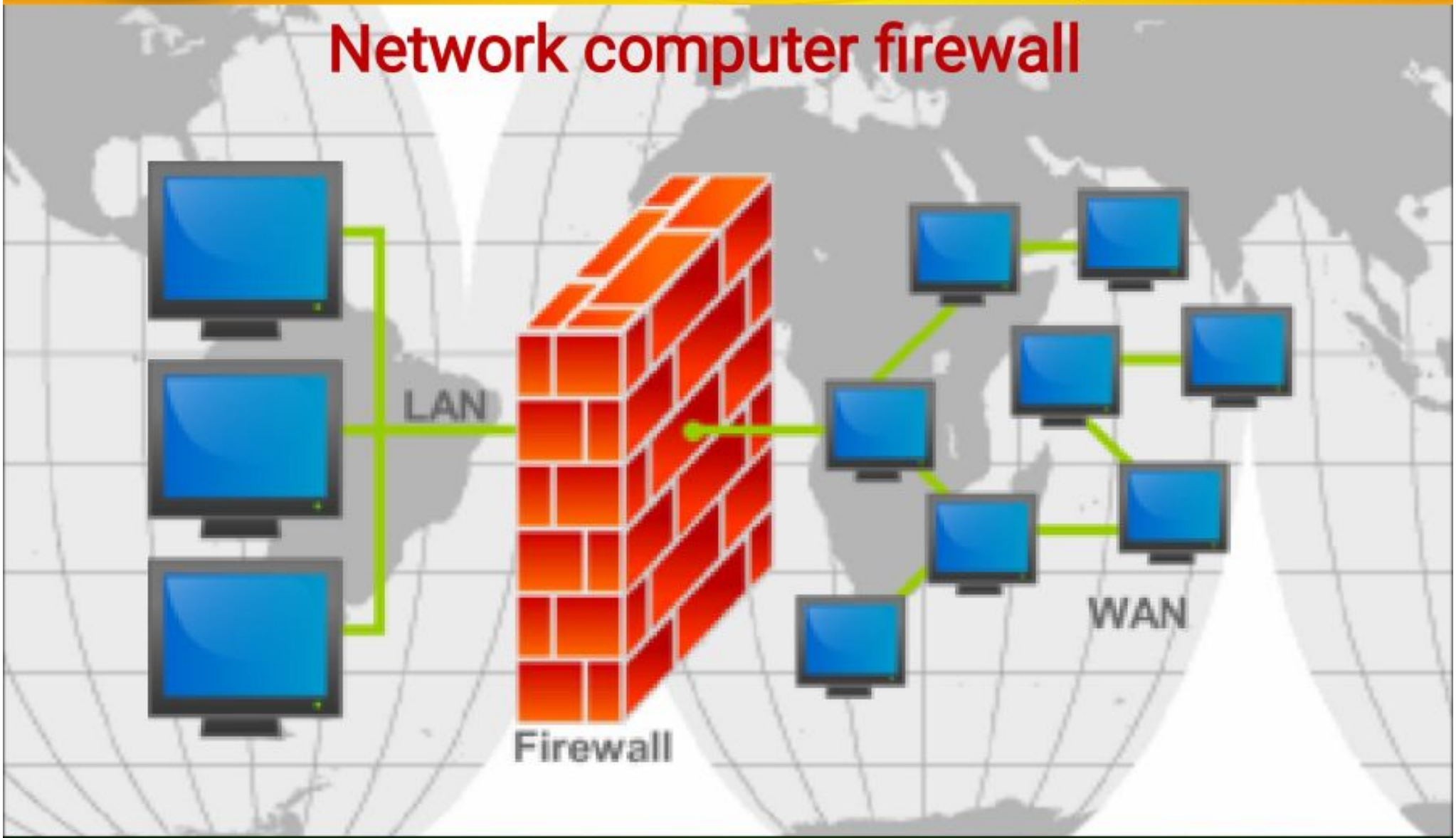
A Corporate Firewall



The firewall is placed between the firm's private network and the public Internet or another distrusted network to protect against unauthorized traffic.

Figure 8-5

Network computer firewall



- **Antivirus and antispyware software:**
  - Checks computers for presence of malware and can often eliminate it as well
  - Require continual updating
- Unified threat management (UTM)
  - Comprehensive security management products
  - Tools include
    - Firewalls
    - Intrusion detection
    - VPNs
    - Web content filtering
    - Antispam software

- Securing wireless networks
  - Wired Equivalent Privacy (WEP) security can be improved:
    - Activating it
    - Assigning unique name to network's SSID
    - Using it with VPN technology
  - Wi-Fi Alliance finalized WAP2 specification, replacing WEP with stronger standards
    - Continually changing keys
    - Encrypted authentication system with central server

- **Encryption:**
  - Transforming text or data into cipher text that cannot be read by unintended recipients
  - **Two methods for encrypting network traffic**
    - Secure Sockets Layer (SSL) and its successor Transport Layer Security (TLS)
    - Secure Hypertext Transfer Protocol (S-HTTP)
  - **Two methods of encryption**
    - Symmetric key encryption (The sender and receiver create a single encryption key that is shared).
    - Public key encryption (uses two different keys, one private and one public).

Public Key Encryption

A public key encryption system can be viewed as a series of public and private keys that lock data when they are transmitted and unlock the data when they are received. The sender locates the recipient's public key in a directory and uses it to encrypt a message. The message is sent in encrypted form over the Internet or a private network. When the encrypted message arrives, the recipient uses his or her private key to decrypt the data and read the message.

Figure 7-6

- **Digital certificate:**
  - Data file used to establish the identity of users and electronic assets for protection of online transactions
  - Uses a trusted third party, certification authority (CA), to validate a user's identity
  - CA verifies user's identity, stores information in CA server, which generates encrypted digital certificate containing owner ID information and copy of owner's public key
- **Public key infrastructure (PKI)**
  - Use of public key cryptography working with certificate authority
  - Widely used in e-commerce

Digital Certificates

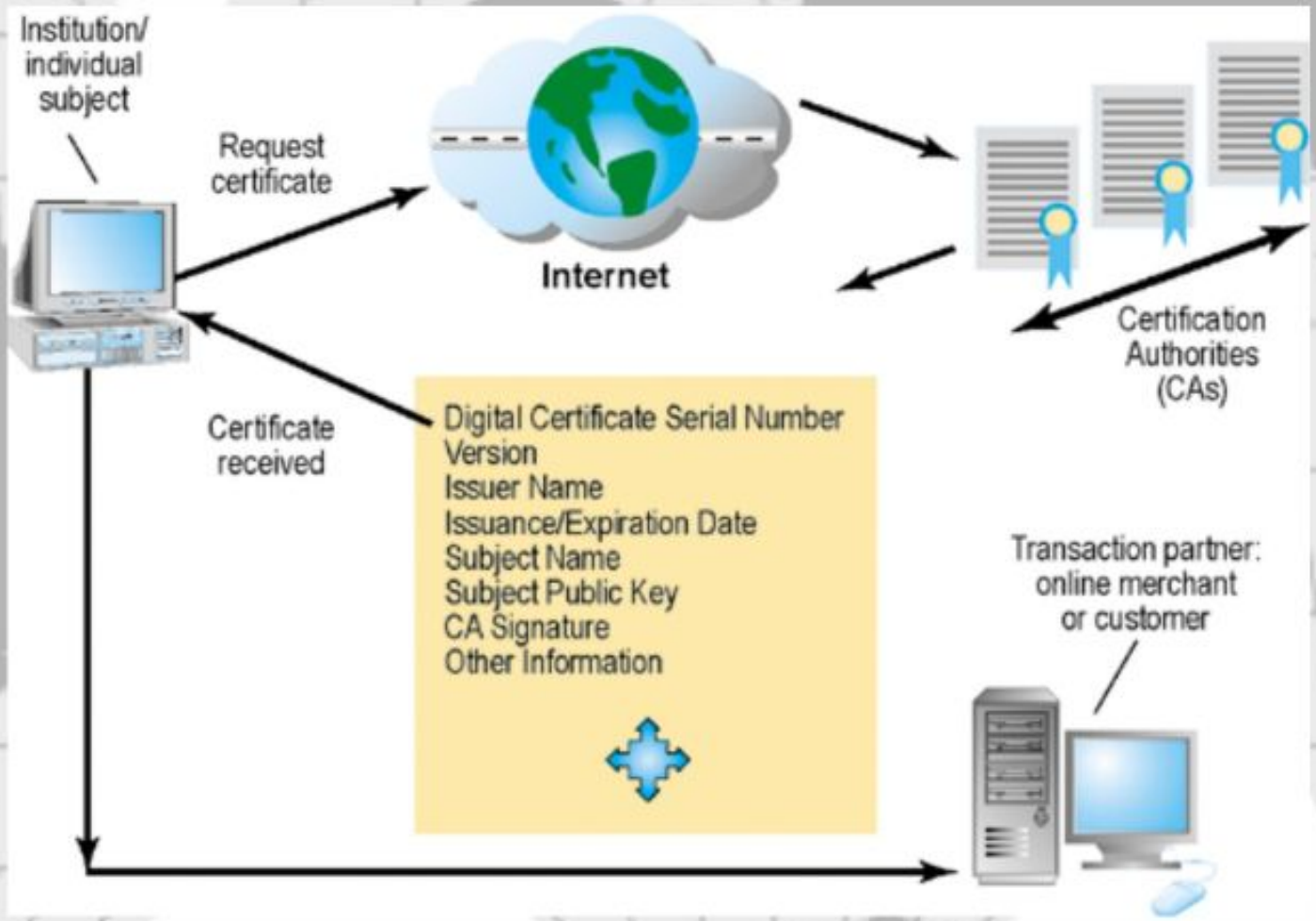


Figure 8-7

Digital certificates help establish the identity of people or electronic assets. They protect online transactions by providing secure, encrypted, online communication.

Technologies and Tools for Security

- Ensuring system availability
  - Online transaction processing requires 100% availability, no downtime
  - Fault-tolerant computer systems
    - For continuous availability
    - Contain redundant hardware, software, and power supply components to provide continuous, uninterrupted service
  - High-availability computing
    - Helps recover quickly from crash
    - Minimizes, does not eliminate downtime

- **Recovery-oriented computing**
  - Designing systems that recover quickly with capabilities to help operators pinpoint and correct of faults in multi-component systems
- **Controlling network traffic**
  - Deep packet inspection (DPI)
- **Security outsourcing**
  - Managed security service providers (MSSPs)

- **Ensuring software quality**
  - **Software Metrics:** Objective assessments of system in form of quantified measurements
    - Number of transactions
    - Online response time
    - Payroll checks printed per hour
    - Known bugs per hundred lines of code
  - **Testing: Early and regular testing**
    - **Walkthrough:** Review of specification or design document by small group of qualified people
    - **Debugging:** Process by which errors are eliminated