

INFORMATION SYSTEMS AND SYSTEM DEVELOPMENT

Introduction to Information and Communication Technologies

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Learning Objectives

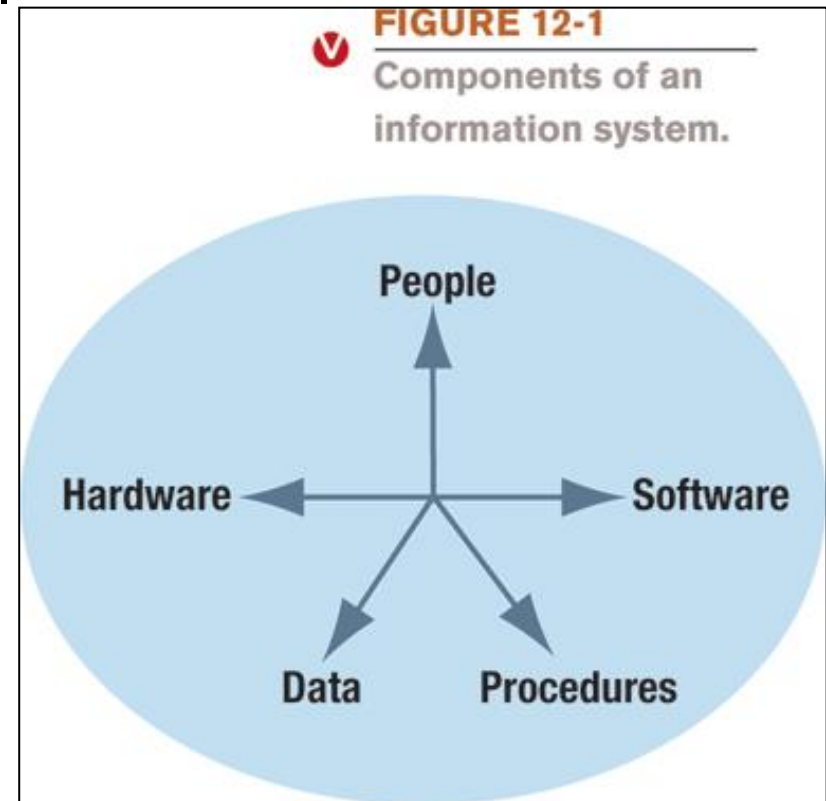
1. Understand what information systems are and why they are needed.
2. Explain who uses information systems in a typical organization.
3. Identify several types of information systems commonly found in organizations and describe the purpose of each.
4. Explain the individuals involved with system development.
5. Identify and describe the different steps of the system development life cycle (SDLC).
6. Discuss several approaches used to develop systems.

Overview

- This chapter covers:
 - How information systems are used and who uses them
 - Common types of information systems
 - Computer professionals who develop systems and their primary responsibilities
 - The system development life cycle (SDLC)
 - The major approaches to system development

What Is an Information System?

- System: Collection of elements and procedures that interact to accomplish a goal
 - Football game, transit systems, etc.
- Information system: A system used to generate the information needed to support the users in an organization
- System development: Process of designing and implementing a new or modified system



What Is an Information System?

- System development may be required because of:
 - New laws (Sarbanes-Oxely Act, HIPAA etc.)
 - Changes to the legal requirements for retaining business data (e-disclosure, etc.)
 - Introduction of new technology
- Enterprise architecture: Provides a detailed picture of an organization, its function, its systems, and the relationship among them
 - Allows managers to organize and maximize the use of IT resources and make better decisions
 - Not easy to develop and requires time and effort, but once in place, it is an invaluable decision support tool

What Is an Information System?

- **Business intelligence (BI):** The processes, technologies, and tools used to gather, store, access, and analyze data about a company
 - The information generated from BI systems is used to help decision makers
- **Data warehouse (data mart):** Comprehensive collection of data about a company and its customers
- **Data mining:** The use of intelligent software to find subtle patterns that may not be otherwise evident
 - Can identify processes that need improvement
 - Web mining: Used in conjunction with Web data

Business Intelligence

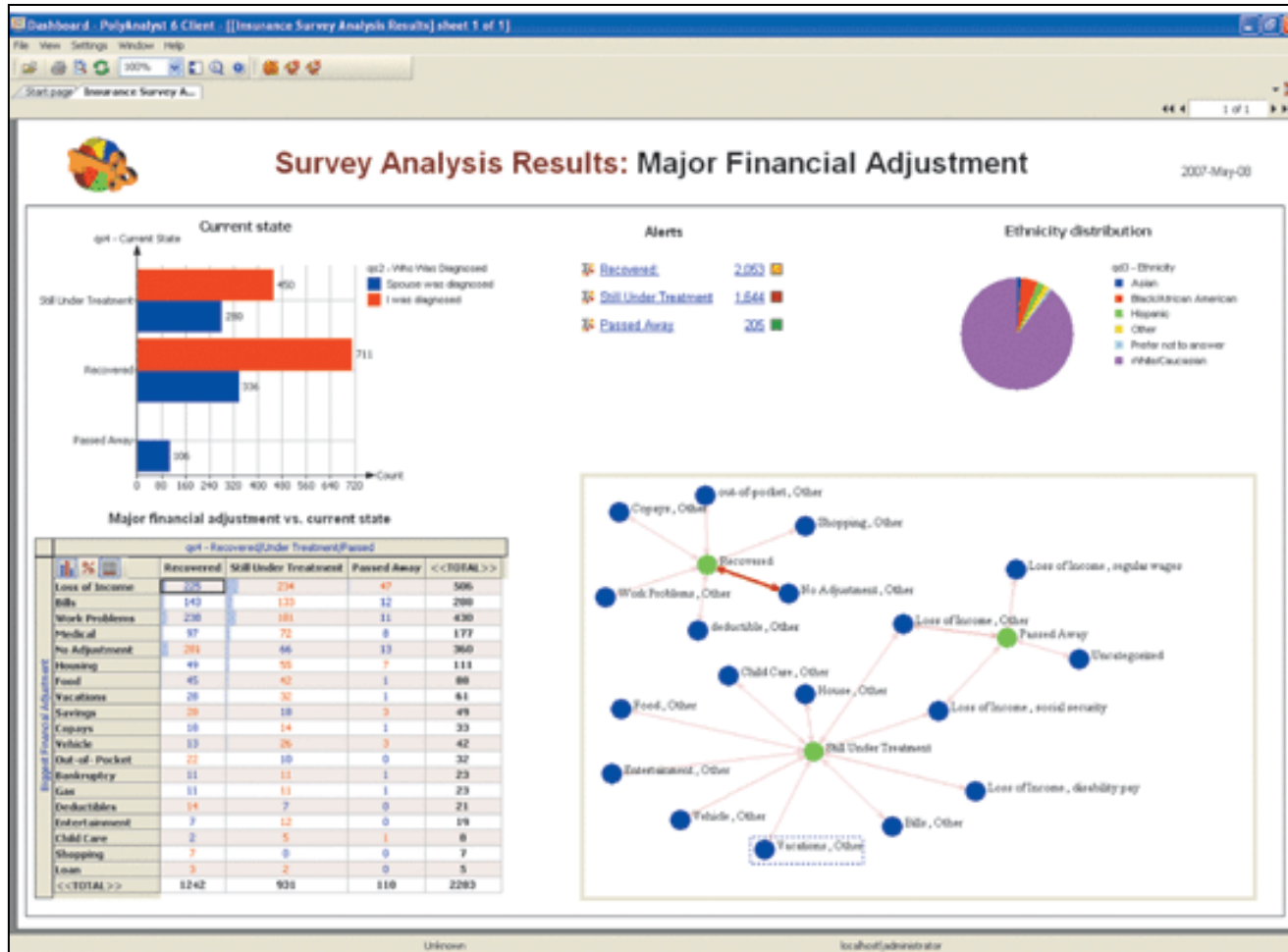
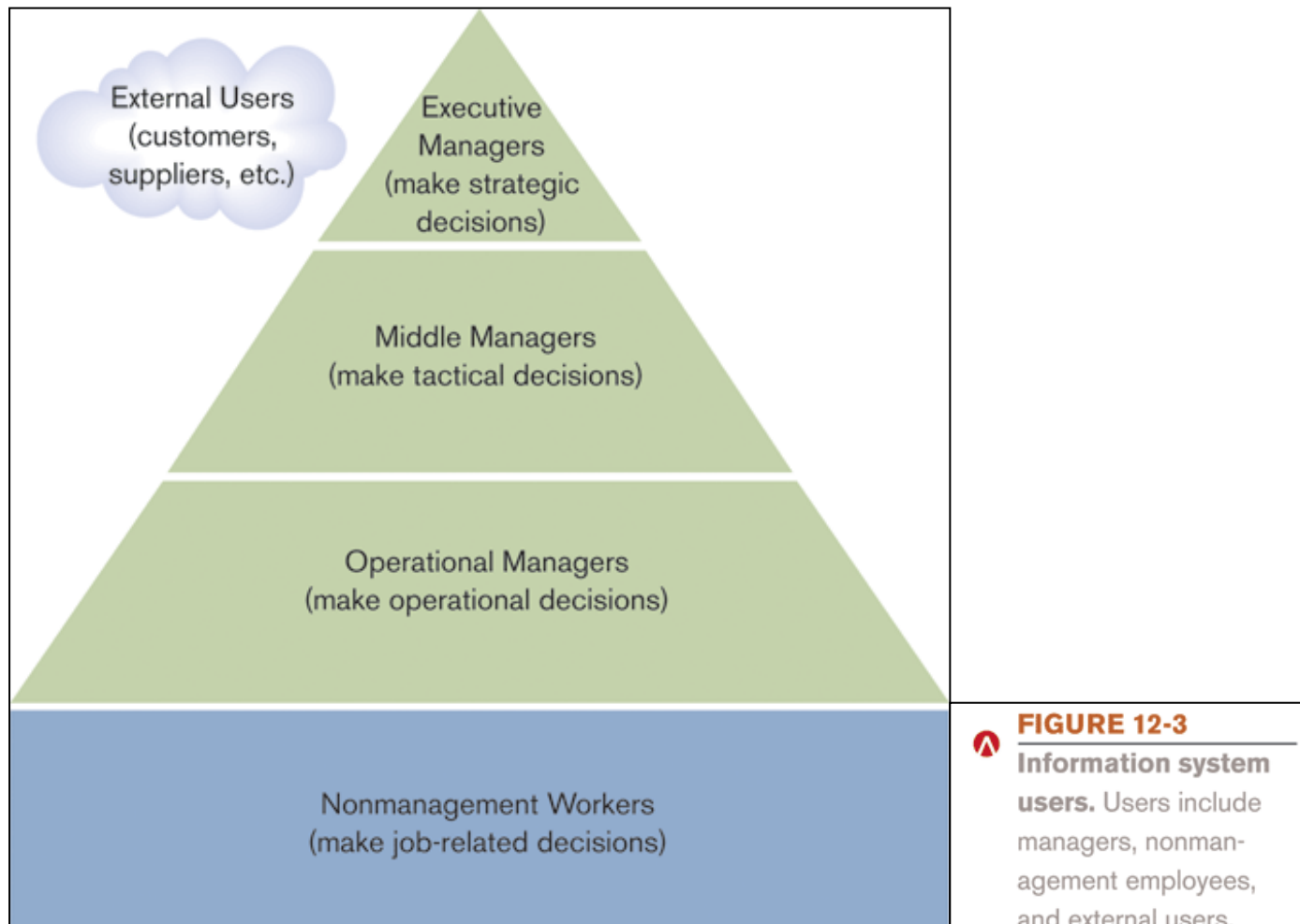


FIGURE 12-2
Data mining. The goal of data mining is to find patterns and relationships in data.

Information System Users

- Information systems can be:
 - Enterprise systems: Used throughout an entire enterprise (business, organization, agency)
 - Inter-enterprise systems: Links multiple enterprises, such as a business and its customers, suppliers and partners
 - Used by one person or all employees
 - Executive, middle, and operational managers
 - Non-management workers
 - External users (customers, suppliers, other partners, etc.)

Information Systems Users



Types of Information Systems

- While hundreds of specific types of information systems exist, many fall into one of six categories



FIGURE 12-4

Types of information systems.

TYPE OF SYSTEM	DESCRIPTION
Office and user productivity systems	Facilitate communications and enhanced productivity in office tasks
Transaction processing systems	Process and record business transactions
Decision making support systems	Provide needed information to decision makers
Integrated enterprise systems	Integrate activities throughout an entire enterprise
Design and manufacturing systems	Help with the design and/or manufacturing of products
Artificial intelligence systems	Perform actions based on characteristics of human intelligence

Types of Information Systems

- Office system: A system used to facilitate communications and enhance productivity
 - Document processing system: Used to create electronic documents
 - Document management system (DMS): Stores, organizes, and retrieves electronic documents
 - Content management system (CMS): DMS that also includes multimedia files and other content
 - Communications system: Allows employees to communicate with each other, with business partners, and with customers

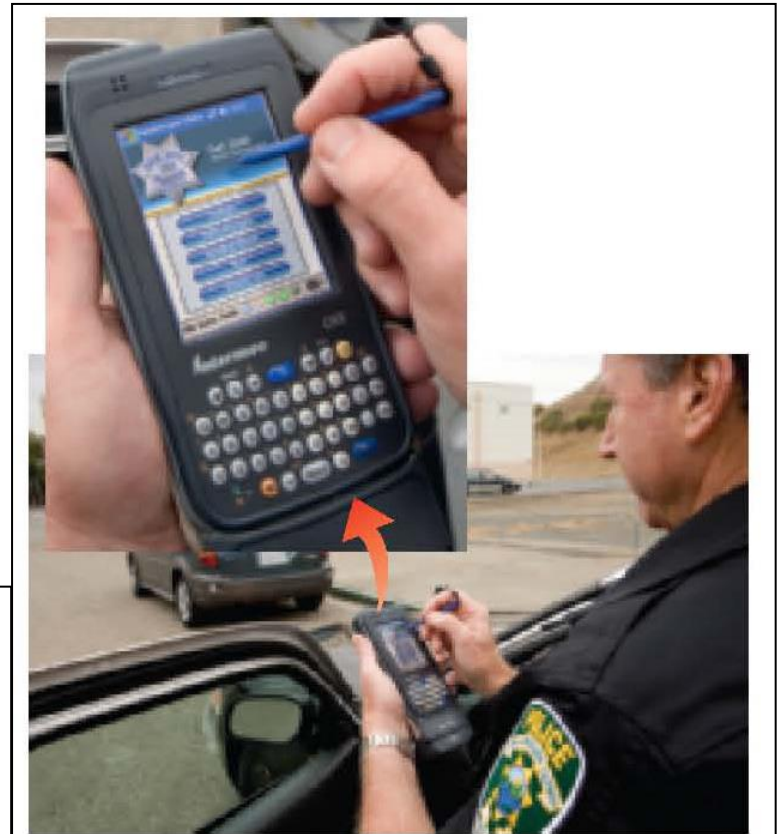
Types of Information Systems

- Transaction processing system (TPS): Processes and records data created by an organization's business transactions
 - Usually processed in real time
 - Specialty systems used in law enforcement, the military, etc.



FIGURE 12-6

Electronic citation systems. This type of transaction processing system allows officers to issue citations electronically.



Types of Information Systems

- Types of transaction processing systems include:
 - Order entry systems
 - E-commerce systems
 - Point-of-sale (POS) systems
 - Payroll systems
 - Accounting systems
 - Accounts receivable systems
 - Accounts payable systems
 - General ledger systems

Types of Information Systems

- Decision making support systems: Help individuals make decisions
 - Management information system (MIS): Provides decision makers with preselected information
 - Usually provides information in the form of computer-generated reports
 - Detailed, summary, exception
 - Much of the time, this information is generated from data obtained from transaction processing
 - Most frequently used to make moderately structured, middle-management decisions

Management Information Systems (MISs)

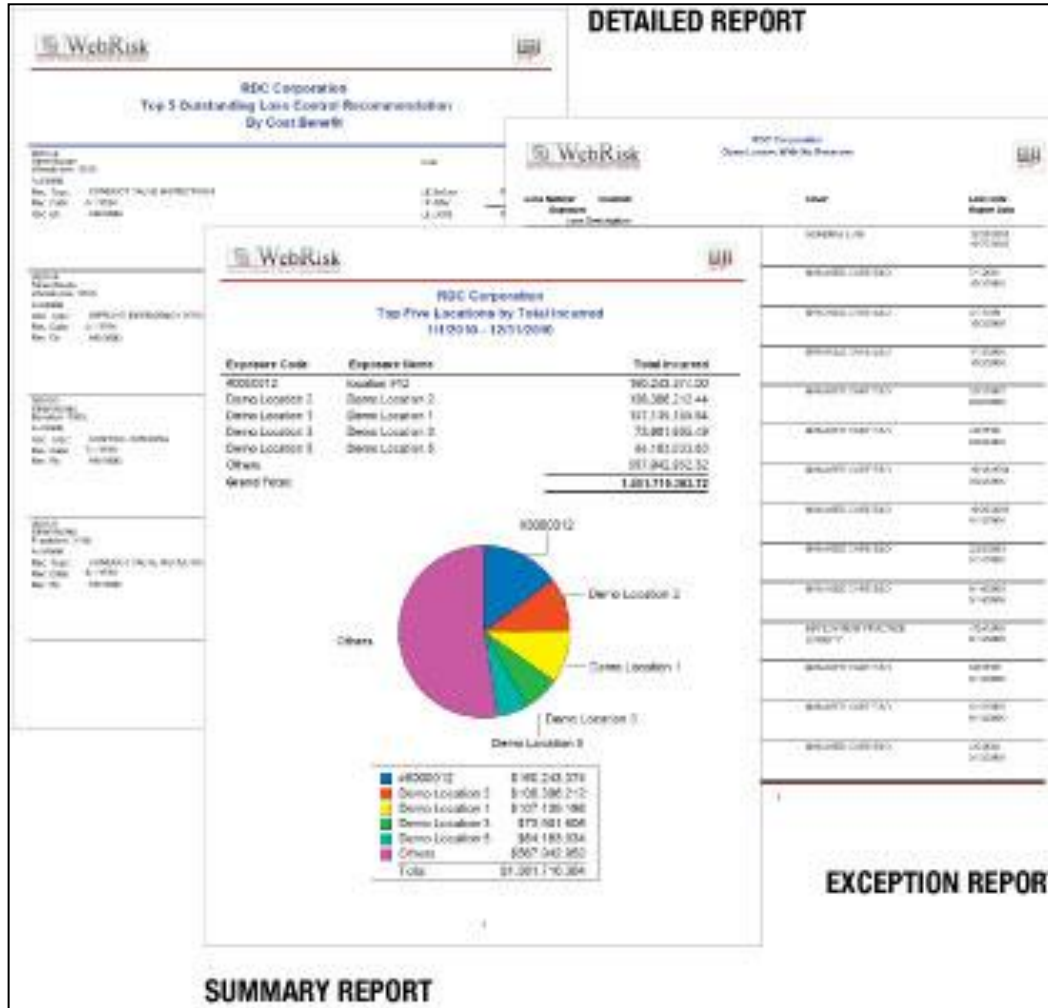


FIGURE 12-7
MISs typically generate a variety of reports.

Types of Information Systems

- Decision support system (DSS): Provides people with the tools and capabilities to organize and analyze their decision-making information
 - Typically used by upper management
 - Useful to anyone who requires unstructured or unpredictable information
 - Usually tailored to help with specific types of decisions (sales, transportation, etc.)
 - Incorporates internal and external data
 - Executive information system (EIS): A DSS targeted directly to upper management

Decision Support Systems (DSSs)

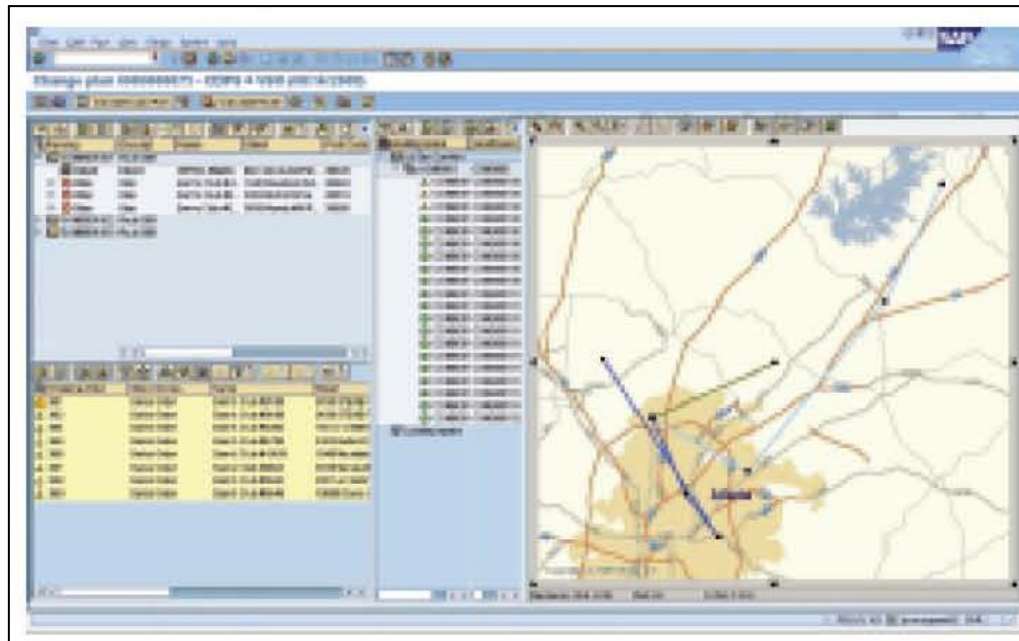


FIGURE 12-8
Decision support systems (DSSs).
This transportation DSS is used to create optimal routes for delivery vehicles.

Types of Information Systems

- Geographic information system (GIS): Combines geographical information with other types of data to provide a better understanding of relationships among the data
 - Commonly used to make decisions about locations (e.g. new facility locations, disaster risk, geographical crime patterns)
 - Also used in disaster relief systems (after hurricane, etc.) to create search and rescue maps, maps of where electrical power is restored, etc.

Geographic Information Systems (GISs)



FIGURE 12-9
Geographic information systems (GISs). This GIS shows the locations of crime incidents based on the selected crime type, location, and date range.

Types of Information Systems

- Integrated enterprise system: Designed to work together throughout an enterprise
 - Electronic data interchange (EDI): Transfers data between different companies using the Internet or another network
 - Often used to automate reordering materials and products
 - Enterprise resource planning (ERP): Large integrated system that ties together all of a business's activities
 - Enterprise application integration (EAI): Exchanging information from an ERP or other internal system among different applications and organizations

Types of Information Systems

- Inventory management system: Tracks and manages inventory
 - Can help optimize ordering
 - Supply chain management (SCM): Oversees materials, information, and finances as they move from the original supplier to the consumer
 - Just-in-time (JIT): Resources are limited to the right amount at the right time to fill orders
 - Warehouse management systems (WMS): Acts as a complete distribution system
 - Product lifecycle management (PLM): Organizes and correlates all information about a product from design to retirement

Types of Information Systems



FIGURE 12-10

Inventory management systems.

Item No.	Description	Unit	Current Stock	Reorder Point	Max Stock	Min Stock	Order Qty	Lead Time	Supplier
1001	Standard Item	EA	100	50	150	20	10	5	ABC Co.
1002	Another Item	EA	200	100	300	30	20	10	DEF Inc.
1003	Third Item	EA	50	25	75	10	5	3	GHI Ltd.
1004	Fourth Item	EA	300	150	450	40	30	15	JKL Corp.
1005	Fifth Item	EA	150	75	225	25	15	7	MNO Pty.

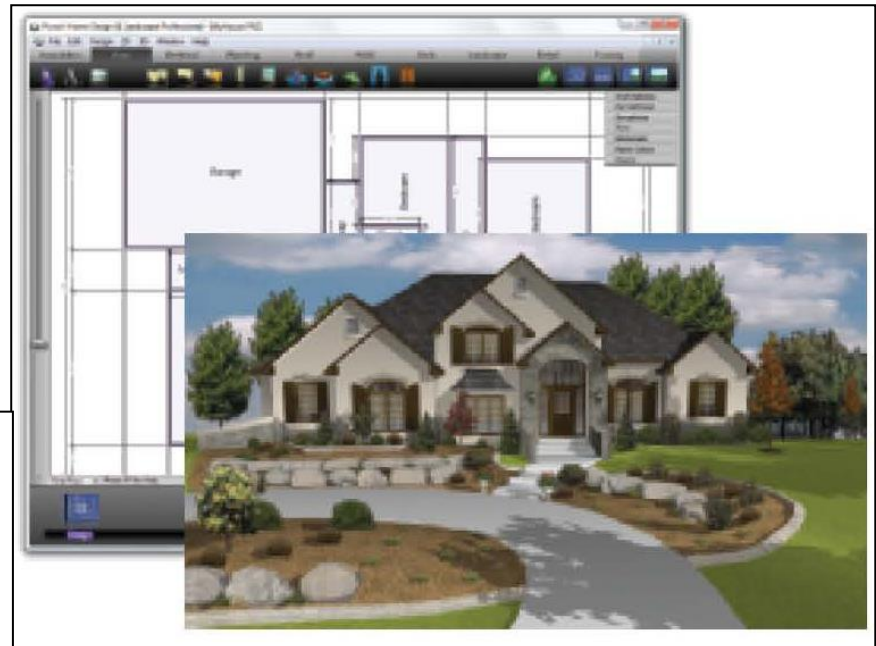
Types of Information Systems

- Design and manufacturing systems: Use computers to automate the design and manufacturing functions
 - Computer-aided design (CAD)
 - Computer-aided manufacturing (CAM)



FIGURE 12-11

Computer-aided design (CAD). CAD programs can be used for a wide variety of design applications.



Types of Information Systems

- Artificial intelligence (AI) system: A system in which a computer performs actions that are characteristic of human intelligence
 - Turing Test and the Loebner Prize
 - Initial advances in AI made through chess-playing programs

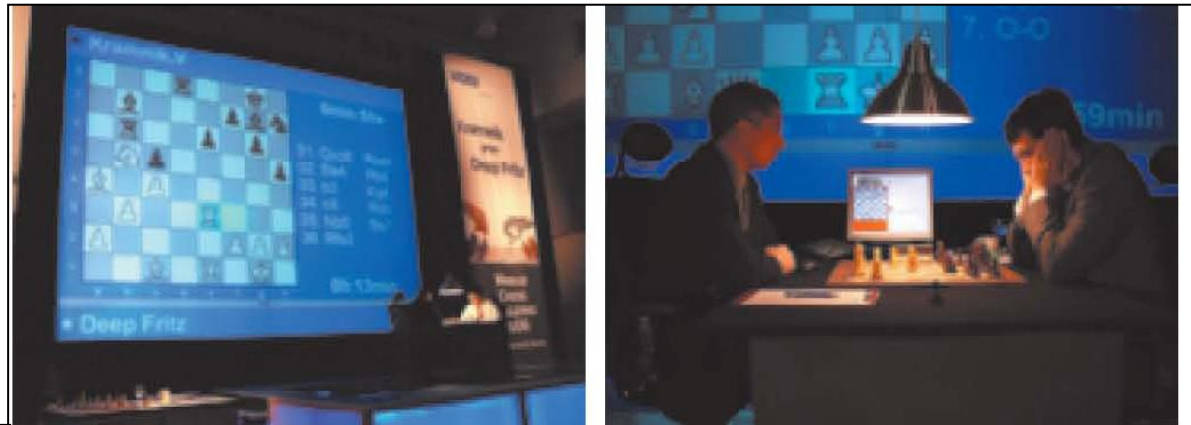


FIGURE 12-12
AI and chess
playing.

KRAMNIK VS. DEEP FRITZ

Shown here are images from the match in 2006 during which the Deep Fritz chess program beat world champion Vladimir Kramnik 4 games to 2.

Types of Information Systems

- Types of AI systems include:
 - Intelligent agents: Programs that perform specific tasks to help to make a user's work environment more efficient or entertaining and that typically modifies its behavior based on the user's actions
 - Application assistants
 - Shopping bots
 - Entertainment bots
 - Chatterbots
 - May be part of semantic Web

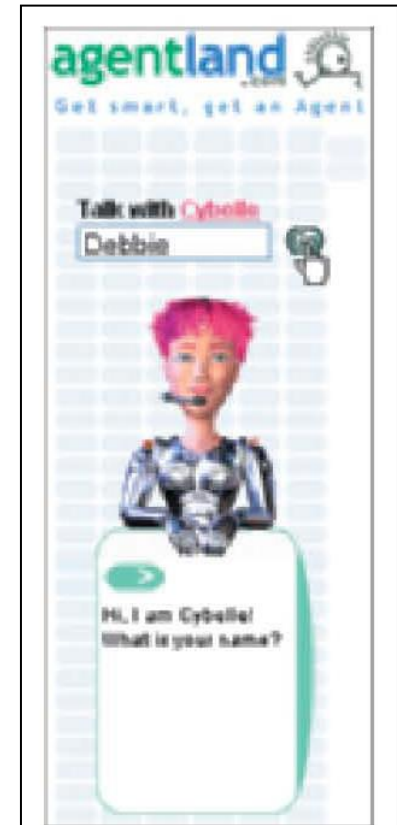


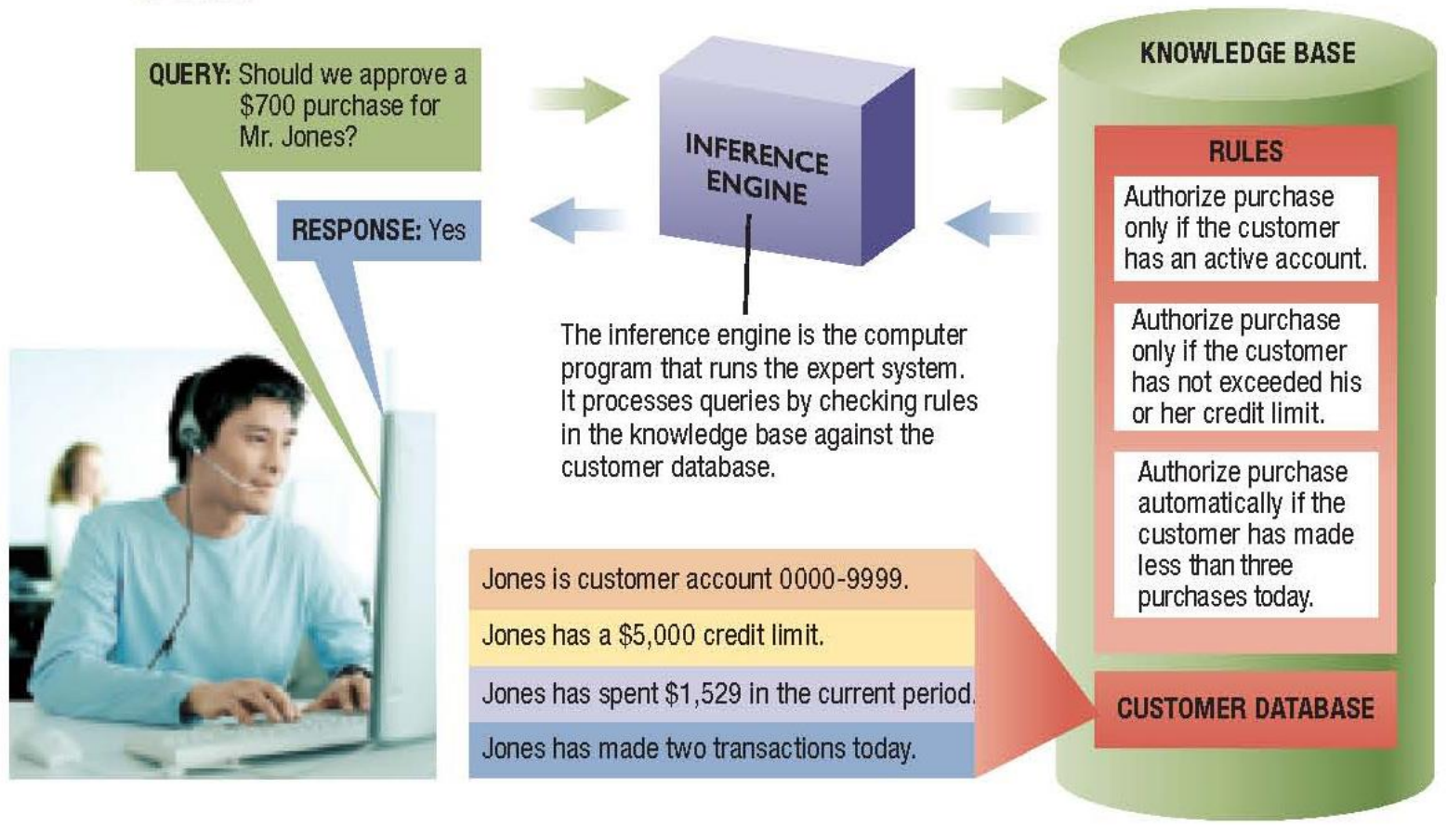
FIGURE 12-13
A Web page
chatterbot.

Types of Information Systems

- Expert system: Provides the type of advice that would be expected from a human expert
 - Knowledge base: Database containing facts provided by human experts and rules the system should use to make decisions based on those facts
 - Inference engine: Program that applies the rules to the data stored in the knowledge base, in order to reach decisions
 - Is only as good as the knowledge base and inference engine; also needs honest, correct information from the user in order to work correctly

Artificial Intelligence Systems

FIGURE 12-14
An expert system
at work.



Types of Information Systems

- Neural network: A system in which the human brain's pattern-recognition process is emulated by the computer
 - Used in:
 - Handwriting, speech, and image recognition
 - Medical imaging
 - Crime analysis
 - Biometric identification
 - Vision systems (quality checks in manufacturing, recognizing postage stamps, etc.)

FIGURE 12-15
Neural network systems. Neural networks are often used in biometric identification systems, such as analyzing fingerprints in the fingerprint identification system shown here.



Types of Information Systems

- Robotics: The study of robot technology
- Robot: A device, controlled by a human operator or a computer, that can move and react to sensory input
 - Military robots
 - Investigate caves, buildings, trails, etc., before soldiers enter
 - Locate and defuse explosive devices
 - Surveillance
 - Exoskeltons are under development

Military Robots

FIGURE 12-16
Military robotic applications.



PACKBOT EXPLORER ROBOT

Designed to investigate hostile and inaccessible areas prior to human entry.



HULC EXOSKELETON

Designed to give soldiers enhanced mobility and endurance while carrying heavy loads.

Types of Information Systems

- Business robots used for:
 - Working on factory assembly lines
 - Mining coal, repairing oil rigs
 - Locating survivors/
rescues
 - Remote
video-
conferencing



FIGURE 12-17
Business robots.



ASSEMBLY LINE ROBOTS



VIDEOCONFERENCING ROBOTS

Artificial Intelligence Systems

- Personal robots used for
 - Entertainment
 - Toys
 - Household tasks
- Societal implication of robots



TOY ROBOTS

This talking robot is designed to be a companion for children.



HELPER ROBOTS

This vacuum robot is designed to clean workshop, garage, and patio floors.



FIGURE 12-18

Personal robots.

Quick Quiz

1. A system using knowledge from medical experts that is used to help diagnose patients would be a type of
 - a. neural network
 - b. natural language system
 - c. expert system
2. True or False: An order-entry system would be classified as a management information system.
3. A(n) _____ is a device, controlled by a human, that can move and react to sensory input.

Answers:

1) c; 2) False; 3) robot

Responsibility for System Development

- Information systems (IS) department: Responsible for that organization's computers, systems, and other technology
 - Also called the Information Technology (IT) department
 - Systems analyst: Studies systems in order to determine what work needs to be done, and how this work may best be achieved
 - Other IT personnel include:
 - Business analysts
 - Application programmers
 - Operations personnel
 - Security specialists

The IS Department

Application programmer

Codes application software.

Network and computer system administrator

Responsible for planning and implementing computers and networks within an organization.

Business analyst

Identifies the business needs of a system and makes sure systems meet those needs.

Network operator/troubleshooter

Responsible for overseeing the day-to-day activities for a network, such as troubleshooting problems, documenting network events, and performing necessary duties to keep the network operating smoothly.

Communications analyst

Analyzes, maintains, and troubleshoots data communications networks and assists with connectivity.

Network systems and data communications analyst

Manages the networks in an organization and determines what changes, if any, are needed; also known as a **network architect**.

Computer operations manager

Oversees the computer operations staff and facility.

Network technician

Installs, maintains, and upgrades networking hardware and software.

Computer operator

Responsible for the operation of mainframe computers and their support.

Operations personnel

Manage the day-to-day processing for a system.

Computer software engineer

Designs and builds complex software applications. Can be an *application software engineer* or a *systems software engineer*.

Security specialist

Responsible for seeing that an organization's hardware, software, and data are protected from hackers, malware, natural disasters, accidents, and the like. Also known as the **chief security officer (CSO)**.

Database administrator

Responsible for setting up and managing large databases within an organization.

System administrator

Responsible for maintaining a large, multiuser system.

**FIGURE 12-19**

Computer and net-working jobs. Many of these positions are found in an organization's information systems (IS) department.

The IS Department

Database analyst Responsible for designing and developing an organization's data flow models and database architecture.	System programmer Codes system software, fine-tunes operating system performance, and performs other system software-related tasks.
Data center architect Manages the whole data center environment including servers, virtualization, power, cooling, security, and so on.	Systems analyst Studies systems in an organization to determine what changes need to be made and how to best accomplish these changes.
Data entry operator Responsible for keying data into a computer system.	Trainer Provides education to users about a particular program, system, or technology.
Help desk technician Assists users in solving software and hardware problems.	Vice president of information systems Oversees routing transaction processing and information systems activities, as well as other computer-related areas. Also known as the chief information officer (CIO) .
Information engineer Analyzes an organization's data to locate trends, problems, and other useful information for management.	Webmaster Responsible for all technical aspects of a Web site.
Knowledge engineer Responsible for setting up and maintaining the base of expert knowledge used in expert system applications.	Web designer/developer Designs and develops Web sites.
Multimedia developer Develops the multimedia content needed for Web sites and other applications.	Web programmer Writes the program code necessary for a Web site, such as to provide animation and database connectivity.



FIGURE 12-19

Computer and net-working jobs. Many of these positions are found in an organization's information systems (IS) department.

Responsibility for System Development

- Outsourcing: Hiring outside vendor to perform specific business tasks
 - Offshore outsourcing: Outsourced to another country
 - Nearshoring: Outsourcing to nearby countries
 - Homeshoring: Outsourcing to home-based workers
 - Crowdsourcing: Often performed via the Web
 - Captive offshoring: Own facilities
 - Security and privacy issues



FIGURE 12-20
Homesourcing is
a growing trend in
outsourcing.

Quick Quiz

1. Which term refers to outsourcing work to another country?
 - a. Homeshoring
 - b. Offshoring
 - c. System development
2. True or False: The IT worker who codes computer programs is called the computer operator.
3. The IT employee most involved with system development is the _____.

Answers:

1) b; 2) False; 3) systems analyst

The System Development Life Cycle (SDLC)

- System development life cycle (SDLC): The development of a system from the time it is first studied until the time it is updated or replaced



FIGURE 12-21
The system development life cycle (SDLC). Each phase of the system development life cycle produces some type of documentation to pass on to the next phase.

The System Development Life Cycle (SDLC)

- **Preliminary investigation:** A feasibility study is performed to assess whether or not a full-scale project should be undertaken
 - Feasibility report: Contains findings on status of existing system and benefits/feasibility of changing to a new system
 - Includes recommendation regarding whether or not the project should move on to the next stage in the SDLC

The System Development Life Cycle (SDLC)

- **System analysis:** Examines the problem area to determine what should be done
 - Data collection: Gathering information about the system (organizational chart, observation, interviewing users, etc.)
 - Data analysis: Analyzing information to determine requirements for the new systems
 - Documentation: Any instruments used for data gathering and the resulting diagrams, trees, models, and other tools used to analyze the data

The System Development Life Cycle (SDLC)

- Data analysis tools include:
 - Entity-relationship diagrams (ERDs): Logical relationships among system entities
 - Data flow diagrams (DFDs): Flow of data through system
 - Decision tables and decision trees: Summarize decision process
 - Business process modeling notation (BPMN): Models business processes
 - Class diagrams and use case models: Object-oriented systems

Data Analysis Tools

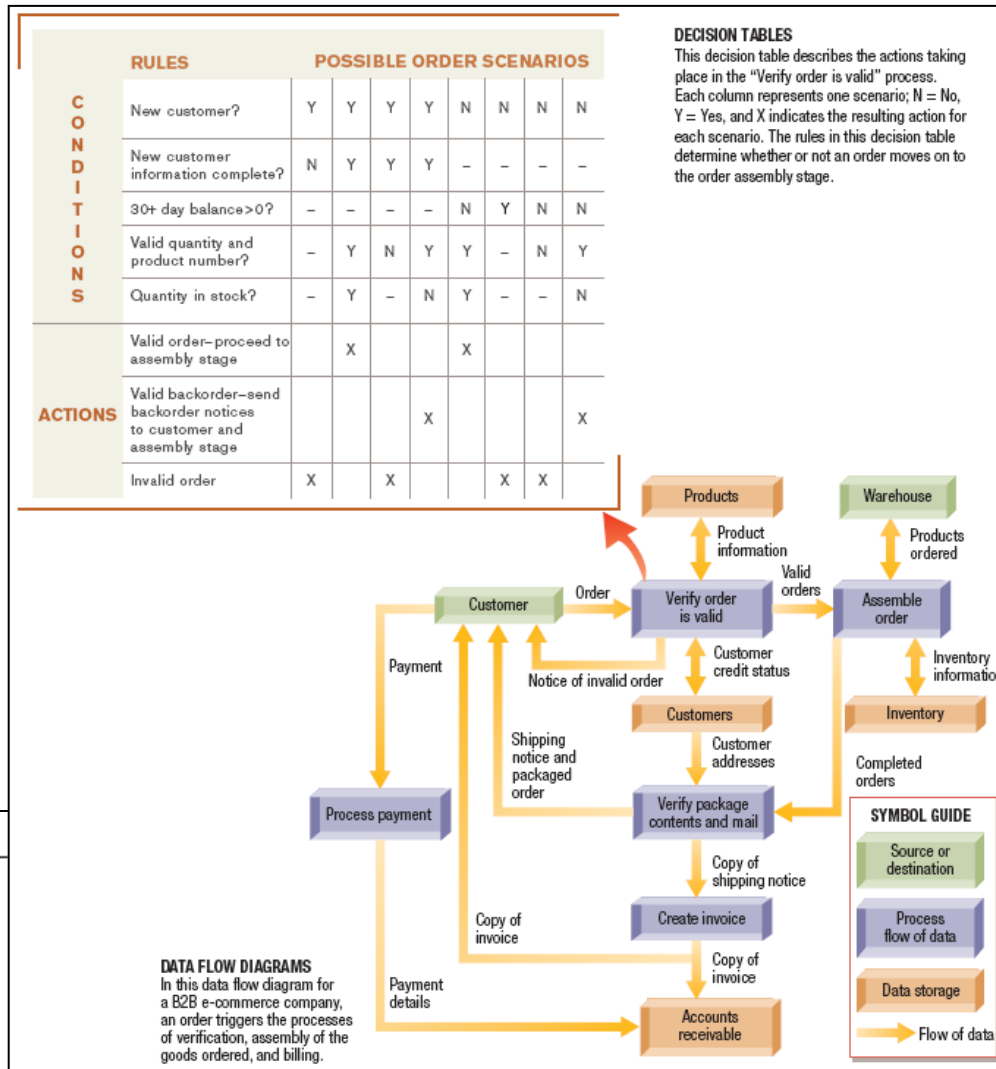
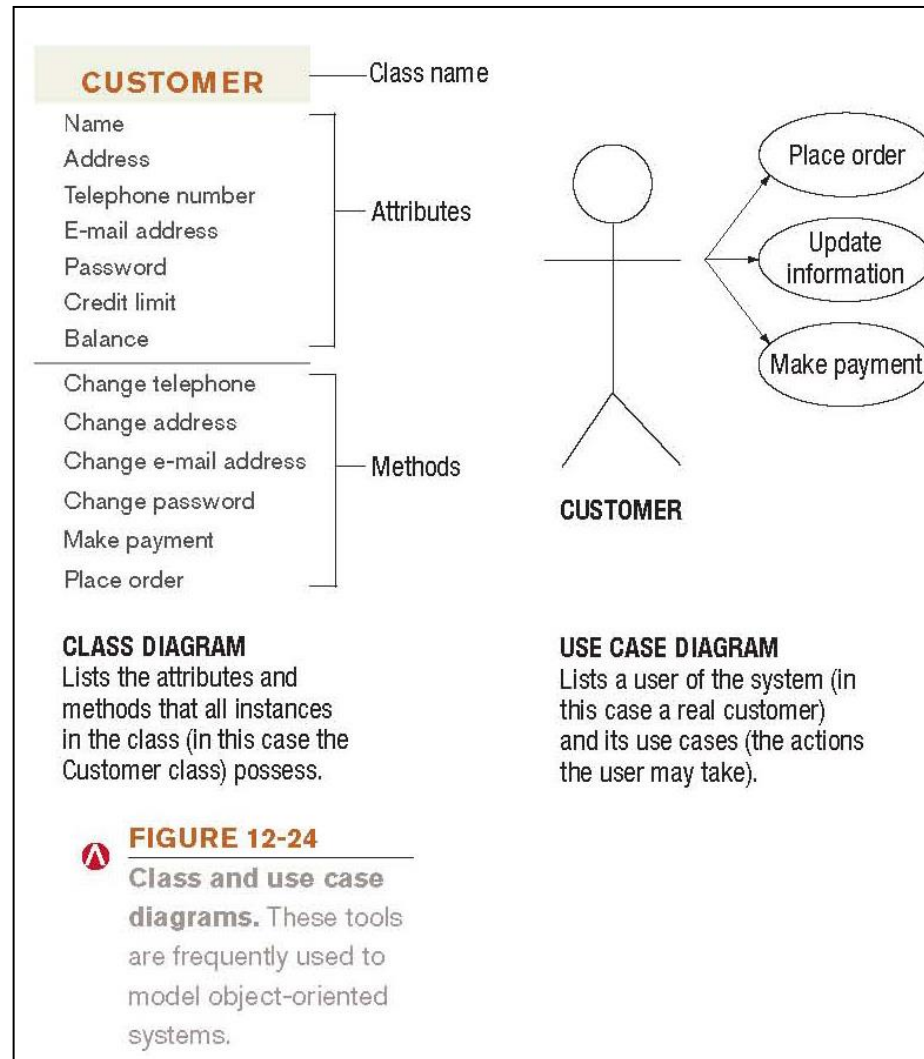


FIGURE 12-23
Data flow diagrams and decision tables. These tools are frequently used to analyze a system during the system analysis phase of the SDLC.

Data Analysis Tools



The System Development Life Cycle (SDLC)

- System design: Specifies what the new system will look like and how it will work
 - Model of new system is developed; diagrams can include:
 - Data dictionary: Describes all data in a system
 - Data flow and/or class diagrams of the new system
 - Input/output designs
 - Cost/benefit analysis: Considers both tangible and intangible benefits to determine if the benefits of the new system outweigh the cost
 - Documentation: System design and specifications developed during the system design phase

System Design

New Customer Entry Screen

Customer Number	First Name	Last Name	Street Address
101	David	Smith	124 Miller St
City	State	ZIP	
Visalia	CA	93270	
Phone	Balance		
(559) 555-3010			\$0.00

Customer Lookup Screen - Enter Customer Number

Customer Number	101	
Name	David	Smith
Balance	\$0.00	

INPUT DESIGN
Design for screen used to input data for new customers.

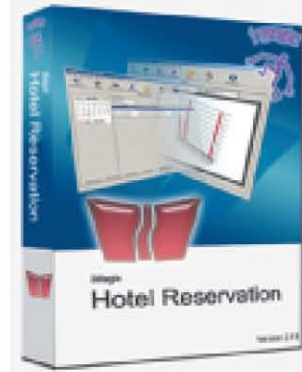
OUTPUT DESIGN
Design for screen used to output customer name and balance once a Customer Number is entered.

FIGURE 12-25
Input and output designs are created during the system design phase.

The System Development Life Cycle (SDLC)

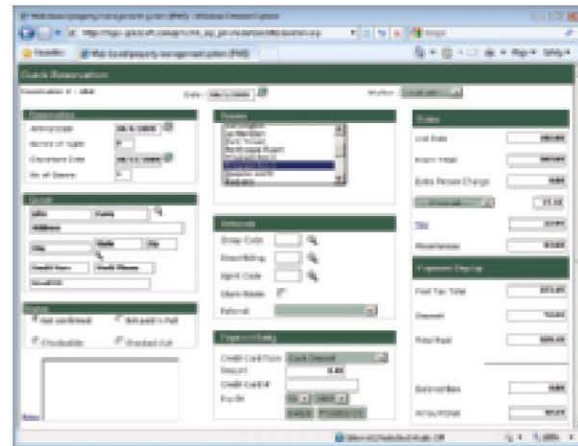
- **System acquisition:** The necessary hardware, software, and other system components are acquired
 - Make or buy decision: Need to determine if needed products will be purchased or developed in house
 - Software to be developed moves into the program development process (Chapter 13)
 - Products to be purchased need to be identified and a vendor selected
 - Can use RFP and/or RFQ
 - Bids need to be evaluated; vendor rating systems and benchmark tests can be helpful
 - Documentation: RFPs, RFQs, any vendor evaluation materials, etc.

System Acquisition



INSTALLED SOFTWARE

Installed on the hotel computers;
typically allows for a small amount
of customization.



WEB-BASED SOFTWARE (SOFTWARE AS A SERVICE)

Accessed via the Internet; typically allows for a small amount of
customization.

FIGURE 12-26
Software purchase
options.



CUSTOM SOFTWARE

Can be created to meet all the
specifications for the new system,
as time and funding permit.

The System Development Life Cycle (SDLC)

- **System implementation:** The new system is installed, tested, and made operational
 - System must be thoroughly tested
 - Test data should be realistic and include incorrect data
 - Data needs to be prepared for data migration
 - System conversion: System is installed
 - User training (hands-on, users' manuals, etc.)
 - Documentation: Implementation schedule, test data, test results, training materials

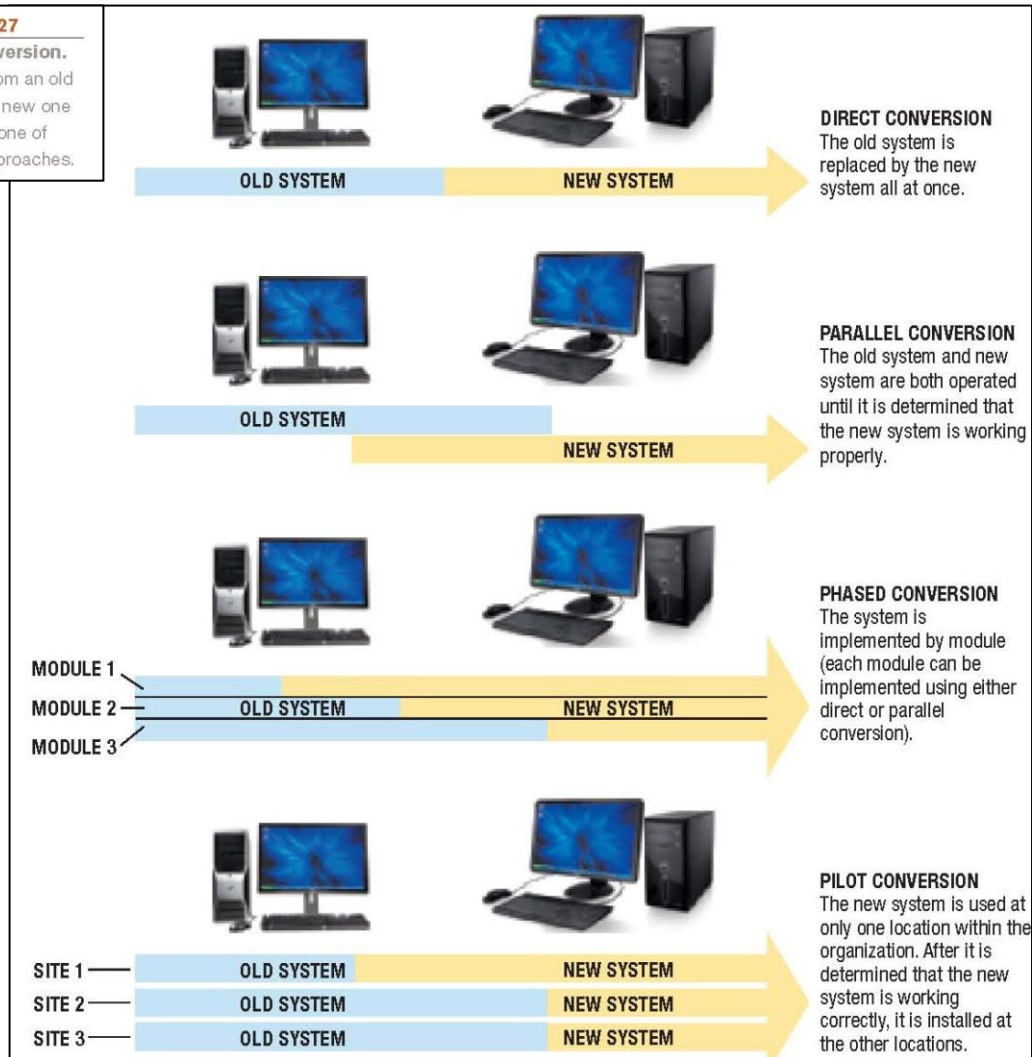
The System Development Life Cycle (SDLC)

- Types of conversions:
 - Direct conversion: Old system deactivated; new system installed
 - Parallel conversion: Both old and new operated for a period of time
 - Phased conversion: New system implemented by module
 - Pilot conversion: New system installed at a pilot location initially

System Implementation

FIGURE 12-27

System conversion.
Converting from an old system to the new one often follows one of these four approaches.



The System Development Life Cycle (SDLC)

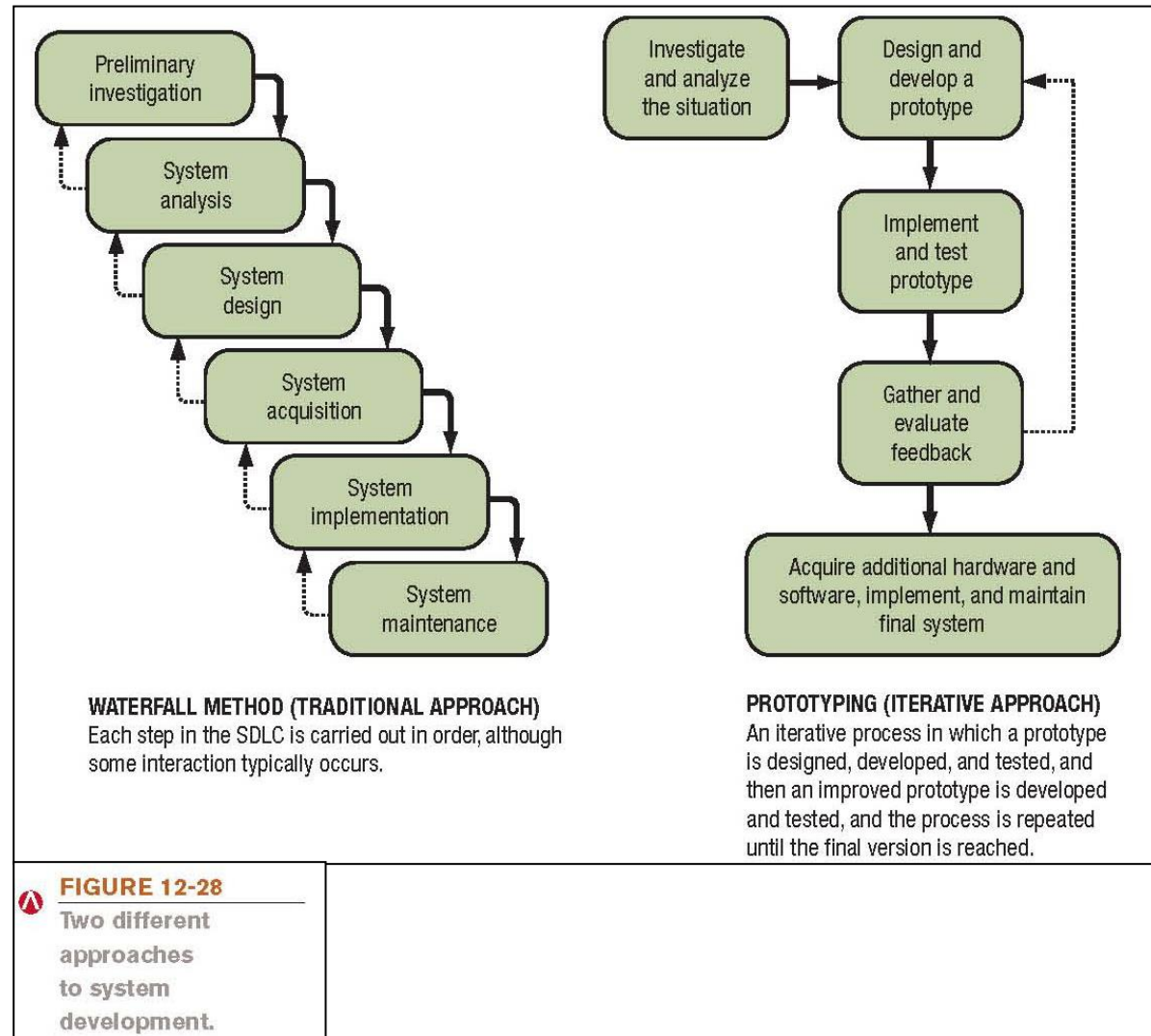
- **System maintenance:** Minor adjustments are made to the finished system to keep it operational until the end of the system's life or until the time that the system needs to be redesigned
 - Post-implementation review: Identifies any glitches in the new system that need to be fixed
 - Maintenance is an ongoing process
 - When a major change is needed, the project goes through the SDLC again
 - Documentation: Completed project folder

Approaches to System Development

- Traditional system development: SDLC phases are carried out in the preset order
 - Referred to as the waterfall model
 - Time-consuming
 - Used primarily when system requirements are easy to determine, when the system is very familiar, or when management requests it
- Iterative approach: Steps are repeated until the system is finalized
 - Prototyping: Small model, or prototype, of the system is built before the full-scale development effort is undertaken

Approaches to System Development

- End-user development:
User is primarily responsible for the development of the system
 - Most feasible when system being developed is small and inexpensive



Quick Quiz

1. The first step of in the system development life cycle is _____.
 - a. to design the system
 - b. to perform a preliminary investigation
 - c. to implement the system
2. True or False: The traditional approach to systems development also is referred to as the waterfall model.
3. A test used to evaluate or measure a systems performance is called a(n) _____.

Answers:

1) b; 2) True; 3) benchmark test

Summary

- What Is an Information System?
- Types of Information Systems
- Responsibility for System Development
- The System Development Life Cycle (SDLC)
- Approaches to System Development