Chapter 9

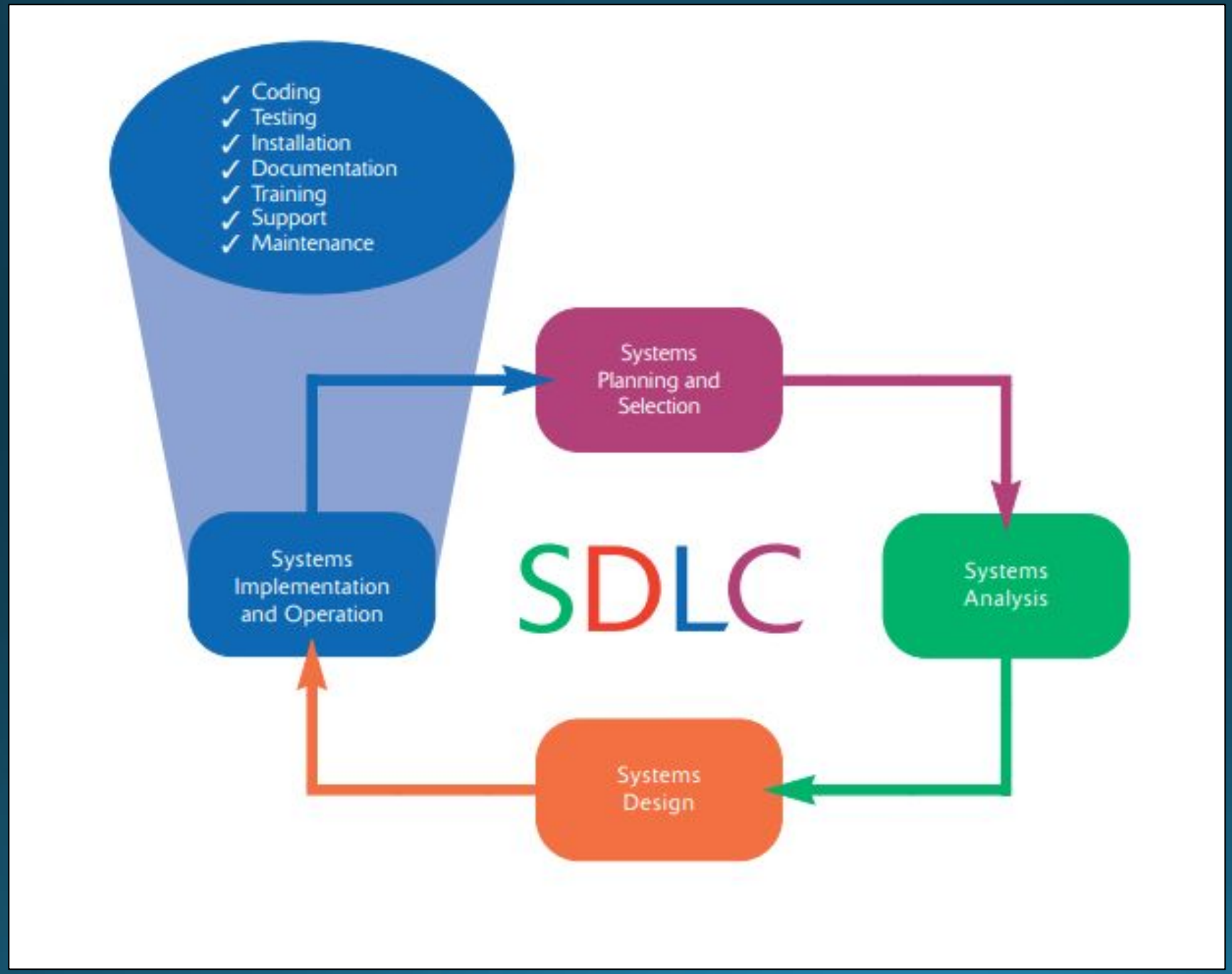
Implementation & Maintenance

5 hours ≈ 6-7 marks

Chapter contains

9. IMPLEMENTATION AND MAINTENANCE

a. System Implementation
b. Software Application Testing
c. Types of Testing
d. Installation
e. Documenting the System
f. Training and Supporting User
g. Project close down
h. Maintaining Information System


✓ Coding
✓ Testing
✓ Installation
✓ Documentation
✓ Training
✓ Support
✓ Maintenance
Systems Planning and Selection
Systems Analysis
Systems Design
Systems Implementation and Operation
SDLC

Background

- System implementation & maintenance is the most expensive and time-consuming phase of the entire life cycle.
  - Expensive because so many people are involved in the process.
  - Time consuming because of all the work that has to be completed through the entire life of the system.

- In this phase, physical design specifications are turned into working computer code.
  - This code is then tested until most of the errors have been detected and corrected.
  - Afterwards, the system is installed, user sites are prepared for the new system, and users must come to rely on the new system rather than the existing one to get their work done.

- Even after the system is installed, new features are added to the system, new business requirements and regulations demand system improvements, and corrections are made as flaws are identified from use of the system in new circumstances.

- The major activities occurring in this phase are
  - Coding
  - Testing
  - Installation
  - Documentation
  - Training
  - Support, and
  - Maintenance.

9.1 System Implementation

- The main purpose of system implementation
  - To convert final physical system specifications into working and reliable software
  - To document work that has been done
  - To provide help for current and future users

- The process of coding, testing, and installation.
  - Coding - Physical design specifications are turned into working computer code
  - Testing - Tests are performed on system using various strategies
  - Installation - The current system is replaced by new system

9.2 Software Application Testing

- Software testing is performed in parallel with coding.
- For testing process, a master test plan is developed during the analysis phase.
- During the design phase, unit, system and integration test plans are developed.
- The actual testing is done during implementation.

- Test plans provide improved communication among all parties involved in testing.

- Testing can be static or dynamic.
  - Static testing means that the code being tested is not executed.
  - Dynamic testing involves execution of the code

- Tests can be automated or manual.
  - Automated means computer conducts the test.
  - Manual means that people complete the test.

9.3 Types of Tests: Manual Testing methods

- Inspection
  - Participants examine program code for predictable language-specific errors
- Walk-though
  - A peer group review for code
- Desk-check
  - Program code sequentially executed by the reviewer manually.

Types of Tests: Automated Testing

- Unit Testing
  - Each module is tested alone in an attempt to discover any errors in its code
- Integration Testing
  - The process of bringing together all of the modules that a program comprises for testing purposes.
  - Modules are typically integrated in a bottom-up, incremental fashion.
- System Testing
  - The bringing together of all of the programs that a system comprises for testing purposes.
- Stub Testing
  - Stubs are two or three lines of code written by a programmer to stand in for the missing modules
  - In stub testing, a few lines of code are used to substitute for missing/incomplete subordinate modules

Test process

- Attention must be paid to many different aspects of a system, such as response time, response to extreme data values, response to no input, response to heavy volumes of input, and so on.
  - anything (within resource constraints) that could go wrong or be wrong with a system must be tested.

- At a minimum, the most frequently used parts of the system and the paths within the system must be tested as much times as the development time permits.

- A test case is a specific scenario of transactions, queries, or navigation paths that represent a typical, critical, or abnormal use of the system.

- A test case should be repeatable so that it can be rerun as new versions of the software are tested.

- One important reason to keep such a thorough description of test cases and results is so that testing can be repeated for each revision of an application.

- Manual code reviews can be time consuming and tedious work.
  - To aid in code reviewing, a special-purpose testing software, called a testing harness, has been developed for a variety of environments to help designers automatically review the quality of their code.

- In many situations, a testing harness greatly enhances, the testing process because they can automatically expand the scope of the tests beyond the current development platform, as well as be run every time with each new version of the software.

User Acceptance Testing

- Testing the system in the environment where it will eventually be used.
- The purpose of acceptance testing is for users to determine whether the system meets their requirements.
- The extent of acceptance testing will vary with the organization and with the system in question
- The most complete acceptance testing will include
  - **alpha testing**, (also called mock client testing), where simulated but typical data are used for system testing
  - **beta testing**, in which live data are used in the users' real working environment; and
  - **a system audit** conducted by the organization's internal auditors or by members of the quality assurance group.

- During alpha testing, the entire system is implemented in a test environment to discover whether the system runs well in a closed environment.

- The types of tests covered during alpha testing is as follows:
  a) Recovery Testing
     - Forcing the software environment to fail in order to ensure proper recovery performed.
  b) Security Testing
     - Verifying that protection mechanisms built into the system
  c) Stress Testing
     - Tries to break the system (e.g., what happens when a record is written to the database with incomplete or unmatched information)
  d) Performance Testing
     - Determining how the system performs on the range of possible environments in which it may be used (e.g., different hardware configurations, networks, operating systems)

- In beta testing, a subset of the intended users run the system in their own environments using their own data.
- The intent of the beta test is to determine whether the software, documentation, technical support, and training activities work as intended.
- In essence, beta testing can be viewed as a rehearsal of the installation phase.
- Problems uncovered in alpha and beta testing in any of these areas must be corrected before users can accept the system

9.4 Installation

- The process of moving from the current information system to the new one.

- All employees who use a system, regardless of whether they were consulted during the development process or not, must give up their reliance on the current system and begin to rely on the new system.

- Four different approaches to installation have emerged over the years:
  - Direct
  - Parallel
  - Single location
  - Phased

- The choice of installation approach depend on the scope and complexity of the change associated with the new system

a. Direct Installation

- Abrupt form of installation (*sudden, unexpected change*)
- Low cost
- High interest in making installation a success
- May be the only possible approach if new and existing systems cannot co-exist in some form.
- Operational errors have direct impact on users and organization
- It may take too long to restore old system, if necessary
- Time consuming

b. Parallel Installation

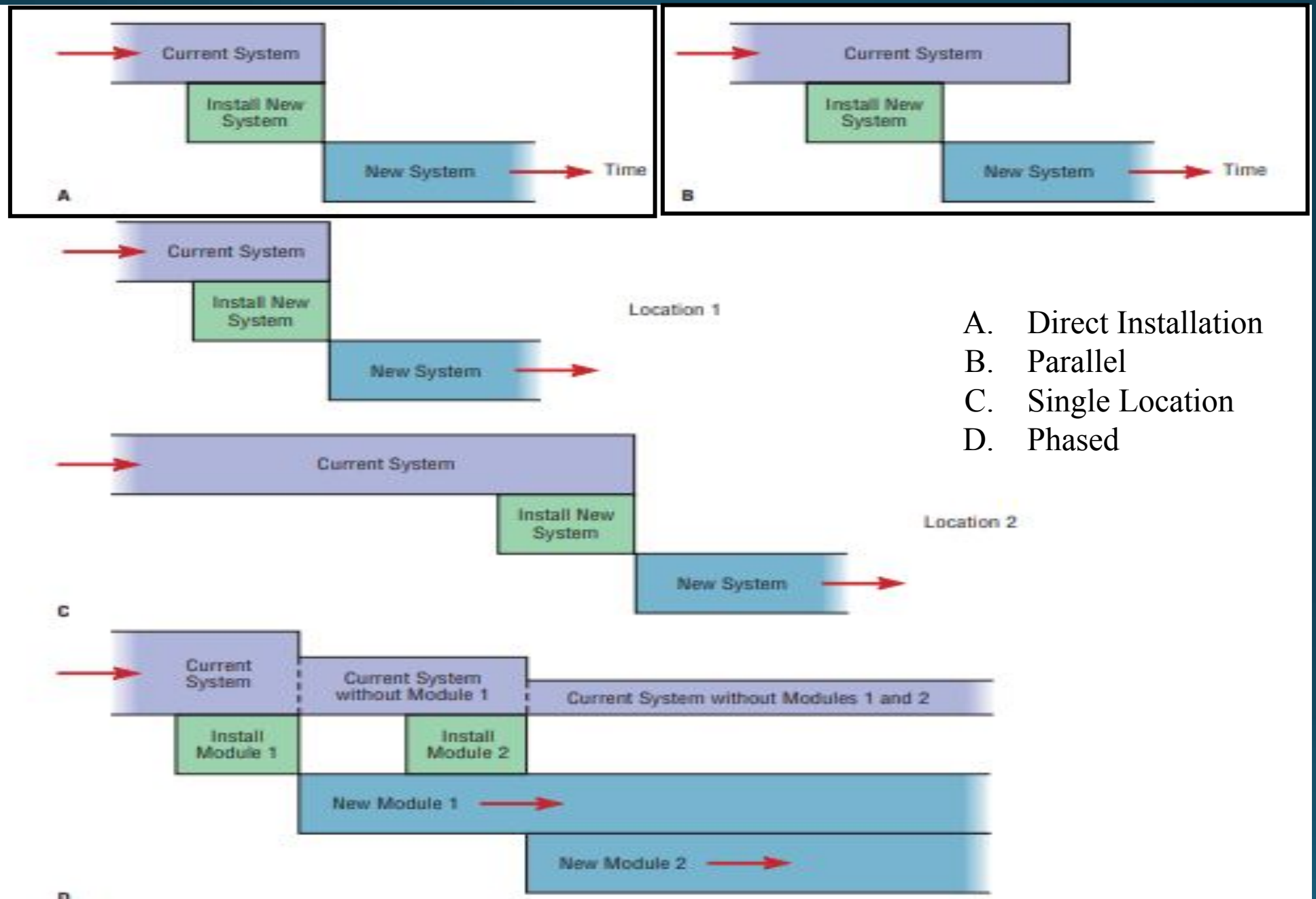
- Old and new systems co-exist
- Safe
- New system can be checked against old systems
- Impact of operational errors are minimized
- Very expensive because of duplication of effort to run and maintain two systems
- Can be confusing to users
- May not be feasible

c. Single location Installation

- Pilot approach.
- May involve a series of single location installations.
- Learning can occur and problems fixed by concentrating on one site.
- Can use early success to convince others to convert to new system.
- Burden on IS staff to maintain old and new systems.
- Some parts of organization get benefits earlier than other parts.

d. Phased Installation

- Staged, incremental, gradual, based on system functional components.
- Similar to bringing system out via multiple releases.
- Allows for phased system development.
- Some benefits can be achieved early.
- Each phase is small and more manageable.
- Requires extra programming to bridge the phases of systems.
- Constant conversion changes.
- Phases conversion may extend over a long period.



A. Direct Installation
B. Parallel
C. Single Location
D. Phased

Planning Installation

- Considerations
  - Data conversion
    - Error correction
    - Loading from current system
  - Planned system shutdown
  - Business cycle of organization

9.5 Documenting the system

- User documentation consists of written or other visual information about an application system, how it works, and how to use it.
  - The documentation lists the item necessary to perform the task the user inquired about.

- Various types of user documentation include user documentation, reference guide, user's guide, release description, system administrator's guide, acceptance sign-off, and many more.

Documenting the System

- **System documentation**: detailed information about a system's design specifications, its internal workings, and its functionality
- **User documentation**: written or other visual information about an application system, how it works, and how to use it

Documenting the System (Cont.)

- **Internal documentation**: system documentation that is part of the program source code or is generated at compile time
- **External documentation**: system documentation that includes the outcome of structured diagramming techniques such as data flow and E-R diagrams

TABLE 13-5 SDLC and Generic Documentation Corresponding to Each Phase

Generic Life-Cycle Phase	Generic Document
Requirements Specification	System Requirements Specification
	Resource Requirements Specification
Project Control Structuring	Management Plan
	Engineering Change Proposal
System Development	
Architectural design	Architecture Design Document
Prototype design	Prototype Design Document
Detailed design and implementation	Detailed Design Document
Test specification	Test Specifications
Test implementation	Test Reports
System Delivery	User's Guide
	Release Description
	System Administrator's Guide
	Reference Guide
	Acceptance Sign-Off

(*Source:* Adapted from Bell and Evans, 1989.)

9.6 Training and Supporting Users

- **Support**: providing ongoing educational and problem-solving assistance to information system users

- For in-house developed systems, support materials and jobs will have to be prepared or designed as part of the implementation process.

Training Information Systems Users

- Potential training topics
  - Use of the system
  - General computer concepts
  - Information system concepts
  - Organizational concepts
  - System management
  - System installation

Types of Training Methods

- Resident expert
- Traditional instructor-led classroom training
- E-learning, distance learning
- Blended learning (instructor plus e-learning)
- Software help components
- External sources (e.g. vendors)

Training Information Systems Users (Cont.)

- **Electronic performance support system** (**EPSS**): component of a software package or an application in which training and educational information is embedded

- An EPSS can take several forms, including a tutorial, an expert system shell, and hypertext jumps to reference materials.

Supporting Information Systems Users

- Support is important to users, but has often been inadequate.
- Providing support can be expensive and time-consuming.
- Vendors usually charge for their support, using 900- numbers, or charge a fee for unlimited or monthly support.

Automating Support

- One approach is through automation.
  - Internet-based online support forums
  - On-demand fax
  - Voice response systems
  - Knowledge bases

Providing Support Through a Help Desk

- **Help desk** is a single point of contact for all user inquiries and problems about a particular information system or for all users in a particular department

Providing Support Through a Help Desk (Cont.)

- It requires
  - *Technical skills*: extensive knowledge about how to use the system and typical problems that can be encountered
  - *People skills (Inter-personal skill)*: good listening and communication, dealing with complaints and frustrations

Support Issues for the Analyst to Consider

- User questions and problems
- Recovery and backup
- Disaster recovery
- PC maintenance
- Writing newsletters
- Setting up user groups

Organizational Issues in Systems Implementation

- Study of "Why does implementation sometimes fail?"
- Traditional wisdom of primary success factors:
  - Management support
  - User involvement
  - But these are not enough
- Other important factors
  - Commitment to project
  - Commitment to change
  - Extent of project definition and planning

Factors Influencing System Use

- Personal stake of users
- System characteristics
- User demographics
- Organizational support
- Performance
- Satisfaction

Success Factors

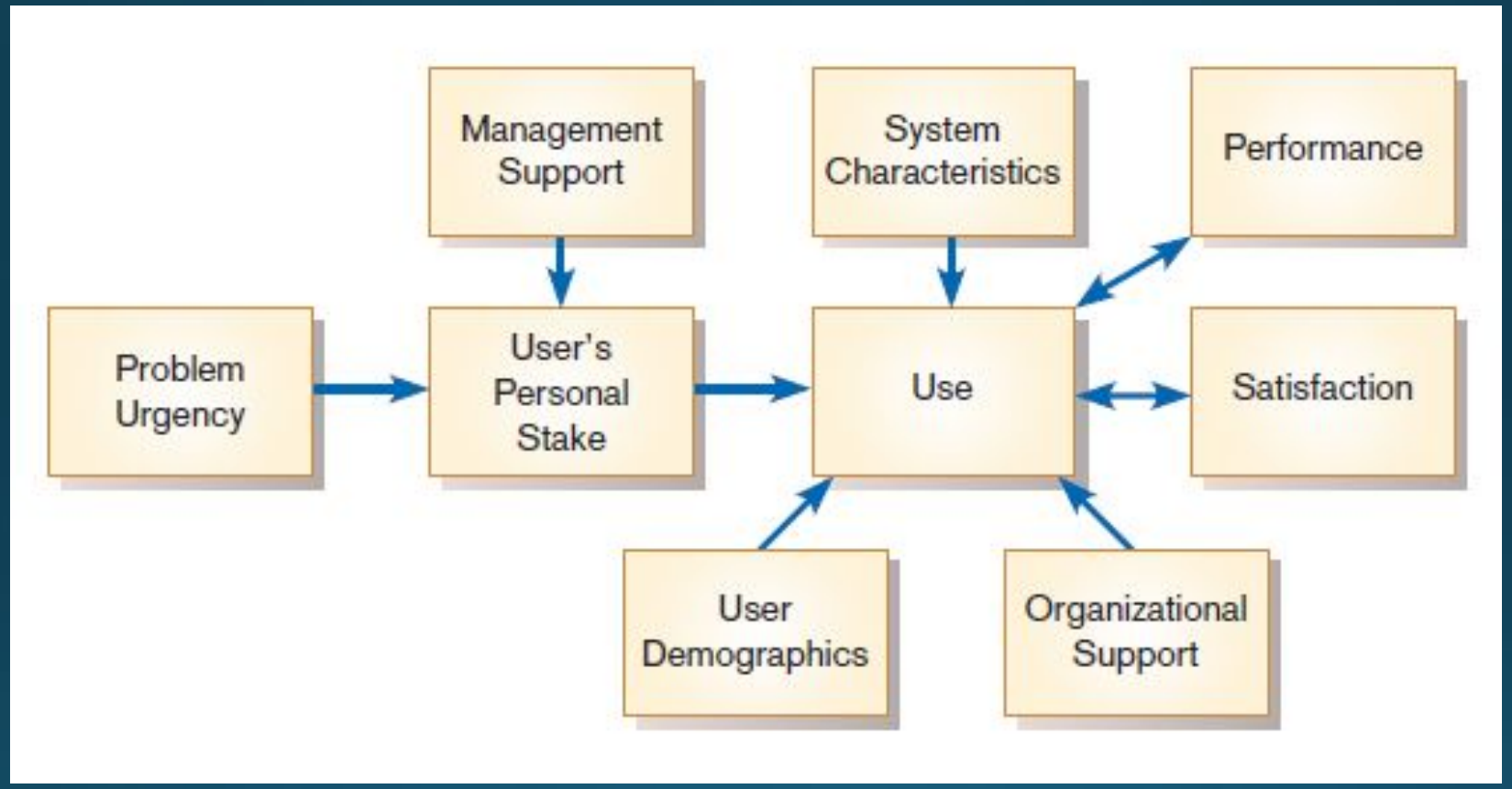


Figure Implementation success
(*Source:* Adapted from Lucas, H. C. 1997.*Information Technology for Management*..)

Security Issues

- Increasingly important issue for organizations and their management
- **Mal**icious soft**ware** (*malware*): includes Trojan horses, worms, viruses, and other kinds
- External sources of threats include laptop theft, system penetration, and denial of service.

9.7 Project Close-Down

- Evaluate team.
  - Reassign members to other projects.
- Notify all affected parties that the development project is ending and that you are switching to operation and maintenance mode.
- Conduct post project reviews.
- Close out customer contract.
  - Formal signoff

9.8 Maintaining Information Systems

The Process of Maintaining Information Systems

- Process of returning to the beginning of the SDLC and repeating development steps focusing on system change until the change is implemented

- Four major activities
  - Obtaining maintenance requests
  - Transforming requests into changes
  - Designing changes
  - Implementing changes

The Process of Maintaining Information Systems

- Deliverables and Outcomes
  - Development of a new version of the software and new versions of all design documents created or modified during the maintenance effort

Conducting System Maintenance

- Corrective maintenance
  - Changes made to a system to repair flaws in its design, coding, or implementation
- Adaptive maintenance
  - Changes made to a system to evolve its functionality to changing business needs or technologies
- Perfective maintenance
  - Changes made to a system to add new features or to improve performance
- Preventive maintenance
  - Changes made to a system to avoid possible future problems

The Cost of Maintenance

- Many organizations allocate eighty percent of information systems budget to maintenance

- Factors that influence system maintainability
  - Latent defects
  - Number of customers for a given system
  - Quality of system documentation
  - Maintenance personnel
  - Tools
  - Well-structured programs

Managing Maintenance

- Number of people working in maintenance has surpassed number working in development

- Three possible organizational structures
  1. Separate
     - Maintenance group consists of different personnel than development group
  2. Combined
     - Developers also maintain systems
  3. Functional
     - Maintenance personnel work within the functional business unit

Managing Maintenance

- Assignment of personnel
  - Maintenance work is often viewed negatively by IS personnel
  - Organizations have historically have rewarded people involved in new development better than maintenance personnel
  - Organizations often rotate personnel in and out of maintenance roles in order to lessen negative feelings about maintenance

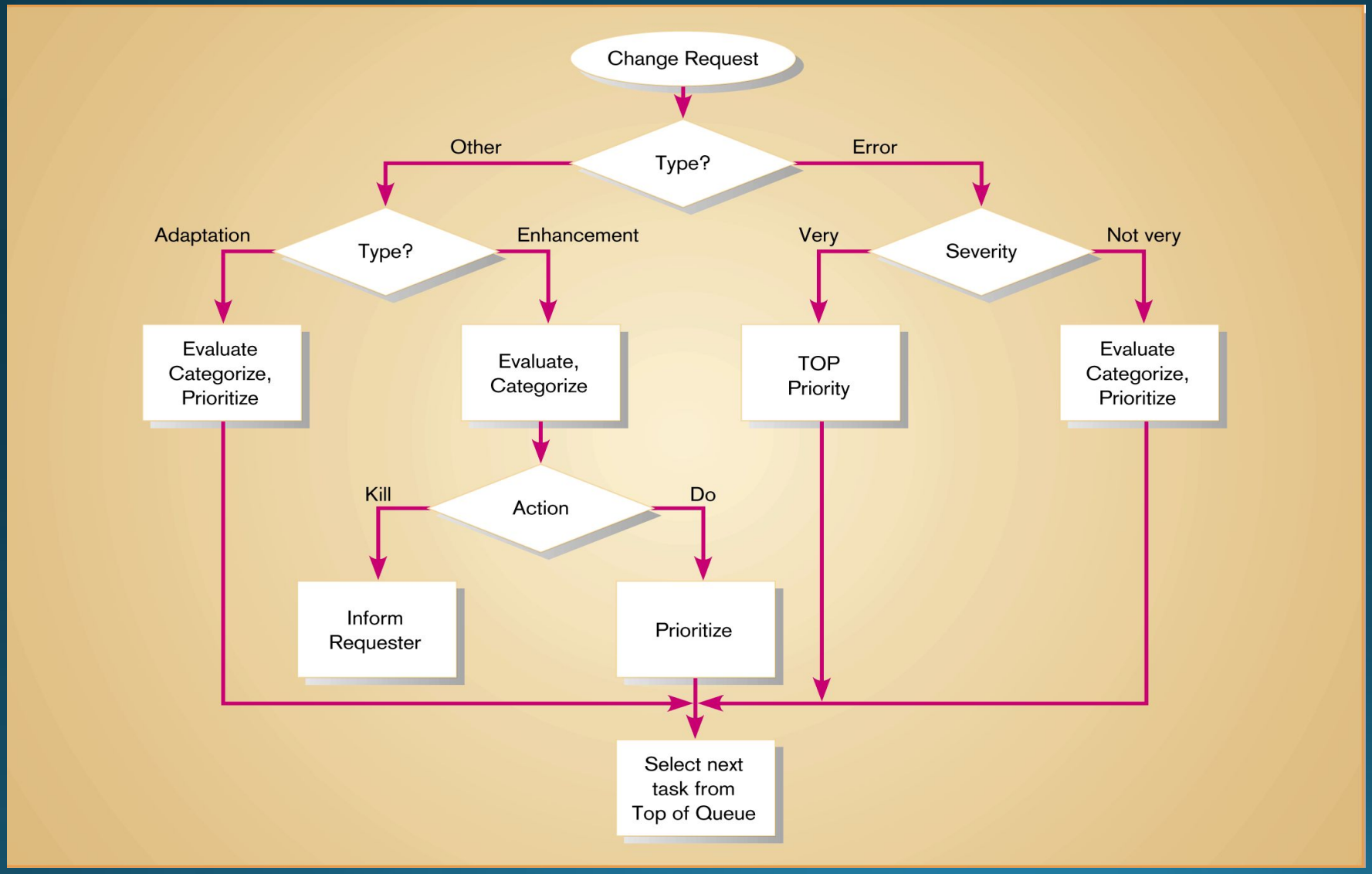
Measures of Effectiveness

- Number of failures
- Time between each failure
- Type of failure
- Mean time between failures (MTBF)
  - A measurement of error occurrences that can be tracked over time to indicate the quality of a system

Controlling Maintenance Requests

- Determine type of request
  - Error
  - Adaptation
  - Enhancement

Flowchart of how to control maintenance requests (Adapted from Pressman, 1992)



Configuration Management

The process of assuring that only authorized changes are made to the system

- Baseline modules
  - Software modules that have been tested, documented, and approved to be included in the most recently created version of a system
- System librarian
  - A person responsible for controlling the checking out and checking in of baseline modules when a system is being developed or maintained
- Build routines
  - Guidelines that list the instructions to construct an executable system from the baseline source code

Role of CASE and Automated Development Tools in Maintenance

- Traditional systems development
  - Emphasis on coding and testing
  - Changes are implemented by coding and testing first
  - Documentation is done after maintenance is performed
  - Keeping documentation current is often neglected due to time-consuming nature of task
- Development with CASE
  - Emphasis is on design documents
  - Changes are implemented in design documents.
  - Code is regenerated using code generators
  - Documentation is updated during maintenance

Website Maintenance

- Special considerations
  - 24 X 7 X 365
    - Nature of continuous availability makes maintenance challenging
    - Pages under maintenance can be locked
    - Date and time stamps
  - Check for broken links
  - HTML Validation
    - Pages should be processed by a code validation routine before publication

Website Maintenance

- Special considerations (continued)
  - Re-registration
    - When content significantly changes, site may need to be re-registered with search engines
  - Future Editions
    - Consistency is important to users
    - Post indications of future changes to the site
    - Batch changes