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VI - Semester

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MANAGEMENT INFORMATION SYSTEM

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SYLLABI-BOOK MAPPING TABLE

Management Information System

Syllabi	Mapping in Book
BLOCK I: INTRODUCTION OF MIS	
UNIT-I: Understanding MIS - Management Information Systems - History of MIS - Impact of MIS - Role and Importance - MIS Categories - Managers and Activities in IS - Types of Computers Used by Organizations in Setting up MIS - Hardware support for MIS.	Unit 1: Understanding MIS (Pages 1-26);
UNIT-II: Conceptual Foundations - Decision Making Process - System Approach to Problem Solving - The Structure of Management Information System.	Unit 2: Conceptual Foundations (Pages 27-42);
UNIT-III: Kinds of Information Systems - Types of Management Systems Concepts of Management Organization.	Unit 3: Kinds of Information Systems (Pages 43-58);
UNIT-IV: Planning and Control - Differences between Planning and Control Information - Systems Analysis - Systems Design.	Unit 4: Planning and Control (Pages 59-84)
BLOCK II: MIS ENTERPRISE & STRUCTURE	
UNIT-V: MIS Planning and Development - Planning - Development.	Unit 5: MIS Planning and Development (Pages 85-98);
UNIT-VI: MIS and BPR -Business Process Re-Engineering, Improving a process in BPR - Object Oriented methodology - BPR - Current Focus.	Unit 6: MIS and BPR (Pages 99-106);
UNIT-VII: MIS Organization Structure - MIS at Management Levels - Strategic Level Planning - Operational Level Planning - Economic and Behavior Theories.	Unit 7: MIS Organizational Structure (Pages 107-116);
UNIT-VIII: Enterprise Resource Planning - Basics of ERP - Evolution of ERP - Enterprise Systems in Large Organizations - Benefits and Challenges of Enterprise Systems.	Unit 8: Enterprise Resource Planning (Pages 117-136)
BLOCK III: E-ENTERPRISE - TRENDS IN MIS	
UNIT-IX: E-Enterprise System - Managing the E-enterprise - Organisation of Business in an E-enterprise - E-business - E-commerce - E-communication - E-collaboration.	Unit 9: E-Enterprise System (Pages 137-172);
UNIT-X: Trends in MIS - Decision Support Systems (DSS) - Artificial Intelligence (AI).	Unit 10: Trends in MIS (Pages 173-184);
UNIT-XI: MIS - Support Models and Knowledge Management - Philosophy of Modeling - DSS - Deterministic Systems - Market Research Methods - Ratio Analysis for Financial Assessment - Management Science Models - Procedural Models - Project Planning and Control Models - Cost Accounting Systems - Operations Research Models - Mathematical Programming Techniques - Knowledge Management.	Unit 11: MIS: Support Models and Knowledge Management (Pages 185-204)

BLOCK IV: ORGANISATION AND STRATEGY OF MIS SECURITY & ETHICAL ISSUES

UNIT-XII: Organization and Computer Networks - Basics of Computer Systems - Basic Network Terminologies - Definitions and Application - The Intranet and the Extranet - Database Management Systems - Types of Database Users - DBMS - Designing of DBMS.

UNIT-XIII: Strategic Management Information System - Background - Performance - Product Differentiation and Value Chain - How IT influences Organizations' goals - The five levels - Governance Modes in the use of IT.

UNIT-XIV: Security and Ethical Issues - Control Issues in Management Information Systems - Security Hazards - Ethical Issues - Technical Solutions for Privacy Protection.

Unit 12: Organization and
Computer Networks
(Pages 205-244);

Unit 13: Strategic Management
Information System
(Pages 245-258)

Unit 14: Security and Ethical Issues
(Pages 259-276)

CONTENTS

BLOCK I: INTRODUCTION OF MIS

UNIT 1 UNDERSTANDING MIS

1-26

- 1.0 Introduction
- 1.1 Objectives
- 1.2 Management Information Systems: Role, Impact and Importance
 - 1.2.1 Nature and Scope of MIS
 - 1.2.2 Characteristics of MIS
 - 1.2.3 Functions of MIS
 - 1.2.4 MIS Categories
 - 1.2.5 History of MIS
- 1.3 Managers and Activities in IS
 - 1.3.1 Business Information System
 - 1.3.2 Organizational Information Strategy
 - 1.3.3 Firm-Level Strategy and Information Systems
 - 1.3.4 Industry-Level Strategy and Information Systems
- 1.4 Types of Computers used by Organizations in Setting up MIS
 - 1.4.1 Classification based on Data-Handling Capability
 - 1.4.2 Classification based on Functionality
 - 1.4.3 Hardware Support for MIS
- 1.5 Answers to Check Your Progress Questions
- 1.6 Summary
- 1.7 Key Words
- 1.8 Self Assessment Questions and Exercises
- 1.9 Further Readings

UNIT 2 CONCEPTUAL FOUNDATIONS

27-42

- 2.0 Introduction
- 2.1 Objectives
- 2.2 Decision-Making Process
 - 2.2.1 Types of Decisions
- 2.3 System Approach to Problem-Solving
 - 2.3.1 Applying the Systems Approach to Problem-Solving
- 2.4 The Structure of Management Information System
 - 2.4.1 Physical Components of MIS
 - 2.4.2 Information System Processing Functions

- 2.5 Answers to Check Your Progress Questions
- 2.6 Summary
- 2.7 Key Words
- 2.8 Self Assessment Questions and Exercises
- 2.9 Further Readings

UNIT 3 KINDS OF INFORMATION SYSTEMS

43-58

- 3.0 Introduction
- 3.1 Objectives
- 3.2 Types of Management Systems
 - 3.2.1 Types of Information Systems
- 3.3 Concepts of Management Organization
 - 3.3.1 Meaning of Organization
 - 3.3.2 Changing Role of Information Systems in Organizations
 - 3.3.3 Impact of Information Systems on Organizations
 - 3.3.4 The Internet and Organizations
- 3.4 Answers to Check Your Progress Questions
- 3.5 Summary
- 3.6 Key Words
- 3.7 Self Assessment Questions and Exercises
- 3.8 Further Readings

UNIT 4 PLANNING AND CONTROL

59-84

- 4.0 Introduction
- 4.1 Objectives
- 4.2 Difference between Planning and Control
- 4.3 Systems Analysis
 - 4.3.1 Requirement Analysis
 - 4.3.2 Requirement Determination
 - 4.3.3 Strategies for Requirement Determination
 - 4.3.4 Tools for Structured Analysis
- 4.4 Systems Design
 - 4.4.1 Principles of Design
 - 4.4.2 Concepts of Design
 - 4.4.3 Conceptual Design
- 4.5 Answers to Check Your Progress Questions
- 4.6 Summary
- 4.7 Key Words
- 4.8 Self Assessment Questions and Exercises
- 4.9 Further Readings

BLOCK II: MIS ENTERPRISE AND STRUCTURE

UNIT 5 MIS PLANNING AND DEVELOPMENT

85-98

- 5.0 Introduction
- 5.1 Objectives
- 5.2 Information Planning and Development
 - 5.2.1 Various Information System Plans
 - 5.2.2 Steps For Information Systems Planning
 - 5.2.3 Development Strategies for Information Systems
- 5.3 Answers to Check Your Progress Questions
- 5.4 Summary
- 5.5 Key Words
- 5.6 Self Assessment Questions and Exercises
- 5.7 Further Readings

UNIT 6 MIS AND BPR

99-106

- 6.0 Introduction
- 6.1 Objectives
- 6.2 Business Process Re-Engineering: Current Focus
 - 6.2.1 Improving a Process in BPR
- 6.3 Object Oriented Methodology
- 6.4 Answers to Check Your Progress Questions
- 6.5 Summary
- 6.6 Key Words
- 6.7 Self Assessment Questions and Exercises
- 6.8 Further Readings

UNIT 7 MIS ORGANIZATIONAL STRUCTURE

107-116

- 7.0 Introduction
- 7.1 Objectives
- 7.2 MIS at Management Levels
- 7.3 Strategic Level Planning
 - 7.3.1 Operational Level Planning
- 7.4 Economic and Behaviour Theories
 - 7.4.1 Economic Theories
 - 7.4.2 Behaviour Theories
- 7.5 Answers to Check Your Progress Questions
- 7.6 Summary
- 7.7 Key Words

7.8 Self Assessment Questions and Exercises

7.9 Further Readings

UNIT 8 ENTERPRISE RESOURCE PLANNING

117-136

8.0 Introduction

8.1 Objectives

8.2 Basics of ERP: Benefits and Challenges of Enterprise Systems

8.2.1 Advantages of ERP Systems

8.2.2 Implementation of ERPs

8.2.3 Evolution of ERP

8.3 Enterprise Systems in Large Organizations

8.3.1 Difference between Custom Built Information Systems and ERP

8.3.2 Developing and Implementing a Custom Built Information System

8.3.3 ERP Implementation Life Cycle

8.4 Answers to Check Your Progress Questions

8.5 Summary

8.6 Key Words

8.7 Self Assessment Questions and Exercises

8.8 Further Readings

BLOCK III: E-ENTERPRISE-TRENDS IN MIS

UNIT 9 E-ENTERPRISE SYSTEM

137-172

9.0 Introduction

9.1 Objectives

9.2 Managing the E-Enterprise

9.3 Organization of Business in an E-Enterprise

9.4 E-Business and E-Commerce

9.4.1 E-Commerce Practices

9.4.2 Administration, Business and Consumer Models of E-Commerce

9.4.3 Business-to-Business (B2B) Models

9.4.4 Consumer-to-Consumer Model

9.4.5 Peer-to-Peer Model

9.5 E-Communication

9.5.1 E-Collaboration

9.6 Answers to Check Your Progress Questions

9.7 Summary

9.8 Key Words

9.9 Self Assessment Questions and Exercises

9.10 Further Readings

UNIT 10 TRENDS IN MIS

173-184

- 10.0 Introduction
- 10.1 Objectives
- 10.2 Decision Support Systems (DSS)
- 10.3 Artificial Intelligence (AI)
- 10.4 Answers to Check Your Progress Questions
- 10.5 Summary
- 10.6 Key Words
- 10.7 Self Assessment Questions and Exercises
- 10.8 Further Readings

UNIT 11 MIS: SUPPORT MODELS AND KNOWLEDGE MANAGEMENT

185-204

- 11.0 Introduction
- 11.1 Objectives
- 11.2 Philosophy of Modelling
- 11.3 DSS
 - 11.3.1 Deterministic Systems
- 11.4 Market Research Methods
- 11.5 Ratio Analysis for Financial Assessment
- 11.6 Operations Research or Management Science Models
- 11.7 Knowledge Management
 - 11.7.1 Knowledge Discovery in Database (KDD) and Data Mining
- 11.8 Procedural Models
 - 11.8.1 Project Planning and Control Models
 - 11.8.2 Cost Accounting Systems
 - 11.8.3 Mathematical Programming Techniques
- 11.9 Answers to Check Your Progress Questions
- 11.10 Summary
- 11.11 Key Words
- 11.12 Self Assessment Questions and Exercises
- 11.13 Further Readings

BLOCK IV: ORGANIZATION AND STRATEGY OF MIS SECURITY AND ETHICAL ISSUES

UNIT 12 ORGANIZATION AND COMPUTER NETWORKS

205-244

- 12.0 Introduction
- 12.1 Objectives

12.2 Basics of Computer Systems

12.2.1 The Input Unit

12.2.2 The Central Processing Unit (CPU)

12.2.3 The Output Unit

12.2.4 The Memory Unit

12.3 Basic Network Terminologies: Definition and Applications

12.3.1 Network Topologies

12.3.2 Private Branch Exchanges (PBX)

12.3.3 LANs and WANs

12.3.4 Broadband Network Services and Technologies

12.3.5 Network Convergence

12.3.6 The Intranet and the Extranet

12.4 Database Management Systems: Types of DBMS Users and Designing of DBMS

12.4.1 Advantages of the Database System

12.4.2 Components of DBMS

12.4.3 People Who Work with Databases

12.4.4 The DBMS Architecture

12.5 Answers to Check Your Progress Questions

12.6 Summary

12.7 Key Words

12.8 Self Assessment Questions and Exercises

12.9 Further Readings

UNIT 13 STRATEGIC MANAGEMENT INFORMATION SYSTEM

245-258

13.0 Introduction

13.1 Objectives

13.2 Strategic Management Information System

13.2.1 Background

13.2.2 Performance

13.2.3 Value Chain

13.3 Product Differentiation

13.4 How IT Influences Organizations' Goals

13.4.1 The Five Levels

13.4.2 Governance Modes in the Use of IT

13.5 Answers to Check Your Progress Questions

13.6 Summary

13.7 Key Words

13.8 Self Assessment Questions and Exercises

13.9 Further Readings

UNIT 14 SECURITY AND ETHICAL ISSUES

259-276

- 14.0 Introduction
- 14.1 Objectives
- 14.2 Control Issues in Management Information Systems
 - 14.2.1 SCIM Components
 - 14.2.2 User Management
- 14.3 Security Hazards
 - 14.3.1 Information Security Attacks from Insiders
 - 14.3.2 Types of Information Security Attacks from Outsiders
 - 14.3.3 Incident Response
 - 14.3.4 Some Attack Techniques and Technologies
- 14.4 Ethical Issues and Technical Solutions for Privacy Protection
 - 14.4.1 Ethics in an Information Society
 - 14.4.2 Ethics for IS Professionals
- 14.5 Answers to Check Your Progress Questions
- 14.6 Summary
- 14.7 Key Words
- 14.8 Self Assessment Questions and Exercises
- 14.9 Further Readings

INTRODUCTION

NOTES

Rapid globalization coupled with the growth of the Internet and Information Technology (IT) has led to a complete transformation in the way businesses or organizations function today. This has not only affected the management culture but has also led to an increase in competition in terms of markets and resources. Businesses have become more customer-driven and e-business is gaining popularity. Traditional means of communication/correspondence have given way to online dealings, e-mails and chats. With such a radical shift in the approach to doing business, came the need for specialized systems to handle the various departments and functions in an organization.

Management Information System or MIS is an organized and well-structured system used by organizations for the collection, storage, processing and dissemination of data in the form of information that facilitates the smooth functioning of the organization. Management information systems involve three primary resources: people, technology and information or decision-making. Management information systems are distinct from other information systems in that they are used to analyse operational activities in the organization. Academically, the term is commonly used to refer the group of information management methods tied to the automation or support of human decision-making, such as decision support systems, expert systems and executive information systems.

Information is considered to be an important asset for any company in the modern competitive world. The consumer buying trends and behaviour can be predicted by the analysis of sales and revenue reports from each operating region of the company. The successful management information systems supports a business's long range plans, providing reports based upon performance analysis in areas critical to those plans, with feedback loops that allow for titivation of every aspect of the enterprise, including recruitment and training regimens. Management information systems not only indicate how things are going, but why and where performance is failing to meet the plan.

This book, *Management Information System*, is divided into fourteen units that follow the self-instruction mode with each unit beginning with an Introduction to the unit, followed by an outline of the Objectives. The detailed content is then presented in a simple but structured manner interspersed with Check Your Progress Questions to test the student's understanding of the topic. A Summary along with a list of Key Words and a set of Self Assessment Questions and Exercises is also provided at the end of each unit for recapitulation.

BLOCK - I

INTRODUCTION OF MIS

Understanding MIS

UNIT 1 UNDERSTANDING MIS

NOTES

Structure

- 1.0 Introduction
- 1.1 Objectives
- 1.2 Management Information Systems: Role, Impact and Importance
 - 1.2.1 Nature and Scope of MIS
 - 1.2.2 Characteristics of MIS
 - 1.2.3 Functions of MIS
 - 1.2.4 MIS Categories
 - 1.2.5 History of MIS
- 1.3 Managers and Activities in IS
 - 1.3.1 Business Information System
 - 1.3.2 Organizational Information Strategy
 - 1.3.3 Firm-Level Strategy and Information Systems
 - 1.3.4 Industry-Level Strategy and Information Systems
- 1.4 Types of Computers used by Organizations in Setting up MIS
 - 1.4.1 Classification based on Data-Handling Capability
 - 1.4.2 Classification based on Functionality
 - 1.4.3 Hardware Support for MIS
- 1.5 Answers to Check Your Progress Questions
- 1.6 Summary
- 1.7 Key Words
- 1.8 Self Assessment Questions and Exercises
- 1.9 Further Readings

1.0 INTRODUCTION

A management information system (MIS) is a hardware and software-based computer system that acts as the backbone of an organization's operations. An MIS collects data from various online systems, analyzes it, and reports it to help managers make decisions. The study of how such systems operate is also part of MIS. In this unit, we will discuss the history and impact of MIS, along with its role and importance. We will also focus on the managers and activities in IS and types of computers used by organizations in setting up MIS.

1.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the history and impact of MIS

- Discuss the managers and activities in IS
- Describe the types of computers used by organizations in setting up MIS

NOTES

1.2 MANAGEMENT INFORMATION SYSTEMS: ROLE, IMPACT AND IMPORTANCE

Information systems that help management in taking decisions are called Management Information Systems (MIS). MIS may consist of a set of information systems working towards the common goal of achieving greater efficiency in management decision-making for each level of management. Typically, management information systems deal with information that is generated internally. The in-house data is processed (summarized/aggregated) to create reports, which enable decision-making at different levels in the organization. Today's management information systems have a data repository at the core, which is in the form of a Relational Database Management System (RDBMS). All in-house transaction-related data are saved in this database that is designed on the basis of set rules. This data repository is topped by several tiers of logic and/or business rules, which enable the creation of an interface and the various reports that managers need at different levels. The MIS is normally designed to achieve an information flow based on the need-to-know principle. Managers are only given information based on their needs and their place in the organization. A shop floor supervisor gets the personnel details of all his subordinates but not the salary details pertaining to senior management. This hierarchical rule-based information delivery to different levels of management is put in place to avoid information overload and to enable data security.

Modern systems, such as ERP, CRM and Supply Chain Management (SCM) systems, have been built to help managers perform various tasks. ERP systems are transaction processing/support systems that include industry-wide best practices and are used to generate integrated scenarios for managers at different levels. CRM systems enable customer management by creating profiles and providing complex analytical tools to process customer data to managers. SCM systems provide tools to enable managers to deal with supply chain data. All these modern systems basically help in achieving greater efficiency by making the job of management decision-making better and, therefore, fall under the category of management information system.

1.2.1 Nature and Scope of MIS

The primary aim of corporate information management is information integration which serves as a basic foundation. The scope and role of MIS change from stand alone systems, such as DSS (Decision Support System), and EIS (Executive Information System), to the integrated component of information management. An outline of the information system and its architecture is provided below.

To classify MIS, one should first understand its business perspective. There are many different areas of MIS having possibilities and important roles. The Second approach for classifying MIS is by system architecture. For this too, different subtypes of MIS and middleware should be identified. Tasks and potentials of middleware and MIS are put forward and real-life examples from companies are discussed.

The main scope of MIS corresponds to different phases such as analysis, design, planning, construction, etc. These also include many other activities such as implementation, utilization, evaluation and handling of information systems for coordinating various activities in the organization. Such activities are given as follows:

- Aimed at most effective utilization of organizational resources using information technology.
- Handling information technologies in an interactive way in relation to the organizational structure.
- Regular evaluation of information systems.
- Analysis of the existing model including changes required in design and implementation of computer-based information systems.
- Incorporating data, knowledge and information in the organization.
- Application of information systems, such as transaction processing, routine data processing, decision support and using relevant data/information to support other systems such as expert support system, executive support system, etc.
- Activities related to research in the field of cognitive science, knowledge engineering, and systems, theory and its application in operations management.

The nature of MIS is passive. It only supplies information to managers; it does not actively lead managers to a decision. Managers take decisions without the support of the management information system. The system only supplies background information, on which such decisions are based. The system does not provide active decision support. It does not have models to imitate the real-life scenarios as a proactive system as in the case of the decision support system. It only supplies the basic information. Even though this role of providing information is very important, it is only an enabler for better decisions. The scope of MIS is thus limited in a way.

1.2.2 Characteristics of MIS

Management information system being a specialized information system category conforms to certain characteristics. These characteristics are generic in nature and remain more or less the same even when the technology around such management information system changes:

NOTES

NOTES

- **Management oriented:** One important feature of MIS is that it is designed top down. This means that the system is designed around the need for information of the management at different levels. The focus of the system is to satisfy the information needs of the management.
- **Management directed:** Since MIS is 'for the management', it is imperative that it also should have a very strong 'by the management' initiative. The management is involved in the design process of MIS and also in its continuous review and upgradation to develop a good quality system. The system is structured according to the directions factored in by the management. This helps in minimizing the gap between the expectation of the management from the system and the actual system.
- **Integrated:** MIS is an integrated system. It is integrated with all the operational and functional activities of the management. This is an important characteristic and requirement for a system to qualify as an MIS. The reason for having an integrated system is that information in the managerial context for decision-making may be required from different areas within the organization. If MIS remains a collection of isolated systems, each satisfying a small objective, then the integrated information needs of managers will not be fulfilled. In order to provide a complete picture of a scenario, complete information is needed, which only an integrated system can provide.
- **Common data flows:** Since MIS is required for an integrated system, the data being stored into the system, retrieved from the system, disseminated within the system or processed by the system can be handled in an integrated manner. The integrated approach towards data management will result in avoiding duplication of data, data redundancy and help simplify operations.
- **Strategic planning:** An MIS is never designed overnight. A very high degree of planning goes into creating an MIS. The reason for this kind of planning is to ensure that the MIS being established not only satisfies the information need of the managers currently but also serves the organization in the next 5 to 10 years with modifications. Sometimes, when the planning is over, systems tend to perform well in the present but tend to become obsolete with time. Planning helps to avoid this problem.
- **Bias towards centralization:** Since an MIS is required to give 'one version of the truth' (that is, it must supply the correct version of the latest information), there is a requirement for the data repository to be centralized. Centralized data management helps an MIS to exercise version control as well as provide an integrated view of data to the managers. In a non-centralized system, data is entered, updated and deleted from different locations. In such a case, it becomes difficult to provide the correct information to managers. For example, in a decentralized system if a person superannuates from an organization and his superannuation is only recorded in the human resource system but not communicated to the finance department system, then it is quite likely that his salary may be generated by the finance system for the

next month. A centralized system where data is entered, updated and deleted from only one location does not suffer from such problems. In a centralized system, the superannuating employee's details are deleted from the master file, thereby eliminating the risk of generating his salary for the next month.

- **Information and Communication Technology-enabled:** The extreme pressure of competition requires information to be timely and accurate for effective decision-making, both of which can be ensured if information is managed using information technology. Hence, any modern MIS has a very high dose of technological intervention in it. In fact, all MIS that run today, run on some ICT platform, to enable a smooth functioning of the system and ensure timely and accurate results.

NOTES

1.2.3 Functions of MIS

The broad functions of MIS are as follows:

- **To improve decision-making:** The MIS provides background information on a variety of issues and helps improve the decision-making quality of the management. The fast and accurate information supplied by the MIS is leveraged by the managers to take quick and better decisions, thereby improving the decision-making quality and adding to the value of the company.
- **To improve efficiency:** The MIS helps managers to conduct their tasks with greater ease and better efficiency. This reflects in better productivity.
- **To provide connectivity:** The MIS provides managers with better connectivity with the rest of the organization.

MIS generally has applicability in system decision-making. For example, MIS can be used to identify problems needing urgent attention for solutions with a timely feedback, to make the upper managers aware of the current progress and its shortcomings. Thus, there are many functions of MIS depending upon the tasks that an organization performs. The main functions of MIS are:

- **Data processing:** This comprises of collection, transmission, storage and processing of data to provide an output.
- **Prediction:** It carries the analysis on data to predict a future situation, by applying methods of modern mathematics, statistics or by way of simulation.
- **Planning:** The analysis of data of a regular nature may give many indications on likely future events or situations and this can be utilized in planning or reviewing the plan already made earlier.
- **Control:** From a record of day to day activities, monthly activities, quarterly or annual activities certain factors may be noted that need control. These factors may be controlled without much difficulty, if noted on time. There may be certain factors that need the attention of the higher management to remain under control. But there are many small factors that if ignored in the beginning, may disturb other factors as well.

NOTES

- **Assistance:** Providing assistance to the higher management by analyzing and inferring from regular records about various factors related to the performance of the business operation, is one of the main functions that MIS has to provide. This data may pertain to human resources, financial resources, material resources, etc.

1.2.4 MIS Categories

Organizations use several types of information systems to suit their needs. The various types of information systems that an organization uses may be classified into the following categories:

- Office automation systems
- Transaction processing system
- Decision support systems
- Executive information systems
- Business expert system

Apart from these broad classes of information systems, organizations also use specific information systems for some special tasks like executive information system, enterprise (wide) resource planning systems, customer relationship management systems and supply chain management system. These systems also fall under the above broad classification.

Office automation systems

This type of information system aids in automating office tasks. They have a limited role in decision-making and are more useful for operational level people. The information coming out of this kind of system can be used for rule-based decision-making for managers at the operational level. These systems however play an important role in automating several functions of an office and thus help in creating paperless offices. These kinds of systems help in increasing the productivity and efficiency of the office workforce by automating simple tasks. These systems mostly deal with operational data. More and more modern businesses are opting for this paperless office environment as this brings in the following unique advantages for the business:

- Office work becomes faster and process driven.
- All basic level data is digitized and stored for future action.

An example of office automation system is the office suite of software that helps in automating simple office tasks like presentations and documentation. Sometimes we also come across a class of systems called the operations support system (OSS). OSS also work with the lowest level of management is ensuring that the operations of the firm are performed smoothly. OSS can be very different from Office Automation System even though they both help bottom level managers, in term of the information complexity involved.

Transaction processing system

This type of system is critical to the smooth functioning of an organization. The objective of this kind of system is to capture all transaction related data between the organization and its external and internal customers. Typically, these transaction level data are stored in a pre-formatted manner in a relational database for further action in future. TPS is the most widely used form of information systems as they provide the management with the flexibility of storing data in a structured manner and retrieving it at a later date using a query facility. The system also helps in aggregating and summarizing the data for creating of management reports. These reports are further improved by using visualization tools that help the management in understanding situations and scenarios better. These systems deal with tactical data from within the organization. An example of TPS would be the sales management system with a relational database management system at the server side back end and a customized front end to interact with the users.

NOTES**Decision support systems**

Decision support systems help senior management to take strategic decisions. Contrary to the other systems, decision support systems are developed with the objective of providing the users (top management personnel) with unstructured information. These systems help the management to develop 'what if analysis' so that different scenarios can be developed for decision-making. Decision support systems deal with both internal and external data.

Such systems are custom built with features like business dashboard and scenario panel. Such systems are complex with working models (internal) on the data to provide the senior managers with decision support. Unlike transaction processing systems, these systems are not query dependent only. Their main role is to access data from a data repository and then pass that data through a model (mathematical, heuristic, statistical, econometric, operations research and combinatorial), so that the senior management can take better decisions by doing either 'what if analysis' and scenario building or by doing 'predictive analysis' to get some insight into a business issue. Such systems are very costly to build and require advanced analytics tools.

Executive support system

Executive support system is also known as the executive information (support) system. It began to gain acceptance in the mid-eighties in large corporations and is now used even in smaller corporations. In functionality, it is nearer to decision support systems than management information systems. Its main objectives are to provide a macro organization-wide view for senior executives, by providing a very user-friendly user-interface so that proactive steps may be taken to beat competition. It provides timely and proactive organization tracking and control. It is able to perform these tasks by providing fast access to all type of data and by filtering and tracking critical data and information. It helps to identify problems and

opportunities and thus, helps senior executives to troubleshoot problems and take advantage of opportunities.

Business expert system

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Some business scenarios are so complex that they require the help of advanced systems that can provide expert solutions. These systems use artificial intelligence and neural networks to reach the performance level of a human expert thereby helping the organization. These systems are different from any other information system as they are capable of decision-making by themselves without human intervention. Actually, these systems are loaded with the knowledge of experts and these systems simply simulate the expert knowledge to arrive at decisions.

1.2.5 History of MIS

Information systems form a special class of systems whose main objective is to store, retrieve, process, communicate and secure data. Information systems, which help management at different levels to take suitable decisions are called Management Information Systems or MIS. Typically, information systems are housed in a computerized environment/platform to enable users to get faster and accurate information.

Information systems can be of several types. At the very basic level, it can be used to automate tasks in the office using an office automation system; it can be used to provide the right kind of information to management; or top management can make decisions by using decision support systems. Decision support systems are complex systems used at the strategic management level for dealing with unstructured decision problems. Models are used in such decision support systems to help in decision-making. Management information systems are used by the management to acquire information for taking decisions. Typically, management information systems do not have a direct decision support role, apart from helping in decision-making by supplying the right information.

Information systems over the years

Information systems have undergone a remarkable transformation in the last 40 years of their existence. Initially, information systems were designed to perform a specific task. The objective was to perform a task as quickly as possible with the minimum number of errors. The concept of using information systems for taking decisions had not been realized before. Organizations used information systems for data processing only. Be it salary processing or bill processing, information systems previously were focused only on the efficiency of the operation. The people who worked on these systems had a certain knowledge about the system and the user interface of the systems were very basic (character user interface). The output was in the form of salary slips, etc. Processing the data in the most efficient way was the prime focus of such systems. Most of these systems used file-based data storage systems on which a program would work, i.e., the program would be able to access the data and organize it but the data would be stored in a file. The

problem with this type of a system was that it led to the replication of data and loss of consistency.

Over the years, information systems have changed. Now the focus is more on helping the management by providing information useful for decision-making. Data processing systems have become obsolete. The focus is on delivering the right information to the right people at the right time. Information systems have become faster, more accurate and user friendly for easy applicability. People who work on information systems nowadays, do not possess much knowledge about the systems per se. They are general users. The systems have become so friendly that they do not require any specialization in information systems. Newer concepts have emerged in information systems to help organizations get better value for their money. Concepts like client-server architecture, networking, distributed computing, centralized database, graphical user interface, the Internet, etc., have completely transformed information systems. Gone are the bulky mainframe systems requiring loads of money to run. Now more money is required to procure the software than the hardware.

Somogyi (1987) placed the development of information systems in a three era model. According to him, the initial era of information systems dealt primarily with the Electronic Data Processing (EDP). These systems worked as isolated islands of data processing without any linkage with any other process. Their main focus was on automating routine repetitive work like payroll preparation, etc., by batch processing of data files. The format of data processing was very inflexible and technology was at the forefront. The data processing tasks were tailored to suit technological requirements. This required specialized personnel who understood the complexities of technology; the general management personnel were unable to use it. Ease of use was definitely not a key feature of such systems. With the advent of personal computers and networking, it became easier to provide information to the management for better decision-making. This was the era of management information systems in which large databases, which housed all transaction level data began to be processed for obtaining significant information for managers. In this era, the business context of information came to the forefront and technology began to be used more as an enabler rather than as an end in itself. The systems began to become user-friendly, so that general management personnel could use it without much difficulty or training. In the modern era, the focus has shifted further to provide strategic value to organizations, so that competitive advantage could be gained through the intervention of information systems. Information systems are now closely integrated with the business strategy to get better value. Technology in such systems is used as an enabler and the business strategy takes the centre stage.

Check Your Progress

1. How does MIS help in better decision-making?
2. Mention any four characteristics of an MIS.
3. How does centralized data management help MIS?
4. State the meaning and main objective of information systems?

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1.3 MANAGERS AND ACTIVITIES IN IS

There are various strategies for running a business. One is to compete in the existing market by providing better price and quality. The other strategy is to create a new market by introducing new products and services. Yet another strategy is to expand the market by becoming global. Strategic information systems can facilitate an organization in changing the goals, operations, products, services or environmental relationships. Strategic information systems can be used for understanding customer requirements and market trends faster and more deeply than the competitors.

Porter's Value Chain Model lists all the activities of an organization and categorizes them as primary activities and support activities. It highlights specific activities in the business where competitive strategies can be best applied and where information systems are most likely to have a strategic impact. The value chain model identifies specific, critical leverage points, where a firm can use information technology most effectively to enhance its competitive position. This model views the firm as a series or chain of basic activities that add a margin of value to a firm's products or services. These activities can be categorized as either primary activities or support activities.

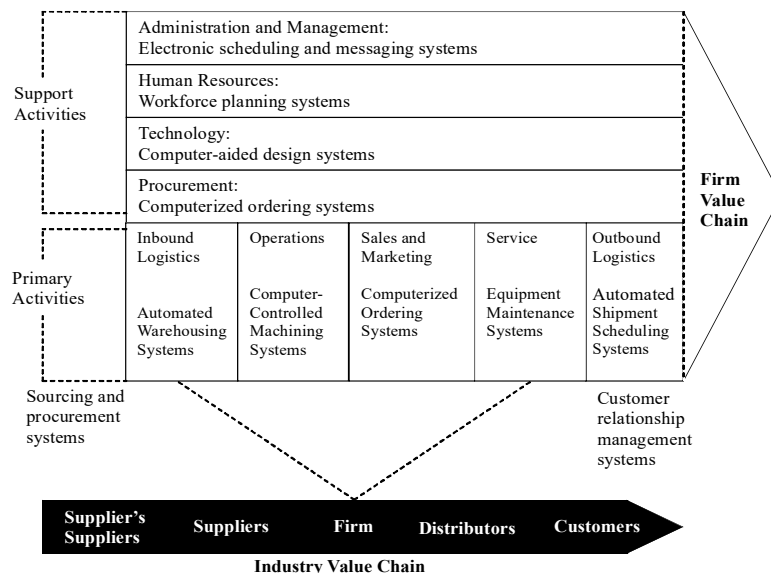
Primary activities are most directly related to the production and distribution of the firm's products and services that create value for the customer. Primary activities include:

- Inbound logistics — managing inventory after it has arrived in the organization
- Operations — to add value to the raw material
- Outbound logistics — get the products to the customers
- Sales and marketing — identify customers
- Service — provide support to the customers

Inbound logistics include receiving and storing materials for distribution to production. Operation transforms inputs into finished products. Outbound logistics entail storing and distributing finished products. Sales and marketing includes promoting and selling the firm's products. The service activity includes maintenance and repair of the firm's goods and services.

Support activities make the delivery of the primary activities possible and consist of:

- Organization infrastructure — administration and management
- Human resources — employee recruiting, hiring and training
- Technology — improving products and the production process
- Procurement — purchasing input



The firm value chain and the industry value chain. Illustrated are various examples of strategic information systems for the primary and support activities of a firm and of its value partners that would add a margin of value to the firm's products or services.

An information system can have a strategic impact if it helps the firm provide products or services at a lower cost than its competitors or if it provides products and services at the same cost as competitors but offers greater value. The activities that add most value to products and services depend on the features of each individual firm.

A firm can link its suppliers and customers to its own value chain. The suppliers can access their orders online, coordinate their deliveries with the production schedule of the company and receive payments online. All these activities help both partners in cutting down on cycle time and cost. Digitally-enabled networks can be used for procurement and for closely coordinating the production of many independent firms. The Internet technology has made it possible to extend the value chain so that it ties together all the firm's suppliers, business partners and customers.

Businesses should try to develop strategic information systems for both the internal and external value activities that add the most value. A strategic analysis studies the organization, its structure, processes and data flow. To conduct such a study, a software model of the organization is created that captures the processes and functions, people who perform these functions and the data required by the functions. An analysis is then done to identify the activities where an information system can help improve the process and its impact. The analyst may identify those sales and marketing activities where information systems can provide the greatest boost. The analysis might recommend a system to reduce marketing costs by targeting marketing campaigns more efficiently or by providing information for developing products more finely attuned to the firm's target market. An information system, after some time, becomes part of an organization and no longer gives

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competitive advantage. The organization has to study its own systems, markets and what competitors are doing, and respond accordingly. It may need to reorganize and reshape its structural, financial and human assets and recast systems to tap new sources of value.

We will now see how IT at the business level helps a firm reduce costs, differentiate products and serve new markets. The ATM was first introduced by the Citi group but they soon lost the competitive advantage because it became part of every bank. Credit cards, online reservation (air/train) systems and single window banking are some of the examples that gave advantage to organizations that introduced them, but competition caught up fast and made these systems an essential part of organizations. Online reservation systems made it possible to check all possible trains/flights, bypass the agents and make reservations, all in real time.

Manufacturers and retailers are starting to use information systems to create products and services that are custom-tailored to fit the precise specifications of individual customers. Dell Computer Corporation sells directly to customers using assemble-to-order manufacturing. Individuals, businesses and government agencies can buy computers directly from Dell, customized with the exact features and components they need. They can place their order directly using a toll-free telephone number or Dell's website. Once Dell's production control receives an order, it directs an assembly plant to assemble the computer based on the configuration specified by the customer using components from an onsite warehouse. These assemble-to-order strategies require careful coordination of customer requirements with production and flexible processes throughout the firm's value chain. In the following sections, you will read about some of the functional areas where information systems are being used for competitive advantage.

1.3.1 Business Information System

A business information system is a set of interrelated procedures using IT infrastructure in a business enterprise to generate and disseminate desired information. Such systems are designed to support decision-making by the people associated with the enterprise for attaining its objectives. A business information system gets data as input from the environment and processes them using the resources of IT infrastructure to satisfy the information needs of different entities associated with the business enterprise. There are systems of control over the use of IT resources and a feedback system offers useful clues for increasing the benefits of an information system to business. Business information system is a subsystem of a business system and serves the function of feedback and control in the business system.

Characteristics of Business Information system

The basic characteristics of BIS are as follows:

- A business information system is subject to the dynamics of business environment and needs to be flexible enough to absorb the inevitable changes

in the pattern of information requirement of business. They have to be efficient to satisfy the changing needs of an organization and its management.

- A business information system needs to be proactive. They should anticipate changes in the information needs of users and accordingly adapt themselves to suit their needs. This has become important so that the managers involved in decision-making, instead of reacting to competitors' moves, make an informed choice.
- The purpose of business information system is to cater to the information needs of decision-making in business.
- A business information system has to be designed keeping in view the availability of financial and human resources to the business enterprise.
- Cost-effectiveness is a matter of prime concern in the development and maintenance of a business information system. Investment in IT infrastructure for maintaining a business information system should have economic justification, as it is a precondition for its existence and sustenance.

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1.3.2 Organizational Information Strategy

Organizational information strategy is being implemented in many firms across the world. These organizations realize that information is an organizational asset and should be regarded as such. They also realize that absence of a chief information strategy has resulted in numerous problems in many firms.

One such problem is the failure of the employees in a firm to obtain specific and qualified information. According to a recent research, 15 to 30 per cent of a knowledge worker's time is spent looking for accurate information. Such drastic losses could be corrected by enabling the information available as and when required.

What is Information Strategy?

Information strategy can be defined as an organization's unified blueprint for capturing, integrating, processing, delivering and presenting information in a clean, consistent and timely manner. All information in a firm should satisfy a certain standard of quality. It should be delivered consistently across the firm, i.e., requests for the same information in various departments should get the same yield immediately and users and applications should not have to wait long to receive their required information.

We can compare information in a firm to the availability of water in a metropolitan city. In the earlier days, the source of drinking water was the well dug in the backyard of each house. This water was used for drinking, cooking and cleaning purpose. This water was not usually shared and was not necessarily hygienic. As people developed in the skill of city planning, they began to consider water as a common utility and integrate, clean and distribute it from a central organization in the metropolis. Thus, the residents of a metropolis have the right to obtain clean, potable water on time. The same can be applied to information in a firm. By implementing the same principles as our city planners, we would be able

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to capture, integrate and cleanse the information in a central repository, and provide it to our internal and external users in a clean, consistent and timely manner.

There are many reasons for implementing an information strategy in a firm. Primarily, information should be treated as an organizational asset. Similar to other assets, it has value. The value of information is in its accessibility and accuracy. Information that is not accessible on demand and/or is not accurate cannot be considered as an asset. Similar to most assets, information loses value as time goes by; hence, it needs to be governed and properly managed. An information strategy permits a firm to manage, govern and provide access to this asset.

Another reason for having an information strategy in the firm is because there is too much information in an organization to manage it loosely. We truly need a plan, a blueprint and a strategy for capturing, storing, governing and delivering all information to the internal and external users of this information.

Another major reason for having such a strategy is the business mandate for it. Business groups have become very perceptive in accessing, manipulating and using information and they expect availability of complete and accurate information.

In fact, with the new Web 2.0 technologies, they not only request internal information, but also external information provided in many websites such as myspace.com. Information available in such community sites could be used to analyse and interpret customer views and their likes and dislikes for improving a firm's products, services, image and marketing campaigns.

1.3.3 Firm-Level Strategy and Information Systems

A business firm is typically a collection of businesses. Often, each business unit manages its own finance, market and suppliers. Information systems can improve the overall performance of these business units by promoting collaboration. Two business units may pool markets and expertise; these relationships can lower costs and generate profits. One use of IT is to tie together the operations of disparate business units so that they can act as a whole. It is possible for a business unit to have core competence that it might have developed over a period of time. This core competence may be useful to other business units as well. Any information system that encourages the sharing of knowledge across business units enhances competency. Such systems might encourage or enhance existing competencies; such systems might also help a business leverage existing competencies to related markets.

1.3.4 Industry-Level Strategy and Information Systems

Firms together comprise an industry, such as the automotive industry, telephone, television broadcasting and forest products industries. The key strategic question at this level of analysis is, 'How and when should we compete with, as opposed to cooperate with, others in the industry?' The three principal concepts of analysing strategy at the industry level are (i) information partnership, (ii) the Competitive Forces Model and (iii) network economics.

Information Partnerships

Firms can form information partnerships and even link their information systems to achieve unique synergies. In an information partnership, both companies can join forces by sharing information without actually merging; for example, Big Bazaar has a tie-up with ICICI Bank to give additional discount to its customers for using ICICI's credit card. Such partnerships help firms gain access to new customers, creating new opportunities for cross-selling and targeting products. Companies that have been traditional competitors may find such alliances to be mutually advantageous.

The Competitive Forces Model

In Porter's Competitive Forces Model, a firm faces a number of external threats and opportunities: the threat of new entrants into its market, the pressure from substitute products or services, the bargaining power of customers and suppliers and the positioning of traditional industry competitors.

How can information systems be used to achieve strategic advantage at the industry level? By working with other firms, industry participants can force all market participants to subscribe to similar standards. Such efforts increase efficiency at the industry level as well as the business level, making product substitution less likely and perhaps raising entry costs, thus discouraging new entrants.

Profits have also been dampened because of the dramatic increase in information made available to customers by the Internet for comparison shopping, thus raising their bargaining power. Although the Internet can provide benefits such as new channels to customers and new operating efficiencies, firms cannot achieve competitive advantage unless they carefully integrate the Internet initiatives into their overall strategy and operations.

Network Economics

A third strategic concept useful at the industry level is network economics. The law of diminishing returns states that the more any given resource is applied to production the lower is the marginal gain in output, until a point is reached where the additional inputs produce no additional outputs. In some situations, the law of diminishing returns does not work; for instance, it is no more expensive to operate a television station with 1000 subscribers than with 10 million subscribers. From this perspective of network economics, IT can be strategically useful. The Internet sites can be used by firms to build communities of like-minded customers who want to share their experiences. This can build customer loyalty and enjoyment and unique ties among customers.

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NOTES**Check Your Progress**

5. What are the three principle concepts for analysing strategy at the industry-level?
6. What are information partnerships?
7. What does the law of diminishing returns state?

1.4 TYPES OF COMPUTERS USED BY ORGANIZATIONS IN SETTING UP MIS

Today, computers are available in many sizes and types, ranging from a small one that fits in the palm to a large one that occupies an entire room. We can classify computers into two categories based on their data handling capability and functionality.

1.4.1 Classification based on Data-Handling Capability

Various types of computers process data in a different manner, and, according to this basic working principle, they are classified into three types, namely analog computer, digital computer, and hybrid computer.

Analog computers

The term analog means continuous wave or data (see Figure 1.1), such as electric current. Analog computers are computers that measure this continuous data by parameters such as speed, pressure, and so on. In analog computers, the operations are performed in parallel, thus making them faster. Analog computers are often used in scientific and engineering applications.

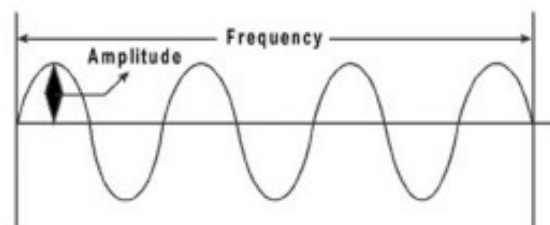


Fig 1.1 An Analog Sine Wave

Digital computers

Digital means data consisting of discrete levels (see Figure 1.2). Devices that work (manipulate) with these discrete levels are known as digital computers. In digital computers, these discrete levels are represented by binary digits (0s and 1s) where 0 means the absence of electric current and 1 means the presence of electric current.

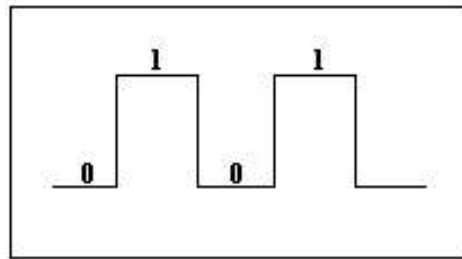


Fig 1.2 A Square Wave

In digital computers, the analog quantities are converted into digital before processing. Digital computers perform counting rather than measuring data which is done in analog systems. Note that digital computers are more accurate, precise and faster than analog computers.

Hybrid computers

Hybrid computers include features of both the analog and the digital computer in a single computer. They use the measuring feature of an analog computer and the counting feature of a digital computer. They comprise a digital unit and an analog unit which are connected together through a hybrid interface. The digital unit controls the analog unit with the help of stored instructions and the analog unit interpolates the digital unit for various input/output (I/O) operations. Hybrid computers are used to solve special type of problems related to science and engineering, such as space vehicle simulations, training of astronauts, and so on.

1.4.2 Classification based on Functionality

Computers differ in performance, size and cost. Depending upon these parameters, computers can be divided into four major categories, namely microcomputers, minicomputers, mainframe computers and supercomputers.

Microcomputers

A microcomputer is a small, low-cost digital computer. It generally comprises a microprocessor, a storage unit, an input channel and an output channel, and all these things may be on one chip inserted into one or several PC boards. Originally, these computers were designed for individual users only, but nowadays, they are used for business purposes as well. Microcomputers can be categorized into desktop, laptop, and hand-held models.

- **Desktop computer:** A desktop computer (see Figure 1.3) also known as a personal computer (PC) is principally intended for standalone (capable of operating independently) use by an individual. This is the most common type of microcomputer that typically consists of a system unit, a display monitor, a keyboard, an internal hard disk storage, other peripheral devices, and memory units. Desktop computers are very popular since they are

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inexpensive. Some of the major personal computer manufacturers are Apple, IBM, Dell, and Hewlett-Packard.

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Fig 1.3 A Desktop Computer

- **Laptop:** A laptop (see Figure 1.4) is a portable computer, that is, a user can carry it around. Since a laptop computer resembles a notebook, it is also known as notebook. The biggest advantage of this computer is that one can use this computer anywhere and at anytime, especially when one is travelling. Moreover, this computer does not need any external power supply as a rechargeable battery is completely self-contained in it. Laptop computers are expensive as compared to desktop computers.



Fig 1.4 A Laptop Computer

- **Hand-held computer:** A hand-held computer, also called personal digital assistant (PDA), is a computer that can be conveniently stored in a pocket and used while the user is holding it. PDAs (see Figure 1.5) are essentially small portable computers and are slightly bigger than the common calculators. A PDA user generally uses a pen or an electronic stylus, instead of a keyboard, for input. Since these computers can be easily fitted in the palm, they are also known as palmtop computers. These computers usually have no disk drive; rather they use small cards to store programs and data. However, they can be connected to a printer or a disk drive to generate output or store data. Some examples of hand-held computers include Apple Newton, Casio Cassiopeia, and Franklin eBookMan.



Fig 1.5 A Personal Digital Assistant

Minicomputers

In the early 1960s, Digital Equipment Corporation (DEC) started shipping its PDP series computer which the media described and referred to as minicomputers. A minicomputer is a small digital computer that processes and stores more data at a faster speed than a microcomputer. Minicomputers are mainly multi-user systems, so they are used in interactive applications in industries, research organizations, colleges, and universities. These computers are designed to meet the computing needs of small to medium-sized business environment. Some examples of minicomputers include PDP 11 (see Figure 1.6), IBM (8000 series), and VAX 7500.



Fig 1.6 PDP 11 Minicomputer

Mainframe computers

A mainframe, an ultra-high performance computer, is made for high-volume and processor-intensive computing. It has a high-end computer processor with peripheral devices that can support large volumes of data processing, and extensive data storage and retrieval. Moreover, it is designed to perform at a faster rate than a minicomputer. Mainframes are the second largest (in capability and size) of the computer family. Mainframe allows its user to maintain large data storage at a

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centralized location and be able to access and process this data from different computers located at different locations. It is typically used by large businesses and for scientific purposes. Some examples of mainframe computers include IBM's ES000, IBM 360 (see Figure 1.7), VAX 8000, and CDC 6600.



Fig 1.7 IBM 360 Mainframe Computer

Supercomputers

Supercomputers are defined as computers which have extraordinary high numbers of integrated chips (ICs) that allow them to process information at a much higher speed than other computers. Essentially, these computers contain a number of CPUs that operate in parallel to make them faster. These computers can calculate billions of scientific calculations in a very short time (seconds). Due to their fast processing speeds, they are used for weather forecasting, automobile crash simulation, oil exploration, and medical research. However, these computers have limited use since they are very expensive. Some examples of supercomputers are CRAY-3, Cyber 205, and PARAM (see Figure 1.8).



Fig 1.8 A PARAM Supercomputer

1.4.3 Hardware Support for MIS

There is a need to select specific hardware and software products for implementing MIS in an organization. The selection of hardware and software products to implement MIS in an organization includes the following steps:

- Requirement analysis
- Preparing tender specifications

- Inviting tenders
- Technical examination and shortlisting
- Detailed evaluation of shortlisted vendors
- Negotiations and procurement decision
- Delivery and installation
- Post-installation review

Requirements analysis

Requirements analysis helps to understand, interpret, classify, and organize the hardware and software requirements. Then a feasibility study is performed to evaluate the technical, operational and economic feasibility. Once the feasibility is evaluated, the system configuration is clearly identified and stated.

Preparation of tender specifications

Once the requirements are analyzed and the configuration is decided, tender documents that are to be provided to the vendors are prepared. These tender documents provide a detailed statement and brief the vendors regarding various specifications, which are listed below:

- Format of the quotation:
 - o Format in which the technical details should be provided
 - o Format for quoting the prices
 - o The prices and levies should be quoted separately or as lump sum
 - o Validity of the quotation
- Schedule and procedure for purchase that comprises:
 - o Criteria for evaluation
 - o Last date of tender submission
 - o Scope for negotiations
- Detailed technical specification of both optional and mandatory items, for example
 - o Operating system required
 - o Other system and application software
 - o Any special hardware configuration
- Terms and conditions of the contract
 - o Training required
 - o Payment details
 - o Warranty terms
 - o Delivery schedule
- Any other information, if required

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NOTES**Inviting tenders**

After the tender specifications are ready, a call for tenders is sent via different modes depending upon the estimated cost of the equipment. Tenders may be invited through open tender (through a newspaper advertisement), propriety purchase (especially for upgrade requirements), limited tender in which queries are sent to only a few vendors, and direct purchase from market.

Technical examination and shortlisting

In this step, first of all the received tenders are disclosed/unclosed and then they are compared with the specifications prepared in Step 2. If there are differences in the received proposals and the specifications provided, then a comparison report is created and the differences are noted there.

Some more factors such as the financial position of the vendor, quality analysis and factory inspection are also taken into account. Once all the inspections are done and all the tenders are reviewed, some (ideally three or four) tenders are shortlisted based on the technical presentations given by the vendors, and the technical comparison being made by the committee.

Detailed evaluation

In this step, detailed evaluation is carried out by visiting the customer sites or through factory inspections. Suitable benchmark tests are conducted to test the product being provided by the vendor.

Negotiations and procurement decisions

Nowadays, there is an extensive competition in the market. Therefore, vendors may offer considerable concessions on products. Price negotiations are held to maximize these concessions. For price negotiations, committee members must have a good knowledge of the price of each product.

However, some vendors do not allow any negotiations. For vendors that do not negotiate, the following steps can be taken into consideration for the procurement decision:

1. Short-list vendors according to the comparison list.
2. Arrange a meeting with the short-listed vendors.
3. Explain the final products configuration (including optional items, such as RAM and additional disk).
4. Allow each vendor to offer his final price for the selected product configuration.
5. Compare the entire final price list and select the lowest bid.

Delivery and installation

In this step, the selected vendor delivers the hardware and software products to the organization. Now, the buyer organization compares the delivered product's

configurations with the specifications mentioned in the tender. If the entire configuration matches, then the hardware and software are installed.

Post-Installation review

After installation, an evaluation is made to determine how closely the new system confirms to the planning. For this, a post-installation review is made in which system specifications and user requirements are examined.

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Check Your Progress

8. What are hybrid computers?
9. Mention the different types of microcomputers.
10. Mention some applications where supercomputers are used.
11. What is the use of tender documents?
12. Why is post-installation review essential?

1.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The MIS provides background information on a variety of issues and helps improve the decision-making quality of the management. The fast and accurate information supplied by the MIS is leveraged by the managers to take quick and better decisions, thereby improving the decision-making
2. The characteristics of MIS are listed below:
 - (a) Management oriented
 - (b) Management directed
 - (c) Integrated
 - (d) Common data flows
3. Centralized data management helps MIS to exercise version control as well as provide integrated view of data to the managers.
4. Information systems form a special class of systems whose main objective is to store, retrieve, process and communicate and secure data. Typically, information systems are housed in a computerized environment/platform to enable users to get faster and accurate information.
5. The three principle concepts for analyzing strategy at the industry level are information partnership, the Competitive Forces Model and network economics.
6. In an information partnership, both companies can join forces by sharing information without actually merging.

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7. The law of diminishing returns states that the more any given resource is applied to production the lower is the marginal gain in output, until a point is reached where the additional inputs produce no additional outputs.
8. Hybrid computers include features of both the analog and digital computer in a single computer. They use the measuring feature of an analog computer and the counting feature of a digital computer. They comprise a digital unit and an analog unit which are connected together through a hybrid interface.
9. The different types of microcomputers are desktop computers, laptops, and hand-held computers.
10. Due to fast processing speeds, supercomputers are used for weather forecasting, automobile crash simulation, oil exploration, and medical research.
11. Tender documents provide a detailed statement and brief the vendors regarding various specifications such as format of the quotation, schedule and procedure for purchase, detailed technical specification of both optional and mandatory items, terms and conditions of the contract, or any other additional information.
12. After installation, an evaluation is made to determine how closely the new system confirms to the planning. For this, a post-installation review is made in which system specifications and user requirements are examined.

1.6 SUMMARY

- Information systems that help management in taking decisions are called Management Information Systems (MIS).
- The scope and role of MIS changes from standalone systems, such as DSS (Decision Support System) and EIS (Executive Information System) to the integrated component of information management.
- Management information system being a specialized information system category conforms to certain characteristics. These characteristics are generic in nature and remain more or less the same even when the technology around such management information system changes
- MIS generally has applicability in system decision-making. For example, MIS can be used to identify problems needing urgent attention for solutions with a timely feedback, to make the upper managers aware of the current progress and its shortcomings.
- Organizations use several types of information systems to suit their needs. The various types of information systems that an organization uses may be classified into the following categories: Office automation systems, transaction processing system, decision support systems, executive information systems, and business expert system.
- Information systems, which help management at different levels to take suitable decisions are called Management Information Systems or MIS.

- Information systems have undergone a remarkable transformation in the last 40 years of their existence.
- Over the years, information systems have changed. Now the focus is more on helping the management by providing information useful for decision-making. Data processing systems have become obsolete.
- Strategic information systems can facilitate an organization in changing the goals, operations, products, services or environmental relationships.
- A business information system is a set of interrelated procedures using IT infrastructure in a business enterprise to generate and disseminate desired information.
- Organizational information strategy is being implemented in many firms across the world. These organizations realize that information is an organizational asset and should be regarded as such.
- Today, computers are available in many sizes and types, ranging from a small one that fits in the palm to a large one that occupies an entire room. We can classify computers into two categories based on their data handling capability and functionality.
- Various types of computers process data in a different manner, and, according to this basic working principle, they are classified into three types, namely analog computer, digital computer, and hybrid computer.
- Computers differ in performance, size and cost. Depending upon these parameters, computers can be divided into four major categories, namely microcomputers, minicomputers, mainframe computers and supercomputers.
- There is a need to select specific hardware and software products for implementing MIS in an organization.

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1.7 KEY WORDS

- **Information partnership:** It means two companies joining forces to share information without actually merging.
- **Electronic Stylus:** It is a pointer that when pointed at a computer display senses whether or not the spot is illuminated.

1.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. State the benefits and limitations of MIS.
2. What are the functions of MIS?

3. State the characteristics of Business Information System (BIS)?
4. What is the difference between digital, analog and hybrid computers?

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Long-Answer Questions

1. Explain the characteristics of MIS in detail.
2. Discuss the various categories of MIS.
3. Discuss the use of information systems to gain strategic advantage at the industry level.
4. Describe the categories of computers on the basis of performance, size and cost.

1.9 FURTHER READINGS

O'Brien, James A. 2001. *Management Information Systems*, 7th edition. New York: McGraw-Hill Education.

Murdick, Robert Gordon; Joel E. Ross; and James R. Claggett. 1984. *Information Systems for Modern Management*, 3rd edition. New Jersey: Prentice Hall PTR.

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Laudon, Jane P. and Kenneth C. Laudon. 2007. *Management Information System: Managing the Digital Firm*. New Jersey: Prentice Hall.

UNIT 2 CONCEPTUAL FOUNDATIONS

Conceptual Foundations

NOTES

Structure

- 2.0 Introduction
- 2.1 Objectives
- 2.2 Decision-Making Process
 - 2.2.1 Types of Decisions
- 2.3 System Approach to Problem-Solving
 - 2.3.1 Applying the Systems Approach to Problem-Solving
- 2.4 The Structure of Management Information System
 - 2.4.1 Physical Components of MIS
 - 2.4.2 Information System Processing Functions
- 2.5 Answers to Check Your Progress Questions
- 2.6 Summary
- 2.7 Key Words
- 2.8 Self Assessment Questions and Exercises
- 2.9 Further Readings

2.0 INTRODUCTION

Information is a way of expanding one's knowledge. It contributes to the overarching framework of concepts and facts that people are familiar with. The significance of information is determined by the context and the recipient's general knowledge. Information systems has developed as a discipline concerned with the design, construction, and usage of information technology (IT)-based artefacts. In today's dynamic environment, information systems are vital for business organizations' expansion and survival. For the management of sensitive information and data, all sectors of the industry are fully reliant on these. In this unit, we will discuss the conceptual foundations of MIS, including the decision-making process and system approach to problem-solving. We will also focus on the structure of Management Information System.

2.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the conceptual foundations of MIS
- Discuss the decision-making process and system approach to problem-solving
- Describe the structure of Management Information Systems

2.2 DECISION-MAKING PROCESS

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Decision-making is considered as a core managerial function. Every task performed by a manager in an organization involves decision-making. Decision-making is not an easy task for a manager. It has become complex due to several reasons. First, because of enhanced technology and communication systems, the number of available alternatives has considerably increased than ever before. Second, the decision to be taken should be most accurate; any wrong decision may prove fatal for the organization. Third, due to increasing competition, managers are forced to act fast and take decisions quickly.

Decision-making is a process of choosing a best alternative from among various alternatives. It visualizes two or more alternatives from which a final decision is to be made. It is not just making a commitment after evaluating alternatives rather it is a complex issue. It includes the whole process of setting up of goals, defining activities, finding alternatives, and developing plans. It involves all the activities of coordinating, information processing, problem solving, and evaluating before finally making a decision.

Decision-making is a process that consists of various different activities. According to Herbert A. Simon, decision-making process can be described in four different stages, namely, intelligence, design, choice and implementation.

- **Intelligence:** This stage includes finding, analyzing, and understanding the problem – what is the problem, why it occurred, and what are its effects on the organization. In this stage, information system provides detailed information in the form of routine reports, interpreted transaction data, and exception reports that help identifying the problem.
- **Design:** This stage includes finding the possible solutions for the problem. Here, the Decision Support System (DSS) proves to be of great help as it provides the user with logical tools for modeling data, thereby, enabling users to find the possible solutions for the problem.
- **Choice:** This stage includes choosing the optimal solution among the alternatives. The Group Decision Support System (GDSS) provides an electronic environment to conduct group discussions among all the managers who discuss the various alternatives and select the suitable solution for the problem.
- **Implementation:** This stage includes putting the solution to work and monitoring the working of the solution. It also includes analyzing the chosen solution and finding whether the applied solution is the optimal solution by comparing it with other possible solutions. Here, Management Information System (MIS) provides routine report and informative data that helps in analyzing the solution.

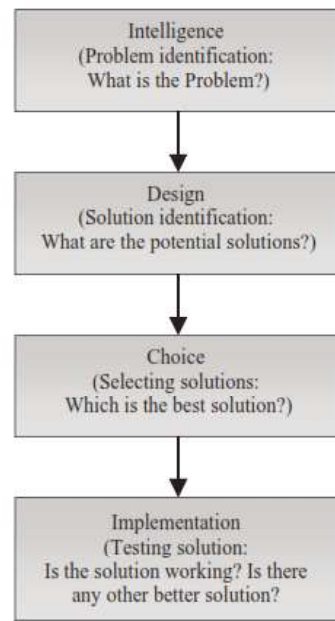


Fig. 2.1 Stages in Decision-Making

According to Simon, the four stages in the decision-making process are linear in nature and occurs in an orderly manner one after the other (see Figure 2.1). But in reality, the stages in decision-making do not necessarily follow a linear path. For example, a manager may be in the process of implementing a decision only to discover that whether the solution is the optimal one. In such cases, the manager is required to repeat the previous stages.

2.2.1 Types of Decisions

There are a number of decisions taken by managers in an organization. These decisions differ in a number of ways. One classification can be on the basis level of programmability: Simon proposed two types of decisions, namely, programmed and non-programmed decisions. Gorry and Scott Morton referred these programmed and non-programmed decisions as structured and unstructured decisions, respectively.

- **Structured Decisions:** Structured decisions are those that are well defined, certain, and need little effort from decision-makers. These decisions are need to be made at a small interval of time. These decisions can be easily made using some definite procedure, thus, operational (lower) level managers are permitted to take such decisions. Inventory reorder decisions, routine credit decisions, etc. are structured decisions.
- **Unstructured Decisions:** Unstructured decisions are those that are not well defined and no certain rules are specified to take such decisions. Such decisions are critical and are of non-routine nature. Therefore, decision-makers must spent sufficient time to have insight into the problems and then

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use their judgment and intuitions to finalize a decision. Such decisions are taken by strategic (higher) level managers of the organization. Introduction of a new product, deciding long-term corporate goals, planning for R&D etc. are unstructured decisions.

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Decisions that are neither structured nor unstructured are called semi-structured decisions. Such decisions have elements of both the structured and unstructured decisions, thus, there are some well defined or certain rules for some part of the problem; rest needs to be solved using judgment and intuition. Generally, middle level managers handle such decisions. Developing a marketing plan, designing a new corporate Website, etc., are semi-structured decisions.

Check Your Progress

1. What are the stages of decision-making process according to Herbert A. Simon?
2. Define semi-structured decisions.

2.3 SYSTEM APPROACH TO PROBLEM-SOLVING

The systems approach is an old concept. It assumes that the breaking down of a complex concept into simpler and easy-to-understand units enables people to understand a complex concept. The systems approach was first proposed under the name of a general systems theory by Ludwig von Bertalanffy. He noted that most systems of any practical relevance are open as they interact with the environment. Therefore, to understand the system, it has to be differentiated from the environment, that is, the boundary of the system, and the point at which it interacts with the environment, has to be clearly defined.

The approach concentrates on the holistic entity of the system without neglecting the components. It attempts to understand the role each component plays in the system while simultaneously understanding the activity of the whole system. Major concepts of the systems approach include the following.

- **Specialization:** A whole system can be divided into granular (smaller and easy to understand) components, so that the specialized role of each component is appreciated.
- **Grouping:** The process of specialization can create its own complexity by proliferating components with increasing specialization. To avoid this, it becomes essential to group related disciplines or sub-disciplines.
- **Coordination:** The grouped components and sub-components need to be coordinated.
- **Emergent properties:** This is an important concept of systems approach. It means that a group of interrelated entities (components) have properties that are not present in any individual component. This is

the holistic view of a system. For example, multi-cellular organisms exhibit characteristics as a whole that are not present in individual constituent parts like cells.

Conceptual Foundations

2.3.1 Applying the Systems Approach to Problem-Solving

The systems approach is widely used in problem solving in different contexts. Researchers in the field of science and technology have used it for quite some time now. Business problems can also be analyzed and solved using this approach. The following steps are required for this.

- **Defining the problem:** Sometimes, one may confuse the symptom or the exhibition of a behavior to be a problem, but actually it may only be a symptom of a larger malaise. It may just exhibit the behavior of a larger phenomenon. It is vital to drill deep into an issue and clearly understand the problem rather than have a superficial understanding of it. One must appreciate that this is the initial stage of problem solving and if the problem itself is not correctly diagnosed, then the solution will be incorrect. The systems approach is used to understand the problem in granular detail to establish requirements and objectives in depth. By using the systems approach, the problem will be analyzed in its entirety with inherent elements and their interrelationships. Therefore, this detailed analysis will bring out the actual problem and separate out the symptom from it.
- **Developing alternative solutions:** In this stage, alternative solutions are generated. This requires creativity and innovation. The analyst uses creativity to come up with possible solutions to the problem. Typically, only outlines of solutions are generated rather than the actual solutions.
- **Selecting a solution:** In this step, the solution which suits the requirement and objectives in the most comprehensive manner is selected as the best solution. This is done after evaluating all the possible solutions and then comparing the possible set of solutions to find the most suitable solution. A lot of mathematical, financial and technical models are used to select the most appropriate solution.
- **Designing the solution:** Once the most appropriate solution is chosen, it is then made into a design document to give it the shape of an actionable solution. At this stage, the details of the solution are worked out to create the blueprint. Several design diagrams are used to prepare the design document. The requirement specifications are again compared with the solution design to double check the suitability of the solution for the problem.
- **Implementing the solution:** The solution that has been designed is implemented as per specification laid down in the design document. During implementation, care is taken to ensure that there are no deviations from the design.

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- **Reviewing the solution:** At this point, the impact of the solution is studied. This is a stage for finding out if the desired result has been achieved.

Example of systems approach

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Let us assume that A is the coach of the Indian cricket team. Let us also assume that the objective which A has been entrusted with is to secure a win over the touring Australian cricket team. The coach uses a systems approach to attain this objective. He starts by gathering information about his own team.

In systems terms, he views his own Indian team as a system whose environment would include the other team in the competition, the umpires, regulators, crowd and media. His system, that is, team itself may be conceptualized as having two subsystems, that is, players and supporting staff for players. Each subsystem would have its own set of components/entities, e.g., the player subsystem will have openers, middle order batsmen, fast bowlers and wicket keeper. The supporting staff subsystem would include the bowling coach, batting coach, physiotherapist and psychologist. All these entities would indeed have a bearing on the actual outcome of the game. The coach adopts a systems approach to determine the playing strategy that he will adopt to ensure that the Indian side wins. He analyzes the issue by following the steps given below:

- **Defining the problem:** In this stage, the coach tries to understand the past performance of his team and that of the other team in the competition. His objective is to defeat the competing team. He realizes that the problem he faces is that of losing the game. This is his main problem.
- **Collecting data:** The coach employs his supporting staff to gather data on the skills and physical condition of the players in the competing team by analyzing past performance data, viewing television footage of previous games and making psychological profiles of each player. The support staff analyzes the data and comes up with the following observations:
 - o Both teams use aggressive strategies during the period of power play. The competing Australian team uses the opening players to spearhead this attack. However, recently the openers have had a personal fight and are facing interpersonal problems.
 - o The game is being played in Mumbai and the local crowd support is estimated to be of some value amounting to around 40 thousands. The crowd has come to watch the Indian team win. A loss here would cost the team in terms of morale.
 - o The umpires are neutral and are not intimidated by large crowd support but are lenient towards sledging.
- **Identifying Alternatives:** Based on the collected data, the coach generates the following alternate strategies:

- o Play upon the minds of the opening players of the competitors by highlighting their personal differences using sledging alone.
- o Employ defensive tactics during power play when the openers are most aggressive and not using sledging.
- o Keep closing fielders who would sledge and employ the best attacking bowlers of the Indian team during the power play.
- **Evaluating alternatives:** After having generated different alternatives, the coach has to select only one. The first alternative may lead to loss of concentration on the part of openers and result in breakthroughs. However, there is a chance that the interpersonal differences between the two openers may have already been resolved before they come to the field and in such a case this strategy will fail. The second strategy provides a safer option in the sense that it will neutralize the aggressive game of the openers but there is limited chance of getting breakthroughs. The third option of employing aggressive closing fielders to play upon the internal personal differences of the openers and at the same time employing the best bowlers may lead to breakthroughs and may also restrict the aggressive openers.
- **Selecting the best alternative:** The coach selects the third alternative as it provides him with the opportunity of neutralizing the aggressive playing strategy of the openers while increasing the chances of getting breakthroughs.
- **Implementing and monitoring:** The coach communicates his strategy to his players and support staff and instructs support staff to organize mock sessions and tactics to be employed to make the strategy a success. The performance of players and support staff is monitored by the coach on a regular basis to ensure that the strategy is employed as planned.

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2.4 THE STRUCTURE OF MANAGEMENT INFORMATION SYSTEM

Structure helps determine the shape of an entity, which provides its basic framework. The structure of MIS is difficult to define because some entities may not have well defined outlines and structures. The multiple approaches to an entity help describe the structure of an entity in a better way. The structure of MIS could be described by using a variety of different approaches, which are as follows:

- Physical components.
- Information system processing functions.
- Decision support.
- Levels of management activities.
- Organizational functions.

2.4.1 Physical Components of MIS

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The physical components of the information system in an organisation help understand the structure of MIS easily. These physical components can be hardware, software, manual procedures, database and operating systems. A brief description of these physical components is as follows:

- **Hardware:** Refers to the physical data processing equipment and peripheral devices such as printer and tapes. The various hardware devices that are used in the information system are discussed as follows:
 - o **Input Devices:** Allows a user to enter data into the system. For example, keyboard and joystick.
 - o **Output Devices:** Displays the data that the user needs to use on the screen of the system. For example, monitor and visual display unit.
 - o **Secondary Storage Devices:** Helps a user to store data on the magnetic media, so that the data is easily accessible and portable to other systems. For example, hard disk and floppy disk.
 - o **Central Processing Unit:** Helps perform the instructions given by the user to the system, such as logical and mathematical instructions.
 - o **Communication Devices:** Helps users to communicate with other users on different physical systems. For example, LAN card and Ethernet card.
- **Software:** Refers to the instructions and programs that direct the functioning of the hardware. The various types of software include system and application.
- **Database:** Consists of all data utilized by the application software stored in files present on the disk.
- **Procedures:** Refers to physical procedures, such as manuals required to operate a system. Such procedures are also termed as physical elements.
- **Operating personnel:** Refers to the personnel, such as computer programmers and system managers, who execute the functions of the information systems.
- **Input and output:** Refers to the physical inputs and outputs from the information systems that exist in various forms, such as printouts and reports.

2.4.2 Information System Processing Functions

Information system has a central importance in any venture. This is an interdisciplinary subject and is much more than just a collection of computerized information for processing and distribution.

The five functions of information systems are as follows:

- (a) Information processing and usability function
- (b) Education and learning function
- (c) Information systems development function
- (d) Management and control function
- (e) Strategy and planning function

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Information Processing and Usability Function

This type of function deals with the final application of the information and the way in which the information is being processed. This requires knowledge of new concepts, models, procedures, techniques, etc., for an efficient processing of information, as illustrated in Figure 2.2.

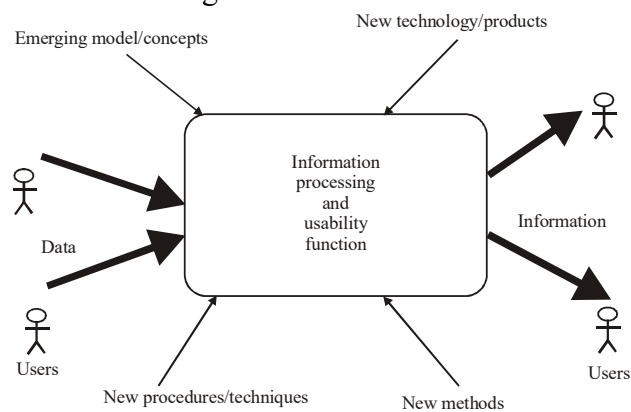


Fig. 2.2 Information Processing and Usability Function

Education and learning function

New things are appearing everyday in the market and the business atmosphere is becoming increasingly competitive. Thus, an information system should be properly understood by those who use the system and work on data as well as those who use information as the end user, i.e., management. Installing a system is one thing and making an efficient use of it is another. The latter is more important. Management must ensure to see that the system provides enough learning opportunities to users who are inexperienced. Creating awareness about the use of the system will enable users to operate them more effectively, which can then be used in the decision-making process.

There is a constant upgradation and innovation in the information handling products reflecting the prevalent business atmosphere. This requires continuous tests and modification of models as well as decisions. Also, the users should be prepared to operate the system in a dynamic environment. This is represented in Figure 2.3.

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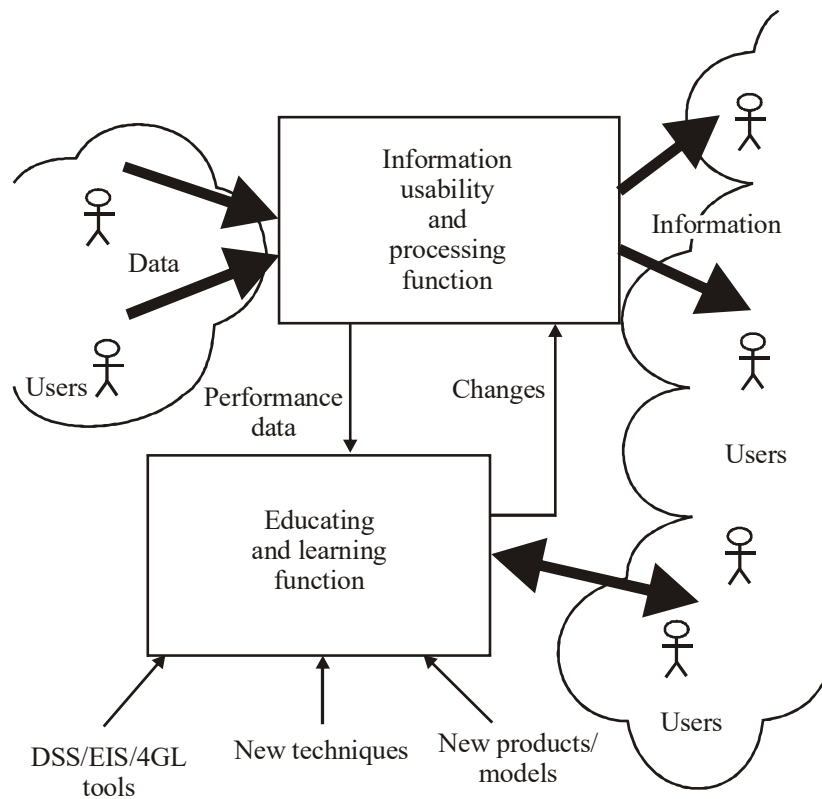


Fig. 2.3 Information Usability and Processing Function

Information systems development function

A business venture these days is open to global competition and every organization develops its own system and methodology to compete globally. An organization's image as a user of new technological products and latest methodology upgrades the market.

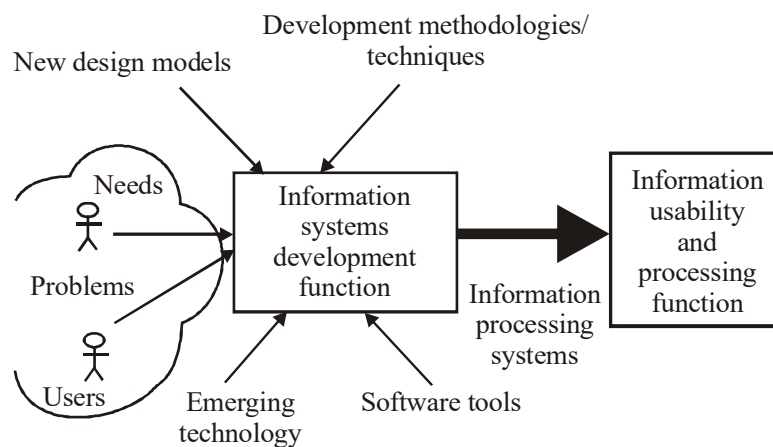


Fig. 2.4 An Information Systems Development Function

New challenges appearing every day in the business atmosphere requires managers and executives of a business enterprise to know about emerging technology, software tools, design models and working methodologies (see Figure 2.4).

Management and control function

This function is basically concerned with the maintenance of the first three functions as mentioned above. Management invests in the information system and its use and aims at a return on investment. Thus, it is concerned with the information system and its usability, proper knowledge and skill of the users and the development of the information system.

Management is concerned with the ‘Information Processing and Usability Function’ based on the following points:

- **Acquisition/Upgradation/Extension/Amendment of new hardware and software:** Management desires to know about the position of the hardware and software of the system, to determine whether it is required to amend, extend or upgrade the existing one or acquire a new one.
- **Making provisions of budget:** Once convinced about investment, management makes provisions of budget through its finance departments.
- **Analysis of cost:** To justify cost, management resorts to cost analysis.
- **Guidelines on statutory obligations and organizational policies:** Departments, at times, make mistake and inadvertently ignore the statutory obligation for which management has to be ultimately responsible. For that management gives clear-cut guidelines and ensures that such guidelines are followed.
- **Contract related to material supply and services:** Whichever department or sections in the organization indents for supply of material and services, floats the tender or awards the contract, some financial guidelines and rules related to the award of contracts has to be followed and the ultimate responsibility lies with the management. Management has to exercise control over such activities.
- **Setting priorities for tasks:** Every department or section in an organization considers its tasks as the highest priority and conflict in priorities are likely. Thus, prioritizing the task, again becomes the overall responsibility of the management and hence it falls under the function ‘management and control’.
- **Compliance with safety standards, quality control and performance of services:** Many workers, in showing expertise, ignore

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safety standards and this may cause some kind of a mishap, leading to loss of important man-hours and drainage of money. The quality of the product and services is another area where the management has to focus as this relates to the credibility of the organization.

- **Control of procedures and further communication to clients, handling of user requests, complaints, amendments and revisions:** Organizations have to care for its clients' satisfaction. Users of the system may want to portray their grievances related to work or behaviour of colleagues, etc. Management is supposed to listen to genuine grievances and settle the matter amicably so that the work environment remains unaffected. Management may revise or amend certain rule in the interest of the organization.
- **Setting of targets and monitoring the availability and working of the system:** Most of the jobs are executed on a computer and there is a target set for completing the same. Management has to exercise control, to ensure an availability of the system in optimum running conditions. In case for some reason, the job is likely to be delayed, a new target date has to be set and conveyed to those associated with the work.
- **Management of users' activities:** This is the most important function. Cases of users, misusing the system for personal work and ignoring the organizational tasks have been noted in many organizations. Some activities of users may be objectionable and management may have to suffer on this account. Management must have a control on the users' activity so that it does not put management into an embarrassing position.

Strategy and planning function

These include analysis of data on the performance of the business and the system which is used to formulate the strategy related to business. Once this function is completed, it falls under the purview of management and control function. Strategy and planning function informs management and control Function in relation to the following activities:

- **Production planning:** Deciding the target volume of products or services.
- **Budgeting:** Allocation of finance for producing the work volume.
- **Capital:** Cost of investment in equipment, processing, conversion and other infrastructure.
- **Available manpower:** Manpower required for the target job. In case of shortage, additional manpower is provided.
- **Selecting technology:** Selection of technology is an important issue. There are various technologies available for performing the same task and every

technology claims to be the best. Technology has to be selected by evaluating bids of various vendors and following a uniform policy.

- **Skills distribution:** To perform various tasks in a coordinated way in order to deliver a product (or services), different types of skills are required. This is known as skill distribution. Present skill distribution has to be reviewed and additional skills may be inducted in the system, by recruiting more skilled employees.
- **Time constraints:** This function has to focus on performing each task within a time limit. This time constraint has to always be kept in mind while taking any decisions.
- **Quality assurance:** If a product or a service delivered to customer is not satisfactory, it deteriorates the organization's image and this aspect has to be kept in mind to assure the quality of the product or service. Some standards have to be set and the organization has to assure the quality of its products before delivering them to customers.
- **Auditing:** This is an essential activity. There is an internal audit and subsequently an outside audit, usually appointed by a government body to do the audit.
- **Manager:** If various tasks have to be performed in a certain sequence, in a coordinated way, then these are to be managed and accordingly managers are required.
- **Legal issues:** Whether the job done is under a private sector or a public sector certain legal issues and statutory obligations have to be fulfilled. There should be proper identification of such issues.
- **Market factors:** Whatever deliverables the organization produces, must compete in the market. For this reason this function must identify all those factors that are favourable to product and also those that are not favourable, in order to take steps to override the latter.

In a nutshell 'Information Strategic Function' has to ensure the following facilities to create an Information Systems Functional Model (see Figure 2.5):

- Adequate support for a corporate strategy.
- Efficient Management Information System with Executive Information Support.
- Assessing strategic positions in relation to the market and the competitors.
- Support in developing the existing market and product quality as well as lateral movement.
- Active participation to develop a corporate strategy.

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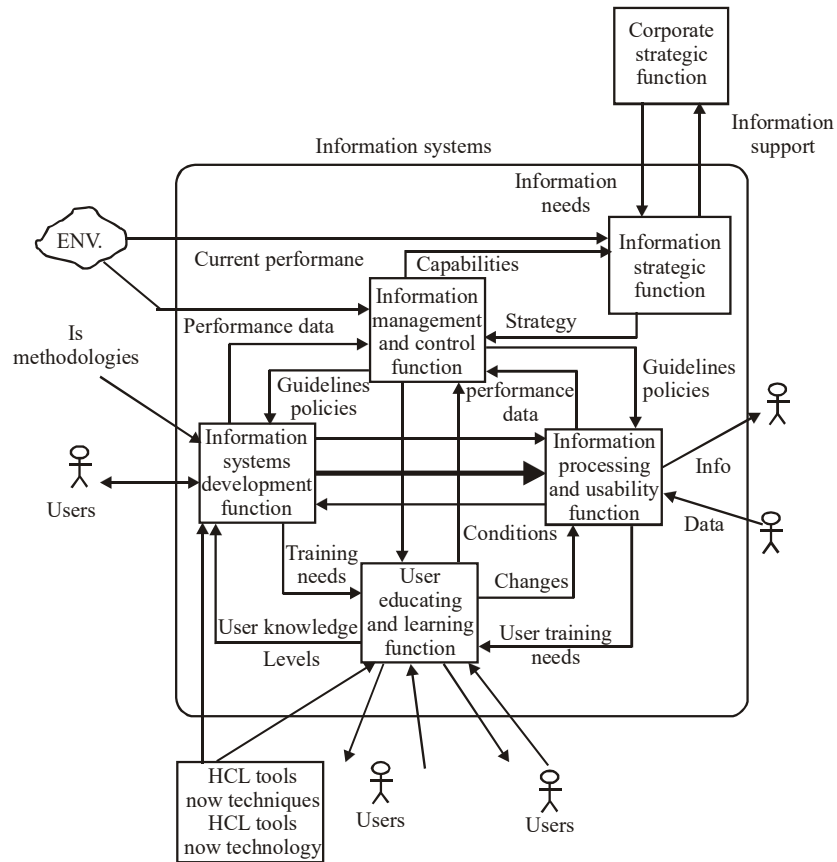


Fig. 2.5 Information Systems Functional Model

Decision support

The structure of MIS also depends on how MIS supports decision-making. Decisions taken using a decision-making process may differ according to the structure of MIS provided for making decisions. Various types of decisions are structured, unstructured, and semi-structured.

Check Your Progress

3. What do you understand by the systems approach?
4. What are the major concepts of the systems approach?
5. How is decision-making important for MIS?

2.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. According to Herbert A. Simon, decision-making process can be described in four different stages, namely, intelligence, design, choice, and implementation.

2. Decisions that are neither structured nor unstructured are called semi-structured decisions.
3. The systems approach assumes that the breaking down of a complex concept into simpler and easy-to-understand units enables people to understand a complex concept. It attempts to understand the role each component plays in the system while simultaneously understanding the activity of the whole system.
4. Major concepts of the systems approach include specialization, grouping, coordination and emergent properties.
5. The structure of MIS depends on how MIS supports decision-making. Decisions taken using a decision-making process may differ, according to the structure of MIS provided for making decisions.

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2.6 SUMMARY

- Decision-making is considered as a core managerial function. Every task performed by a manager in an organization involves decision-making.
- Decision-making is a process of choosing a best alternative from among various alternatives. It visualizes two or more alternatives from which a final decision is to be made.
- Decision-making is a process that consists of various different activities. According to Herbert A. Simon, decision-making process can be described in four different stages, namely, intelligence, design, choice and implementation.
- There are a number of decisions taken by managers in an organization. These decisions differ in a number of ways. One classification can be on the basis level of programmability.
- The systems approach is an old concept. It assumes that the breaking down of a complex concept into simpler and easy- to-understand units enables people to understand a complex concept.
- The systems approach is widely used in problem solving in different contexts. Researchers in the field of science and technology have used it for quite some time now. Business problems can also be analyzed and solved using this approach.
- Structure helps determine the shape of an entity, which provides its basic framework. The structure of MIS is difficult to define because some entities may not have well defined outlines and structures.
- The physical components of the information system in an organisation help understand the structure of MIS easily. These physical components can be hardware, software, manual procedures, database and operating systems.

- Information system has a central importance in any venture. This is an interdisciplinary subject and is much more than just a collection of computerized information for processing and distribution.

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2.7 KEY WORDS

- **Ethernet Card:** It is the communication hub for a computer, which connects to a network using a network cable. Ethernet cards can also communicate one-on-one with another Ethernet card, allowing for peer-to-peer network connections.
- **Audit:** It is the examination or inspection of various books of accounts by an auditor followed by physical checking of inventory to make sure that all departments are following documented system of recording transactions. It is done to ascertain the accuracy of financial statements provided by the organisation.

2.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the different types of decisions?
2. Briefly explain the major concepts of systems approach.
3. Write a short note on the physical components of MIS.

Long-Answer Questions

1. What is decision-making? Explain the decision-making process in detail.
2. Describe all the steps of applying the systems approach to problem-solving.
3. Describe the functions of information system.

2.9 FURTHER READINGS

O'Brien, James A. 2001. *Management Information Systems*, 7th edition. New York: McGraw-Hill Education.

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UNIT 3 KINDS OF INFORMATION SYSTEMS

*Kinds of Information
Systems*

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Structure

- 3.0 Introduction
- 3.1 Objectives
- 3.2 Types of Management Systems
 - 3.2.1 Types of Information Systems
- 3.3 Concepts of Management Organization
 - 3.3.1 Meaning of Organization
 - 3.3.2 Changing Role of Information Systems in Organizations
 - 3.3.3 Impact of Information Systems on Organizations
 - 3.3.4 The Internet and Organizations
- 3.4 Answers to Check Your Progress Questions
- 3.5 Summary
- 3.6 Key Words
- 3.7 Self Assessment Questions and Exercises
- 3.8 Further Readings

3.0 INTRODUCTION

An information system is a set of interconnected components that work together to gather, process, store, and breakdown data to aid decision-making. Information systems provide managers with the resources and information they need to prepare, organize, and track their work, make decisions, develop new products and services, and make long-term strategic decisions. Organizational levels, data mode, processing, system objectives, and type of support provided are all used to classify information systems. In this unit, we will discuss the different kinds of information systems including the types of management systems. We will also focus on concepts of management organizations.

3.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the different kinds of information systems
- Discuss the types of management systems
- Describe the concepts of management organizations

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3.2 TYPES OF MANAGEMENT SYSTEMS

There are many application areas that implement information systems in a business environment to solve the business problems and to pursue business opportunities. The Figure 3.1 shows the various application areas of information systems in an organization.

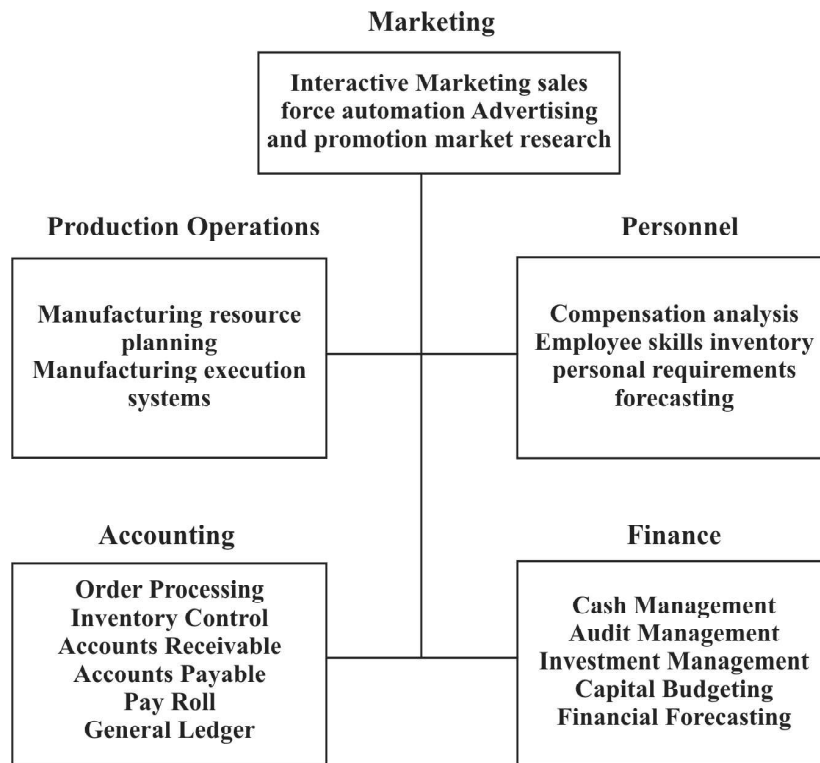


Fig. 3.1 The Application Areas of Information Systems

3.2.1 Types of Information Systems

Information systems manage data and process the data for the operational and managerial support in an organization. The operational support systems control the business operations, generating sales orders and determining payment to the employees. The management support systems help to take managerial decisions for the development of the organization. The Figure 3.2 shows the classification of the information system.

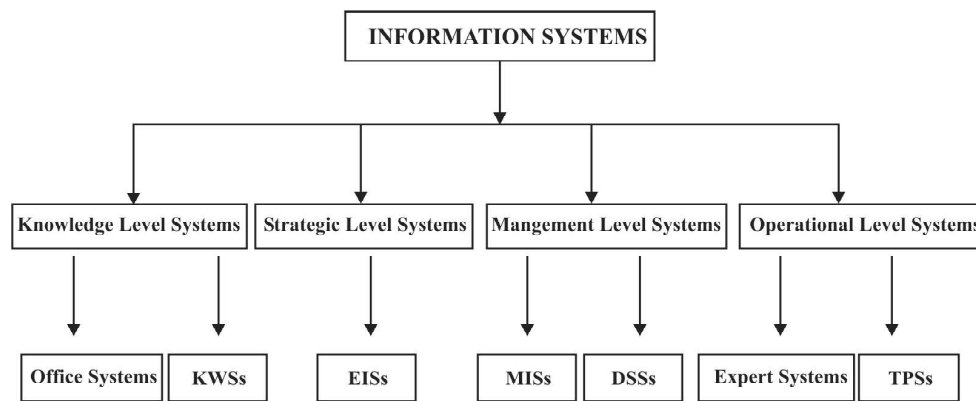


Fig. 3.2 The Classification of Information Systems

Organizations use different types of information systems for the exact requirement of the organizational functions. Various types of information systems on the basis of organizational functions that help in integrating business processes and information are as follows:

- Management Information System (MIS) which manages the information to plan and control the organizational tasks and to make decisions.
- Decision Support System (DSS) which supports the low-level and the middle-level workers to take the decisions for the better performance of the organizational functions.
- Executive Information Systems (EIS) which helps top business executives in decisions making using key business information.
- Expert Systems which analyse the business information and provides the solutions to the business problems already defined in its implementations.
- Knowledge Work Systems (KWSs) which takes inputs as designing specifications, model them and generate the pictures and graphics. The output of the system helps technical staffs and professionals to understand the business operations visually. KWSs generate, share and distribute knowledge and helps in decision-making.
- Transaction Processing System (TPS) which is an essential business system that assists the functional plane. As an inbuilt system, it plays a vital role in the execution and documentation of routine dealings for the smooth running of the business.
- Office Systems (OS) which helps to keep records and manage various office operations, such as accounting and sales. These systems process the word documents and generate electronic information.

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Different types of information systems are used for different types of functions. For example, an EIS is used for strategic planning. Strategic planning helps to take decisions for future plans.

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3.3 CONCEPTS OF MANAGEMENT ORGANIZATION

Different organizations may have different needs. Information systems are developed to serve the needs of a particular organization. The role and usage of information system is influenced by the needs of organizations, surrounding environment, etc. At the same time, organizations are influenced by the information systems. Introduction of a new information system affects the organization's structure, day-to-day working, performance, productivity, work-design, etc.

3.3.1 Meaning of Organization

Organization can be defined in more than one ways. From technical viewpoint, an organization is a formal social structure that takes inputs from its surrounding environment and transforms these inputs into outputs through production process. Here, inputs consist of capital and labor provided by the environment and outputs are products and services. The environment consumes the outputs (products and services) and provides more inputs (capital and labor) in the feedback loop (see Figure 3.3).

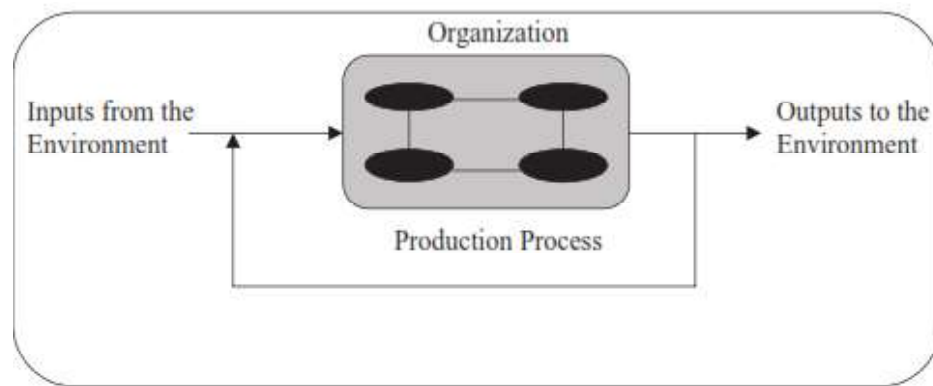


Fig. 3.3 Technical View of Organization

Another more descriptive definition of organization is from behavioral point of view. From this view, an organization is a collection of rights, privileges, and responsibilities that is balanced over a period of time. The Figure 3.4 illustrates the behavioural view of organization.

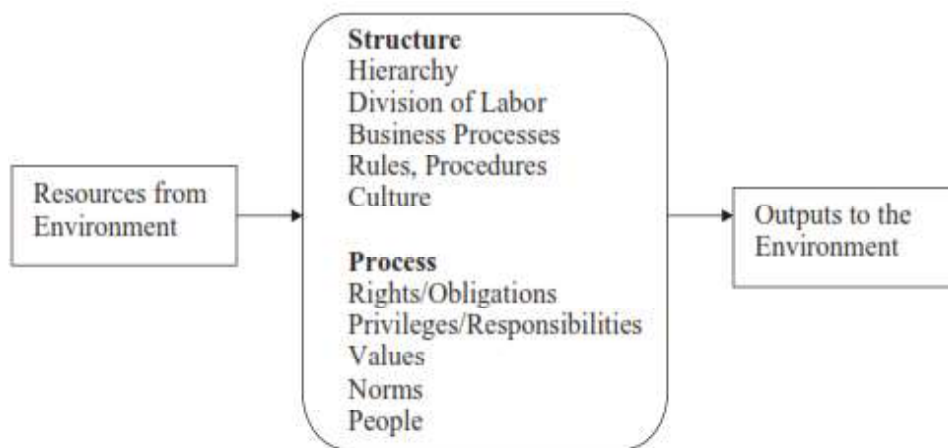


Fig. 3.4 Behavioural View of Organization

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Common Features of Organizations

Some of the features common to all organizations are as follows:

- **Hierarchy:** Organization is a hierarchical structure with different levels and specialists. All specialists are arranged in a hierarchy of authority and responsibility. Hierarchy arranges people in a pyramid of rising authority and responsibility. The managers, professionals and technical employees are at the upper levels while operational personnel are at the lower levels.
- **Rules and procedures:** Authorities and responsibilities are defined by rules. Organizations develop different rules to accomplish tasks. These rules guide employees in various procedures like writing bills, replying to customer complaints, etc.
- **Unbiased judgments:** Rules created by the organization are impartial. That is, everyone must follow rules and everyone is treated equally.
- **Technical qualifications for positions:** Organization needs various people with different skills like managers, architects, engineers, etc. It recruits and trains the employees on the basis of their technical qualifications.
- **Maximum efficiency:** Organization believes in maximizing the efficiency that is maximizing the output by using limited inputs.
- **Organizational culture:** All organizations have some basic, secure, and undisputed assumptions that define their goals and products. Organizational culture is this set of assumptions that describes the products to be produced by the organization, how to produce, where and for whom. It is a powerful force that limits political differences and encourages common understanding, agreement on procedures and common practices. It adds significantly to the organization's goodwill and reputation, thus leading to on-time projects and high productivity.

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- **Routines and business processes:** The individuals in all organizations develop some routines over time for producing goods and services so that the organizations become more efficient. These routines (also called standard operating procedures) are specific rules, methods, and practices developed to deal with all expected situations. Learning these routines help employees to become more creative and efficient. For example, in a school, receptionist has some specific set of routines for gathering information, teachers have a different set of routines for teaching students, and the principal has a well-developed set of routines for running the school.

Business processes are the collection of such routines. Analyzing business processes and routines help understanding the actual working of a business. It also helps in making business more effective and efficient. All business processes together make a business firm (see Figure 3.5).

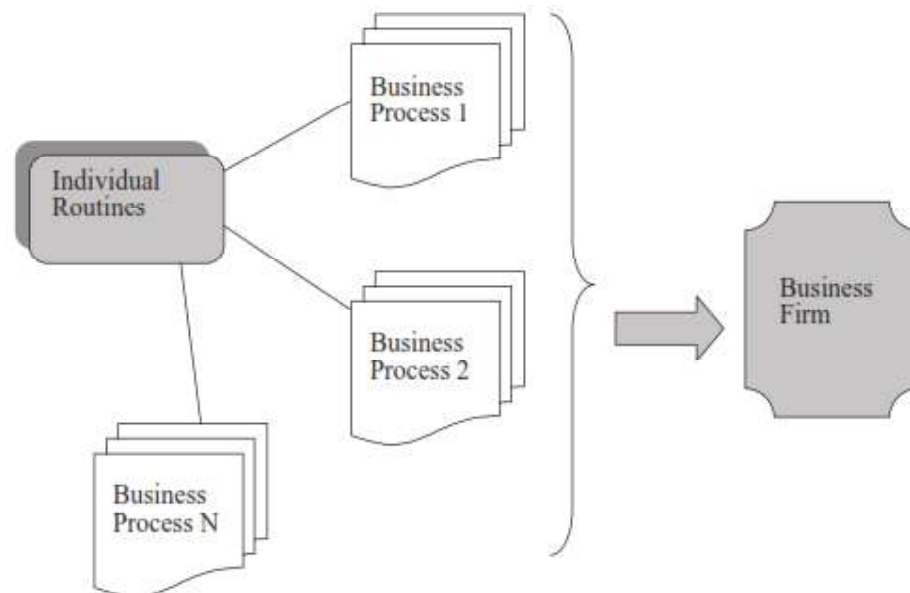


Fig. 3.5 Routines, Business Processes and Business Firm

Unique Features of Organizations

All organizations have also some features that are unique to them. These features distinguish one organization from another. These include leadership styles, goals, tasks, structures, and surrounding environments.

The leadership styles differ greatly from one organization to other. Some organizations are more influential or self-governing than others. Another difference between the organizations is the tasks performed and the technology used by them. Some organizations perform the tasks that require little judgment (such as, manufacturing firms) while others perform those tasks that require judgment in

some or the other way (such as, educational and consultancy firms). Organizations also differ in their ultimate goals and the power used to achieve these goals. Some organizations have coercive goals (such as, prisons), some have utilitarian goals (such as, businesses) and some have normative goals (such as, universities and religious groups).

The most important factors that make the organizations different from others are the organizational structure and its surrounding environment, which is being discussed in detail.

Organizational structure

There are several ways of classifying the organizations based on their structures. The most common classification is the Mintzberg's classification, which identifies five basic types of organizations as shown in Table 3.1.

Table 3.1 Organizational Structures

Type	Description	Example
Entrepreneurial	■ Small firm managed by an entrepreneur ■ Simple structure ■ Solve simple tasks ■ Lack standardization of tasks	Small new business
Machine Bureaucracy	■ Large bureaucracy ■ Produce standard products ■ Dominated by centralized management team	Medium-sized manufacturing firm
Divisionalized Bureaucracy	■ Combination of multiple machine bureaucracies ■ Each bureaucracy produce different product or service ■ All divisions are handled by central headquarters	Firms like General Motors
Professional Bureaucracy	■ Knowledge-based organization where goods and services are dependent on the knowledge of professionals. ■ Ruled by department heads ■ Weak centralized authority	Hospitals, Law firms, Schools
Adhocracy	■ Task force organization that must adapt to quickly changing environments ■ Consists of large groups of specialists that are organized into short-lived multidisciplinary teams and has weak central management.	Consulting firms

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Organizations and environment

All organizations are situated in an environment, which could be business, governmental, or educational. In this environment, there are other organizations and people such as suppliers, clients or customers and competitors with whom transactions have to take place. Organizations on the one hand, depend on social and physical environment, financial and human resources. The legislative and other requirements imposed by the government as well as the actions of customers and competitors must be fulfilled by the organization. Organizations on the other hand, can control their environments. For instance, business firms bonds with other businesses to influence the political process; they advertise to influence customer acceptance of their products.

Information systems play an important role in environmental scanning and also help managers to identify external changes that require organizational response.

3.3.2 Changing Role of Information Systems in Organizations

Information system has become vital for organizations as it helps them deal with fast-paced changes in global economies and businesses. It provides communication and logical tools and is involved in minute-to-minute operations, thus, creating an economic value for the firm. Information systems have changed the economic condition of organizations and enhanced their working conditions. As the technology changes, organization's infrastructure and the services it provide to its employees, customers, and suppliers also change.

Usually, there is an information systems department in organizations that provides information technology services. Typically, the members of information system departments maintain hardware, software, networks, and other components of IT infrastructure.

Earlier, the department mainly consists of skilled programmers, whereas, now-a-days, the department consists of programmers, system analysts, and managers. Programmers are the technical persons and are expert in one or more programming languages. They are responsible for developing computer programs. System analysts are the persons with good analysis and technical skills. They are responsible for analyzing the business problems and requirements, and proposing solutions to these problems. They interact with end users to understand the problems thoroughly and also discuss with the managers. End users are the people for whom the applications are to be developed. Though they are not part of the information systems department, they also play a major role in designing and developing of applications. System managers are the mangers of such teams and also manage the teams of staff responsible for data entry. Many companies now appoint Chief Information Officer (CIO) as a senior manager who supervises the information system department.

3.3.3 Impact of Information Systems on Organizations

*Kinds of Information
Systems*

Over the last few years, the information systems have greatly changed the organizational economics and increased the possibility of organizing work.

Economic impact

Both the cost of information and capital are affected by the change in IT. With the decrease in cost of information technology, many firms depend much on IT. Further, since the cost of labor and capital has been rising constantly, today's managers have increased their investments in IT. Slowly, IT started substituting labor and various forms of capital like property, machinery, etc.

Information system helps organization in running their business effectively with reduced costs. This can be explained with the help of an example. Suppose a company develops a policy regarding revised salary, it first instructs the HR assistant to write the plan of policy on paper and forward it to the HR director for review. After the HR director has reviewed (or made certain changes to) the policy plan, the assistant reprints the document. However, if there is an information system, the assistant can directly forward the plan to the director electronically. Further, the director can modify the electronic version of the file and return it to the assistant. Once the plan is finalized, it can be sent to each employee via e-mail, thereby, reducing the need to print various copies. Hence, both time and resources are reduced with the use of information system.

Information system also affects the cost and quality of information. It makes the firm smaller in size as it can reduce transaction costs. Transaction costs are the costs incurred when a firm buys the goods, which it cannot make itself. The transaction cost theory is based on the notion that firms try to economize their transaction costs in the same way as they economize their production costs. Traditionally, firms have tried to reduce their transaction costs such as communicating with remote suppliers, purchasing insurance, acquiring information on products etc. by hiring more employees, buying their own distributors, and suppliers.

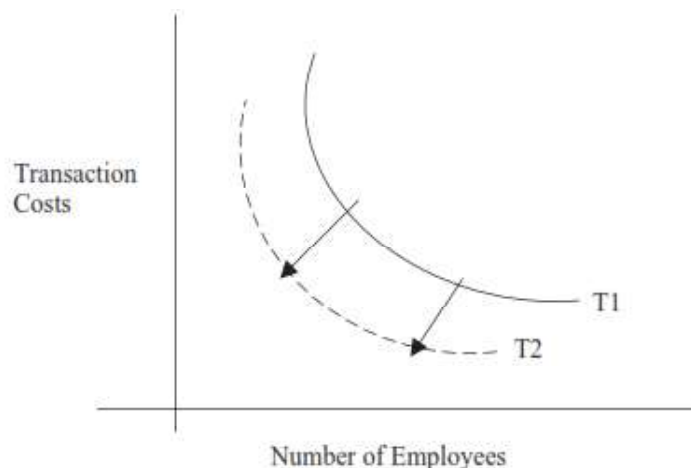


Fig. 3.6 Transaction Cost Theory

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The Figure 3.6 shows that as transaction cost decreases, number of employees in a firm (firm size) also decreases. This makes easier and cheaper for the firms to shrink, so that they can buy the goods and services in the marketplace rather than make the goods or offer the service itself. Hence, information system reduces the cost for a given firm size, thereby, shifting the transaction cost curve inward and increasing the revenues of the company.

With the help of information system, the internal management costs are also reduced. According to agency theory, an owner hires agents (employees) who work on his or her behalf. These agents are delegated some decision-making authority. They are required to be constantly supervised or else they would practice their own interests. The cost incurred in supervising the agents is called agency cost or coordination cost. Information system reduces these agency costs by reducing the cost of acquiring information.

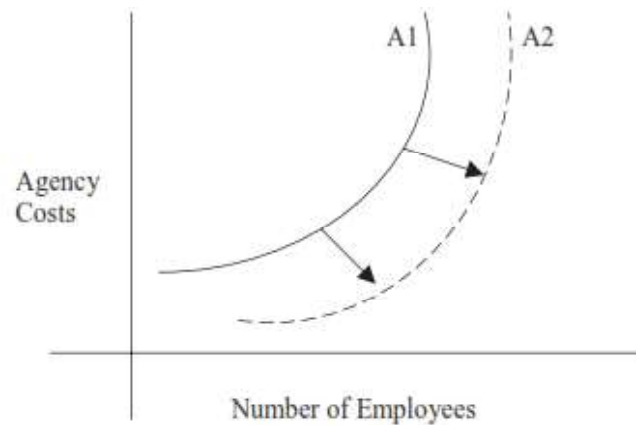


Fig. 3.7 Agency Theory

In Figure 3.7, agency costs increase as the number of employees (firm size) increases. Information system shifts the agency cost curve down and to the right, thus, allowing the firms to increase size by lowering agency costs.

Organizational and behavioral impact

The growth of information system and the implementation of new applications have been affecting the structure of the organizations. In this section, we discuss how and why IS affects the organizations.

Information system flattens organizations

Before computerization, organizations were usually inefficient and their work process remains unchanged for a long time. There were various levels of management that managed the lower-level staff (see Figure 3.8). Managers were responsible for making decisions and the lower-level staff operates under the supervision of senior managers. Since there is a limit on the number of people a person can supervise, the managers

were not efficient in handling various employees at lower level. Therefore, traditional organizations are usually less competitive than the modern organizations that involve advanced IT applications in their work process.

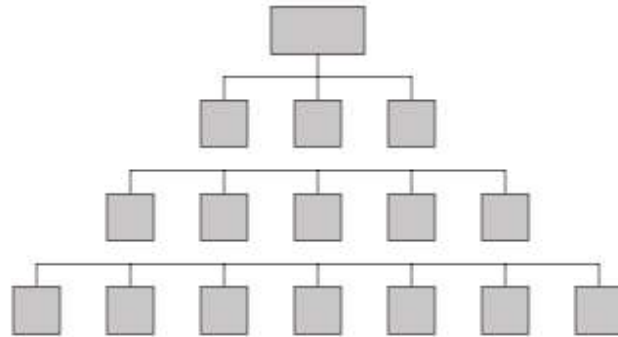


Fig. 3.8 Traditional Organization with Hierarchy of Management

In today's organizations, the use of information system increases the efficiency of organizations and help flattening the hierarchies. The IT applications provide the lower-level employees with the information they require, thus, empowering them and they are empowered with the rights to make decisions without supervision. Moreover, the efficiency of managers in making decisions has enhanced because they receive accurate information on time. Therefore, fewer managers are required to supervise employees than before (see Figure 3.9).

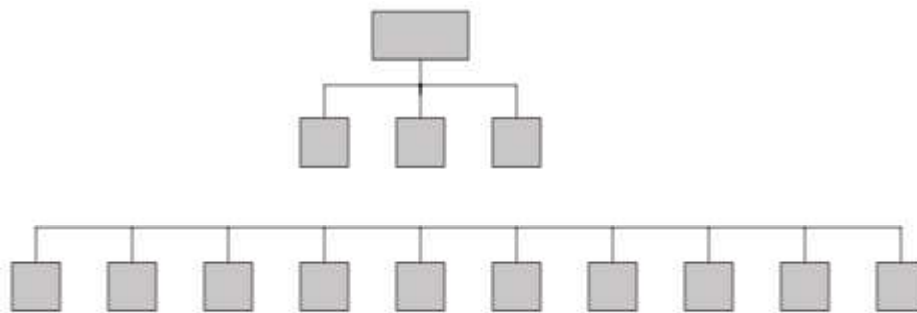


Fig. 3.9 Flattening of Hierarchies in Organizations

Virtual organizations

Information technology enables some organizations to act as virtual organizations where work is no longer limited by geographic locations. Virtual organizations connect people, assets, and ideas with the help of networks. They can support customers, suppliers and even competitors in creating and distributing new products and services without any limitation of physical locations. In other words, virtual organization is one whose members are geographically apart, while appearing to others to be a single, unified organization with a real physical location. Many people

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are forming virtual companies as the optimal way to implement key business strategies and alliances that ensures success in today's competitive business environment.

Virtual companies develop flexible and adaptable virtual workgroups and alliances to make best use of fast-changing business opportunities. For example, a business wants to make use of new market opportunity but it is lacking time and resources, information technologies needed to develop the infrastructure. This problem can be solved just by creating a virtual company through a strategic alliance so that it can integrate the components needed, such as Internet, intranets and other internet technologies to sort out the customers' problems as well as exploit the market opportunity.

There are many reasons as to why many organizations are implementing virtual organizations:

- **To increase the flexibility:** Since large number of workers is available, the organization can hire the best regardless where they live, thus increasing the flexibility of organizations.
- **Globalization:** Many organizations are finally realizing that vast pool of untapped skills, knowledge, and abilities are available throughout the world. Thus, when these different skills and abilities are integrated in a virtual organization, greater level of collaboration, cooperation and efficiency is achieved.
- **Changes in employee values and attitude towards work:** Employers have realized that a balance of professional as well as personal life, family requirements, and personal fulfillment are important considerations among employees.
- **Cost reduction:** The cost of physical assets used to support work environments, cost of infrastructure or the cost involved in maintaining the offices at several physical locations is reduced.

Although there are many situations that are driving organizations to implement virtual organizations, but not all companies can make virtual work effective because it is difficult to evaluate and organize the workers.

Organizational resistance to change

The use of information systems result in many changes in the organizations. They potentially change an organization's structure, culture, politics, and work. Hence, there is a considerable resistance to them when they are introduced.

Since organizational resistance to change is very powerful, many information technology investments stagger and do not increase productivity. After thorough research on project implementation failures, it is observed that the most common reason why large projects fail to reach their goals is not due to failure of technology,

but due to organizational and political resistance to change. The Figure 3.10 depicts that to implement change, all the four components, that is, task, technology, people, and structure must be changed simultaneously.

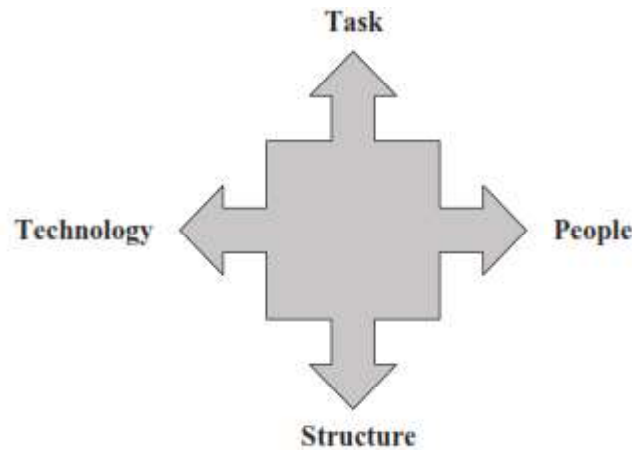


Fig. 3.10 Organizational Resistance to Change

Organizational change may be essential in order to survive in competition. Hence, organizations must adapt to fit changing economic factors and other circumstances. The top managers of the organization must try to diagnose the cause of resistance and then work to solve it before it ruins the progress of organization. In order to overcome the resistance to change, following three steps are required:

1. **Generate a climate for change:** A suitable climate should be created by exposing the employees to seminars and conferences so that they can focus on the shortcomings of present system as well as find the methods to overcome those shortcomings.
2. **Create effective agents of change:** Organizations should recognize their efficient leaders who could be sent to seminars so that new ideas stimulate in their minds, which will help them in gaining the support of other employees.
3. **Rearrange the organization:** To achieve better working relationships, organization should be modified to fit evolving organization behavior.

3.3.4 The Internet and Organizations

Internet has made phenomenal changes in the working of organizations. It provides precise, timely, and accurate information and also helps in effective decision-making. It increases the accessibility, storage, and distribution of information and knowledge for organizations, thereby, lowering the transaction and agency costs. For example, various banks in abroad can now deliver their internal operations procedures manuals to their employees at remote locations by simply posting them on the corporate

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Website. As a result, the huge amount of money they used to spend in distribution has been saved. Other than affecting the cost of running an organization, the Internet has also affected the task, technology, structure, culture, and people of the organizations. For example, the tasks have become automated from manual with the help of technology. Similarly, workers have been transformed to knowledge workers.

Check Your Progress

1. What is the purpose of the operational and management support systems?
2. How do information systems flatten the organizational hierarchies?
3. Why are managers increasing their investments in IT?
4. What is the other name of agency cost?

3.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The operational support systems control the business operations, generating sales orders and determining payment to the employees, while the management support systems help to take managerial decisions for the development of the organization.
2. In today's organizations, the use of information system helps flattening the hierarchies. The IT applications provide the lower-level employees with the information they require, thus, empowering them with the rights to make decisions without supervision. Moreover, the efficiency of managers in making decisions has enhanced because they receive accurate information on time. Therefore, fewer managers are required to supervise employees than before.
3. Since the cost of labour and capital has been rising constantly, today's managers have increased their investments in IT.
4. The agency cost is also known as coordination cost.

3.5 SUMMARY

- There are many application areas that implement information systems in a business environment to solve the business problems and to pursue business opportunities.
- Information systems manage data and process the data for the operational and managerial support in an organization.
- Different types of information systems are used for different types of functions. For example, an EIS is used for strategic planning. Strategic planning helps to take decisions for future plans.

- Different organizations may have different needs. Information systems are developed to serve the needs of a particular organization. The role and usage of information system is influenced by the needs of organizations, surrounding environment, etc.
- From technical viewpoint, an organization is a formal social structure that takes inputs from its surrounding environment and transforms these inputs into outputs through production process.
- Information system has become vital for organizations as it helps them deal with fast-paced changes in global economies and businesses.
- Over the last few years, the information systems have greatly changed the organizational economics and increased the possibility of organizing work.
- The growth of information system and the implementation of new applications have been affecting the structure of the organizations. In this section, we discuss how and why IS affects the organizations.
- Internet has made phenomenal changes in the working of organizations. It provides precise, timely, and accurate information and also helps in effective decision-making.

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3.6 KEY WORDS

- **Sales Order:** It is a document generated by the seller upon receiving a purchase order from a buyer specifying the details about the product or service along with price, quantity, buyer details like the shipping address, billing address, mode of payment and terms and conditions.
- **Business Processes:** It is a set of logically related tasks and behaviours developed by organizations with time for producing specific business results.
- **Agency Cost:** It is the cost incurred in supervising the agents.

3.7 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short note on the changing role of information systems in organizations.
2. Briefly explain the economic impact of information systems on organizations.

Long-Answer Questions

1. Explain the various types of information systems on the basis of organizational functions.
2. Discuss the common and unique features of organizations.

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3.8 FURTHER READINGS

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UNIT 4 PLANNING AND CONTROL

Structure

- 4.0 Introduction
- 4.1 Objectives
- 4.2 Difference between Planning and Control
- 4.3 Systems Analysis
 - 4.3.1 Requirement Analysis
 - 4.3.2 Requirement Determination
 - 4.3.3 Strategies for Requirement Determination
 - 4.3.4 Tools for Structured Analysis
- 4.4 Systems Design
 - 4.4.1 Principles of Design
 - 4.4.2 Concepts of Design
 - 4.4.3 Conceptual Design
- 4.5 Answers to Check Your Progress Questions
- 4.6 Summary
- 4.7 Key Words
- 4.8 Self Assessment Questions and Exercises
- 4.9 Further Readings

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4.0 INTRODUCTION

The concept of 'planning and controlling' has been widely used in management circles in recent decades. Most managers in business and service organizations today are at least aware of the concept and its general applications. Regardless of the form of company being controlled, planning and control are essential management tasks. In small and relatively simple organizations, as well as big, more complex ones and non-profit organizations, modern managers face the task of sound planning and control. In this unit, we will discuss the concepts of planning and control, along with the difference between the two. We will also focus on systems analysis and design.

4.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the concepts of planning and control
- Discuss the difference between planning and control
- Describe the systems analysis and design

4.2 DIFFERENCE BETWEEN PLANNING AND CONTROL

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A number of management thinkers have given their own definition of planning, with the central core being that of making decisions now that will affect the future of the company. As such the planning process has three characteristics. These are:

- Planning is anticipatory in nature. A decision must be made now as to what to do and how, before it is actually done.
- Planning is a system of decisions. It involves a process of making decisions which will define what is to be achieved in the future and the formulation of action plans for achievement of goals.
- It is focussed on desired future results. Planning is a means of ensuring that the important organizational objectives are accomplished as and when desired.

On the other hand, management control is a systematic effort to set performance standards with planning objectives, to design information feedback systems, to compare actual performance with these pre-determined standards, to determine whether there are any deviations and to measure their significance, and to take any action required to assure that all corporate resources are being used in the most effective and efficient way possible in achieving corporate objectives.

Based on these definitions, we can see that planning and control are useless without each other, and thus, dependent on each other. However, this does not mean that both these management functions are not independent. Let us discuss the differences between them.

Firstly, plans are formulated for the future and determine the future course of action. On the other hand, controlling is about looking back and determining whether the work that has been done has been done according to the standards that are set. Secondly, planning is the first function while controlling is the last function of the managerial process. The managerial process moves in a definite sequence like planning, organising, staffing, directing and controlling. This sequence shows that planning is the first step in the managerial process and controlling happens to be the last step.

4.3 SYSTEMS ANALYSIS

System analysis is a process in which data is collected and then interpreted to identify problems within the system. After interpretation, problems are identified. Therefore, the collected information can then be used to recommend improvements in a system. In other words, system analysis includes identifying, understanding and examining a system so that the objectives of the system can be achieved. The pre-determined objectives of the system analysis include:

- Knowledge of the system operation
- Identification of the user requirements in the proposed system

The system analysis stage investigates the system operations and determines the solutions to solve the problem. Therefore, system analysis is considered a logical process.

System analysis is really vital in the completion of the development process of a system. It may be possible that a user is aware of the problem but may not have the solution. In such a scenario, a system analyst works with the user so that a logical model of the system can be developed. A system analyst from a technical background may move too quickly to the program design stage in order to make a system more physical. This approach is not desirable and should be avoided because it can affect the ultimate success of the system. A system analyst can work with a user to obtain a complete knowledge of a system. For complete information about a system, a logical model of the system is developed, based on a detailed study of the system. A detailed study should involve various modern tools and techniques, which include data flow diagrams, data dictionary and rough descriptions of the relevant algorithms. A set of system requirements for a proposed information system is the final product of the system analysis stage.

4.3.1 Requirement Analysis

The basic understanding of a system can be developed by analysing the requirements of the system. The requirements tell us the need for the system, the users of the system, the problem that the system is being created to solve, etc. In short, it gives us a lot of information about the functional nature of the system and hence it is very important to thoroughly analyse the requirements, so that there is no gap in the analysis.

Requirement analysis is a formal process of interacting with a client to understand and establish the requirements of the client in a formal document. It involves the use of fact-finding techniques and a keen eye for detailed information to find the underlying cause of an issue. Sometimes, the client may not be sure of the requirements. The requirement analysis process should take the client through a journey by which the client is able to articulate the requirements clearly. The client may look at the requirements from a superficial angle, thereby identifying the symptoms of the problem as requirements instead of analysing the source of the problem. The requirement analysis phase helps to structure the process of requirement analysis highlighting the actual requirement of the client.

While initiating the process of requirement elicitation and analysis, some key issues must be understood so that this analysis is easier. The key issues from the perspective of the developers are as follows:

- The key people driving the request. This will help them to focus their information collecting activity on these people, so that the actual nature of the requirement becomes evident.

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- The key people who will use the system. This gives the development team an understanding of the user profile.
- The financial benefit. This gives the requirement elicitation team an understanding of the financial benefit that is expected from the solution.
- What according to the user is a good solution? This gives the team an idea of the expectation from the system by the user.
- What is the problem that the system will address? This gives the team the reason for the development of the system.

A series of client interactions result in the preparation of a system requirement specification document, which is then used for designing the system.

Analysis principles

The key principles on the basis of which analysis is done are as follows:

- **The information domain of the problem is to be given due regard:** This means that the domain of information in which the problem operates has to be appreciated.
- **The key functions of the system have to be defined:** The key functionality of the system has to be defined clearly.
- **System must be modular:** This is required to help create the system in a faster way.
- **System has to be defined in an abstract term:** This helps reduce complexity.
- **Reduce ambiguity:** The ambiguity in the system must be reduced to enable the system designer to clearly focus on the outcome.

System Requirements Specification (SRS)

This is a formal document that is created to capture the requirements of the system. It should have the following descriptions:

- **Information description:** A detailed information description.
- **Functional description:** A description of the functionality required from the system.
- **Validation description:** This is the data validation and business rule description required in the system.

SRS is a formal document and the entire process of system development depends on this. SRS is also a matter of negotiation between the client and the developer as there may be differences in the understanding of the requirement. IEEE and ANSI have set guidelines for SRS.

4.3.2 Requirement Determination

It is essential to determine the requirements of a system for the system analysis process. The requirement determination is the preliminary step of the system development activity and is also known as software requirement specification (SRS). The requirement determination activity is the most difficult activity involved in the development of a system. Since there is a communication gap between a user and a developer, this activity is more prone to errors. The communication gap arises because the user usually may not understand the software of the organization or the developer may not understand the user's problem and application areas. To bridge the communication gap between the user and the developer, requirement determination is introduced. This requirement determination process provides a means of translating the ideas given by a user, into a formal document. The benefits provided by a good SRS are as follows:

- It bridges the communication gap between a user and a developer.
- It reduces the development cost as it overcomes errors.
- It acts as a basis of reference for the system, so that it can validate the final product.

Requirement determination consists of the following activities:

- **Requirement anticipation:** This activity includes the past experience of the system based on a study performed on the existing system. It also predicts the possibility of certain problems and requirements for a new system.
- **Requirement investigation:** This activity is central to the system analysis process. In this activity, the existing system is studied and documented for further analysis. For this purpose, various methods such as fact-finding techniques are used.
- **Requirement specification:** This activity involves the analysis of the data that was produced during the fact-finding investigation in order to determine the requirement specification.

We can conclude that requirement determination involves the following information:

- The general process
- The data produced during the process
- Various constructs in terms of time and volume of work
- The performance controls applied in the system

These activities are further elaborated in the following section.

Understand the process

The basic step in the requirement determination activity is the knowledge of the process. The process can be well understood if the information collected includes:

- The purpose of the business activity

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- The steps involved in the activity
- The persons performing those activities
- Other information such as the frequency, time and user of the resulting information

Identify the data used and the information generated

After understanding the process, the system analyst should look for the data that is required to perform each activity discussed in the previous step. For example, in an inventory system, a buyer may require data describing the quantity of an item, supplier name, item cost and demand for the item.

Determine frequency, timing and volume

After the identification of data, information is collected so that it can be identified how often an activity is repeated. It also determines the number of items that can be handled in each activity. Similarly, time is another constraint while evaluating certain steps of an activity.

Know the performance controls

The determination of performance control is important in the requirement determination activity as it enables the system analyst to understand how business functions can be maintained. It allows the system analyst to gather information during system investigation. The information in this phase can be gathered mainly from the personnel and the written documents of the organization. The written documents include financial reports, personnel documents and various other documents such as transaction documents and manuals.

It should always be kept in mind that the personal managerial attributes of an individual manager and an organizational environment affect the information requirements of the proposed system. Personal attributes may include the manager's knowledge of information systems, managerial style and his perception of information needs. On the other hand, organizational environmental factors may include nature of the company, level of management and structure of the organization.

4.3.3 Strategies for Requirement Determination

There are certain strategies for requirement determination that allows a system analyst to understand the existing system and also to determine the information requirement. Various strategies that solve the purpose are described below:

Interview

The interview strategy follows a method in which a user and a developer interact with each other to collect the required data. In this method, the developer poses questions to the user and based on the response given by the user, the developer

finds some solutions. The interview can be formal or informal and the questions asked may be structured or unstructured. This method is helpful for gathering information from individuals who may be weak in written communication or who may not have the time to answer questionnaires.

This strategy is the oldest and the most often used device for gathering information about an existing system. Though it is one of the preferred techniques, it is not always the best source of application data. This is because the users are sometimes unable to explain the system in detail. This process is time-consuming and hence other methods are used to gather information.

It is important that the system analyst must be trained in interviewing the personnel, as the success of an interview depends on the skill of the interviewer and on his or her preparation for the interview. Hence, it is important for a system analyst to plan the interview. A system analyst must have the following information before the interview:

- The person to be interviewed
- The time of interview
- The questions to be asked
- The venue of the interview
- The initiation point of the interview
- The termination point of the interview

The advantages of interview can be summarized as follows:

- Useful in exploring issues of an undefined nature and complexity.
- Useful in gathering more information in less time.
- Useful in knowing the reactions and responses of the respondents.

Questionnaire

A questionnaire is a method that involves a set of questions to which an individual needs to respond. This strategy allows a system analyst to gather information regarding different aspects of a system among a large number of persons. This strategy provides more reliable data in comparison to the other fact-finding techniques, such as, interviews and focus groups. In addition, a questionnaire is less time consuming as compared to interviews. The downside of a questionnaire is that sometimes it becomes difficult to design exhaustive questionnaires. In addition, the expressions and reactions of respondents cannot be observed through a questionnaire but can be observed easily during an interview. Questionnaires need to be tested and modified by the interviewer based on prior questionnaires and the experience and background of the respondents.

The advantages of a questionnaire can be summarized as follows:

1. Respondents could hide their identity if they do not want to reveal it.

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2. It is an efficient way of collecting information through paper documentation or through the Internet.
3. It is less time consuming.

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Record review

The record review strategy is also known as review of documentation strategy. The main purpose of this strategy is to find the quantitative information regarding constraints such as volumes, frequencies and ratios. A system analyst examines the information that has been recorded about a system and its users. The records include manuals, regulations and standard operating procedures of an organization. The records act as a guide to the managers and other employees. To study and understand the existing system, records prove to be helpful for the system analyst.

The limitation of this approach is that the records may not be completed or updated. An existing system can be viewed in two different views. One such view that favours the study of the existing system states that the shortcomings associated with an existing system can be learned. This knowledge of shortcomings is then further used and therefore, the common mistakes can be identified and avoided.

Another view argues that new ideas cannot be generated and the developer must follow the logic associated with the old system. Both the views seem valid and therefore, it is difficult to comment upon each view.

Observation

Observation is also one of the strategies used for gathering information. This is a process in which people, object and occurrences are recognized and noticed in order to collect information from sources. The information collected using this strategy is useful when a system analyst needs to observe the way in which the records are handled, processes are carried out and whether the specified steps are actually followed. The drawback of this strategy is that an observer may not be able to gather all the required information. Moreover, the method used in this strategy is time-consuming and costly. Electronic observation and monitoring methods are widely used as information gathering tools because of their speed and efficiency. A system analyst uses a combination of all the approaches to study an existing system because one approach may not be sufficient for gathering the required information of the system.

4.3.4 Tools for Structured Analysis

The above discussed fact-finding strategies represent only one aspect of system analysis. These strategies do not provide any mechanism that can help in organizing the details collected in each phase of the system analysis process. The information collected needs to be organized. Various tools that can be used for organizing information are known as structured analysis tools. These tools help a system analyst to document the system specifications of a system. These tools are:

- Data Flow Diagram (DFD)
- Data Dictionary
- Structured English
- Decision Trees
- Decision Tables

These tools are described in further detail in the following section.

Data Flow Diagram (DFD)

Data flow diagram is a tool that helps in expressing the system requirements in a simple form. It provides a graphical representation of the logical flow of data. This tool is also known as a bubble chart. The purpose of data flow diagram is to simplify the system requirements. DFD is responsible to decompose the requirement specification in each stage of the system analysis process. Lines that represent data flow in a system can join the information or data. The main symbols that are used in DFD are as follows:

- **Square:** This symbol is used to represent the source or destination of system data. Figure 4.1 shows the square symbol.

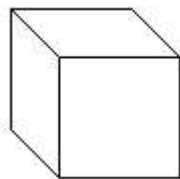


Fig. 4.1 The Square Symbol

- **Arrow:** This symbol is used to identify the data flow. The arrow specifies a pipeline through which the data flows. Figure 4.2 shows the arrow symbol.



Fig. 4.2 The Arrow Symbol

- **Circle/Bubble:** These symbols are used to represent a process that transforms incoming data flow into outgoing data flow. A process can be represented by a circle or an oval bubble. Figure 4.3 shows the circle symbol.

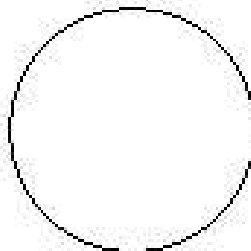


Fig. 4.3 The Circle Symbol

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- **Open rectangle:** This symbol is used to represent a data store. Figure 4.4 shows the open rectangle symbol.

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Fig. 4.4 The Open Rectangle Symbol

There are certain rules that need to be followed while drawing a DFD. These rules are as follows:

- The processes must have a name and number associated with it. The name of the process represents the process.
- The direction in which the data flow is represented should be from top to bottom and from left to right.
- A proper numbering of processes must be maintained. This means when a process is exploded into lower levels, the exploded processes can be easily identified. For example, process 1 is exploded to further processes, which should be numbered as 1.1, 1.2 and so on.
- The name of the data stores, sources and destinations should be written in capital letters. The name of the process and data flow must have first letter capitalised.
- The data flows should not intersect.
- Looping is not allowed. This means that the data flow out of process A going to process B cannot come back to process A from process B, without going through another step in between.
- Entities should not directly access data stores. They should go through a process.
- Data flows cannot be orphan data flows, which means that they must terminate to a process or an entity of a data store or another DFD.

Logical DFDs are more popular and physical DFDs are rarely used. It is important to note that a DFD can contain 10–12 processes. The DFD is just a graphical representation of data flow and therefore, it should have minimum content of a data store. This tool is very effective when the required design is not clear and the user and analyst require some symbolic representation for communication.

The concept of DFD can be explained with the help of an example. Consider the example of a library management system to issue books to each student of an institution. Figure 4.5 represents the data flow for the library management system.

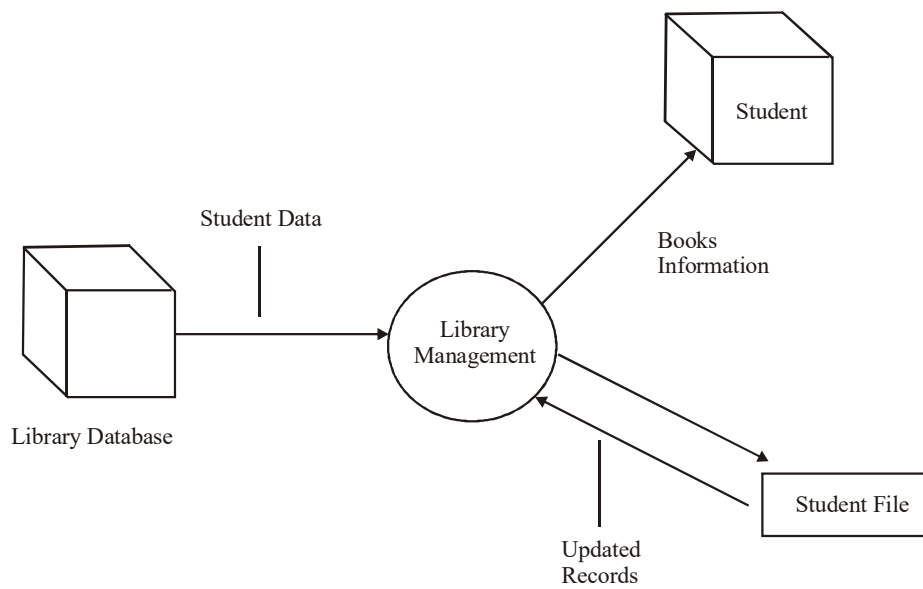


Fig. 4.5 A DFD for Library Management System

The student data originates from the library database and acts as a source. The data is then processed and the students receive the information regarding the books. The updated data on students is stored in an intermediate file known as the data store and is required for processing in the subsequent months. The drawback of this approach is that it requires a large number of iterations to arrive at an accurate and complete solution.

DFD is a powerful tool to understand the functional and informational perspective of a system. It can be of two types—logical data flow diagram and physical data flow diagram. Logical data flow diagram deals with the functional view of the system and defines the system in terms of its functionalities and information flows. It uses the following symbols for such representations:

An entity is represented by this:



Fig. 4.6 An Entity

Figure 4.7 illustrates a curve which represents information flow from one entity or process or data store to another.



Fig. 4.7 Information Flow from One Entity or Process

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Figure 4.8 illustrates two parallel lines which represent data store.



Fig. 4.8 Data Store

Figure 4.9 illustrates a process which is represented by a circle.

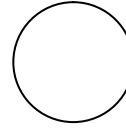


Fig. 4.9 A Circle

Figure 4.10 illustrates a DFD of a cheque deposit system.

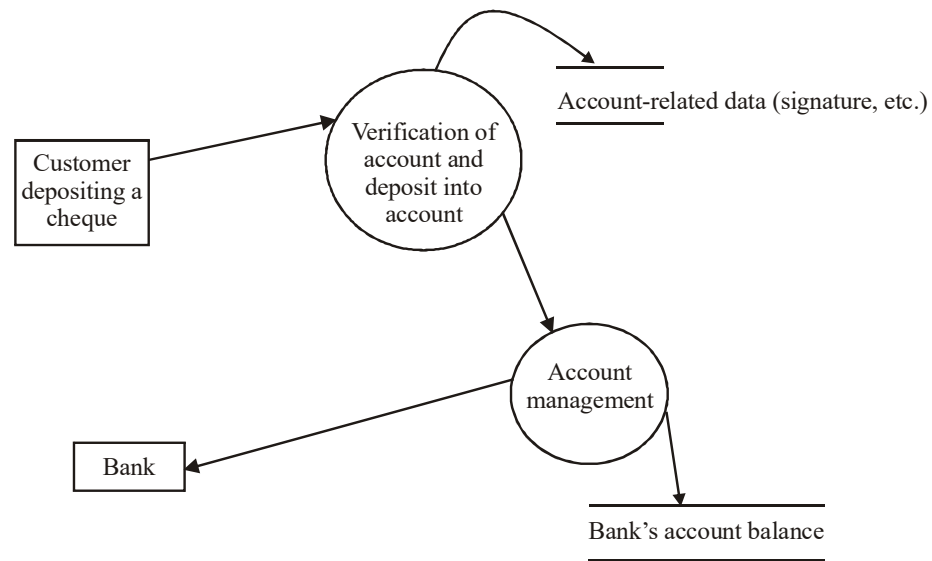


Fig. 4.10 Cheque Deposit System

A DFD can be represented in levels of detail. The abstraction provided by a DFD helps in understanding the system. The top-level DFD is called level 0. All the processes of a DFD are numbered and named. All entities, data flows and data stores are named. A DFD is hierarchical in nature and the top-level DFD is called a context diagram. A DFD further breaks down the levels of abstraction and complexity, until the atomic level is reached and no more granularity is possible. According to the numbering convention for processes in a DFD, the level of the DFD comes first, followed by a dot and then the number of the process. If the process is a subprocess, then this goes on until the process number unique to the process is given.

Data dictionary

A data dictionary is a structured repository of data that defines the basic organization of a database. The data dictionary contains a set of precise and accurate definitions

of all the DFDs, data elements and data structures. A data dictionary makes accessing of data more simple, as it supports documentation in a better way. The data dictionary does not contain any actual data from the database. It only provides precise and consistent definitions for various data elements, terms and procedures. It also helps in improving communication between a user and a system analyst. It serves as a common database for programmers and can also be used for control purposes. The data dictionary is a desirable feature for most of the databases.

The data items present in a data dictionary include:

- **Data element:** The smallest unit of data that cannot be further decomposed.
- **Data structures:** A group of data elements that are handled as a single unit. It contains a number of data elements as its fields.
- **Data flows and data stores:** Data flows are the data structures in motion and data stores are the data structures in rest. Data stores are the locations where the data structures are temporarily stored.

Table 4.1 explains the different symbols used in the data dictionary.

Table 4.1 Symbols Used in Data Dictionary

Symbol	Meaning
=	Is equivalent to
+	Add
[Option 1 Option 2]	Only one of the options is used at a given time
Max {Component}	Highest possible number of iterations. Component is optional
Min {component}	Lowest possible number of iterations. Component is optional
* Comment *	Words included within asterisks are considered as comments

You need to follow certain rules while constructing a data dictionary. The rules are:

- The terms used to describe the data structures should always be in capital letters.
- Multiple word names must be hyphenated.
- Assigned names should be straight forward and user-oriented.
- Every data flow, data store, data structure and data element must have a name associated with them.
- A consistency check should be performed.

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- The processes must have their identification numbers and names that must be mentioned in the data dictionary.
- Assumed names of the processes must be discouraged.

It is important to note that the data dictionary and DFD are correlated and the data should be presented in a specification. A data dictionary does not provide functional details and therefore, is not much acceptable among non-technical users.

This is another tool used in the design of systems. A data dictionary includes a complete and comprehensive definition of all the data elements in the system. It is the source document for specifications of all inputs, protocols, outputs, data structures, database structures, metadata and algorithms. It is a data repository of all design data about the system. Several description formats are available. One such format requires that for each data item, the following information must be stored in DD:

- **Name:** Formal name of the data item/control item according to the convention used.
- **Alias:** Any other name for the same item.
- **Use:** Where the data/control item is used, by which process, when and for what purpose.
- **Description:** Standard description of the item.
- **Additional information:** Any other information critical for the item.

A well-constructed DD is very useful not only for design but also for posterity. When the system breaks down for some reason, a DD sometimes comes to the rescue.

A DD normally serves the following purposes:

- A summary of the documentation
- A tool to reduce redundant data
- A background for I/O design
- A centralized control of all data in the system
- A controller of data integrity

Decision tree and structured English

A process can be represented using a decision tree as well. Similar to DFDs, a tree is formed in this graphic representation. The logic of the process that is not understood by data dictionary can be made clear using a decision tree. A decision tree has as many branches as many logical alternatives are there. It is easy to construct, read and update. Figure 4.11 shows the decision tree.

The logic can also be represented using structured English. Structured English uses logical construction and imperative sentences that are designed to carry out instructions for actions. In structured English, decisions are made using if-then-

else statements.

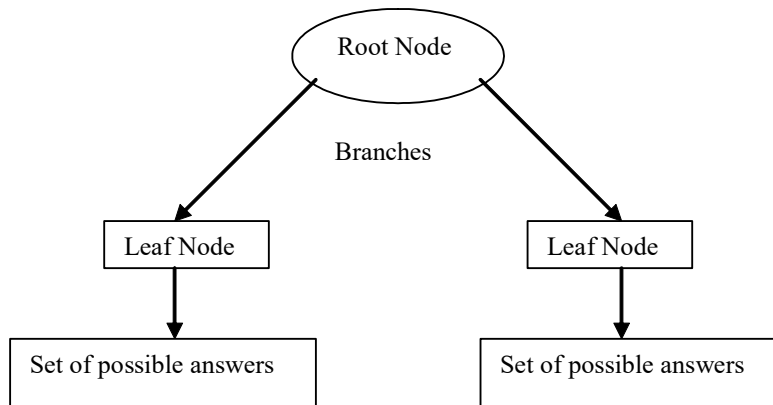


Fig. 4.11 Shows the Decision Tree

Structured English consists of:

- Sequences of instructions (action statements)
- Decisions (if-else)
- Loops (repeat-until)
- Case
- Groups of instructions

Decision trees can be used to verify logic in problems that involve few complex decisions. However, its biggest limitation is a lack of information due to its structure.

Decision table

A decision table is a compact way to represent complicated logic. It is a matrix that contains rows and columns representing conditions and actions. Decision tables are used in situations where complex branching routines are required.

Decision tables are divided into four quadrants. Table 4.2 shows a decision table.

Table 4.2 Decision Table

Conditions	Condition alternatives
Actions	Action entries

The above shown table describes a decision table in which the following quadrants are included:

- **Conditions:** These are at the upper left corner in the table. The questionnaire is listed in the conditions.
- **Condition alternatives:** This section is at the upper right corner and contains answers to the questions that were asked in the conditions column.

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- **Actions:** This section is at the lower left corner in the table and it outlines the action that is required to perform in order to meet each condition.
- **Action entries:** This section is at the lower right corner in the table. It indicates the appropriate action, resulting from the answers to the conditions in the condition quadrant.

There are certain rules that must be followed for constructing a decision table. These rules are:

- A name should be given to each decision that has to be written at the top left of the table.
- The logic should be independent of the sequence in which the condition rules were written, but the actions take place in the order in which the events occur.
- There should be a proper usage of consistent and standardized language.
- Duplication of terms should be avoided to the maximum extent.

Check Your Progress

1. Mention any two characteristics of a planning process.
2. What are the two pre-determined objectives of system analysis?
3. What does max {component} signify?
4. Which symbol is used to specify the source or destination of system data?
5. What is the use of condition alternatives?

4.4 SYSTEMS DESIGN

System design is an important step in the system development process. This phase comes into existence after the system analysis is completed. This means the output of the system analysis phase provides an input to the system design phase. In other words, the requirement specifications provided by the system analysis is used in the system design phase of the system development process. The identification of data requirements include:

- Identifying data sources
- The nature and type of available data
- Data gaps

The design of a system must adhere to the following objectives:

- **Practicality:** This objective notifies that the design of a system should be user-oriented. This means the users of the system can easily learn and operate the system.

- **Flexibility:** The flexibility of a system design describes the dynamic nature of a system. In other words, a system must be designed in such a way that the system may respond to the changes requested by the users.
- **Integrity:** The integrity of the system design requires use of specific practices and processes such as requirements tracing and verification and validation. The integrity of the system allows the system design phase to be easily integrated with other phases of the software development, to carry out the system development process.
- **Reliability:** The reliability of the system design describes the dependency on the system design for any system errors and faults, in order to analyse the time period of the existence of the system.
- **Efficiency:** Efficiency is highly important while designing a system. A system must perform its jobs within a specified time period. The efficiency of a system can be measured based on the following features:
 - o **Throughput:** is the rate at which a system performs its jobs per unit time.
 - o **Response time:** is the time taken by a system to react to a given input.
 - o **Run time:** is the ability to undertake a complete job within a specified time limit.
- **Security:** The security of a system includes:
 - o The hardware reliability of the system
 - o Physical security of data
 - o Detection and prevention of exploited data

The system design phase is carried out at two levels:

- (i) Conceptual level or conceptual design
- (ii) Physical level or physical design

4.4.1 Principles of Design

The fundamental principles of design are as follows:

- **The first principle of a good design is that it should have an overall macro view of the system rather than a tunnel view:** This helps the designer to fit the components and integrate them in the overall design. The designer will have a comprehensive view rather than only a problem-solving view.
- **The design process should be logical:** The design should have steps, which blend logically. The relationship of logic in the process of design should be unidirectional and strong.

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- **The design should not reinvent the wheel:** The design should not tread into territories, which have already been confirmed. The idea is not to revisit an issue unnecessarily.
- **The design should be a very close abstraction of the problem:** The design should make a clear abstraction of the problem it is supposed to solve.
- **The design should be uniform and integrated:** The design should be uniform throughout and integrated, without having loose components which do not have any linkage with the system.
- **The design should be structured:** The design has to be structured in order to be of value to the developer. The process of design itself and the output from the design process will have to be structured.
- **The design should be reviewed on a real-time basis to minimize errors:** The design should not be allowed to proceed unreviewed. While accepting the fact that design is a creative endeavour, the process around design should be such that mistakes in the design should be identified before more time is spent on creating more design around the mistake.

4.4.2 Concepts of Design

Some major design concepts that are to be adhered to in designing the system are discussed in the following sections.

Abstraction

Abstraction is the conceptualization of an issue or problem or entity in terms of some level of generalization, without regard to irrelevant low-level details (Wasserman, 1983). At the top level, abstraction is used in broad terms and defined with the variables of the environment; however, at the lower levels, it is defined in problem-oriented, procedure-oriented and implementation-oriented terms. Several types of abstraction are possible at the lower level. They are as follows:

- **Procedural abstraction:** When abstraction is used to define procedural issues. It is a named collection of several sequential procedural steps.
- **Data abstraction:** A set of data that defines an object.
- **Control abstraction:** A named control mechanism, which has several steps.

Refinement

Refinement is a top-down design strategy in which the design is refined after successive steps. In each step of refinement, greater detailing is done in the instructions. Refinement helps the designer in elaborating the systems and identifying low-level details as the design progresses.

Modularity

Modularity is a very important concept for any system design. It helps the designer to compartmentalize the design into functional compartments as the entire system can be conceived to be composed of a set of modules, each having its own special feature and functionality rather than a monolithic entity. Modularity helps the designer to comprehend the system better. However, the division of a system into modules comes at a cost. If modules increase in number, then initially the cost/effort per module for creating the system decreases as less dependencies make the system less costly; however, the cost of integration rises. Thus, the total cost reduces initially but then rises. Therefore, any system should be divided into an optimum number of modules, so as to keep the cost low.

Effective modular design in general, reduces the complexity of the system by dividing the system into easily understandable modules. These modules, in order to be effective, must exhibit a functional independence, cohesion and coupling. Functional independence in a module means that the module is focused on the delivery of some output, in a functionally independent manner. It does not interact with other modules a lot to achieve this goal. Functional independence make the modules easier to create, maintain and reuse. They work like components in an engineering application, each module performing a task with minimum interaction with other subsystems. These types of modules are easy to create and develop. Cohesion is the degree of singularity of purpose in a software procedure. Coupling is a measure of interconnectivity of modules.

4.4.3 Conceptual Design

The conceptual design stage allows a system analyst to choose an effective information system from among different management information system designs. This design stage determines the feasibility of the management objectives that are accomplished. The conceptual design is also known as external design or high-level design. This high-level design becomes a basis for the detailed design of the information system. In other words, we can say that a conceptual design is a prerequisite for the detailed design. The steps involved in the conceptual design are:

1. Problem definition
2. Set system objectives
3. Constraints identification
4. Determination of information requirements
5. Determination of information sources
6. Development of designs
7. Conceptual design documentation
8. Preparation of report

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A brief discussion of these steps will make the concept clear.

1. Problem definition

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The first step in the conceptual design of an information system involves the problem definition. It is important to understand the definition of the problem before implementing the information system. The function of information system is to solve problems related to information requirements for the organization. It is important to note that in the problem definition step, not only the current problems are considered, it also deals with the long-range planning of an organization, so that future problems also get resolved. The information requirements of an organization are identified and then determined by understanding the objectives and strategic plans of the organization.

2. Set system objectives

After the problem definition step, a system analyst must set the system objectives. The system objectives are always set with the help of the users. This is because the value of an information system lies in the benefits of the users. Setting the system objectives is not a straightforward process and hence, a system analyst needs to consider specific objectives. Once specific objectives are set, they help an organization in improving the efficiency of the information system. However, it is quite difficult to set the real objectives of an information system. Such circumstances should be avoided in which the objectives of an information system are set in vague terms. In other words, the objectives such as keeping accurate records, maximum efficiency, reduced costs and quality information should not be considered as specific objectives.

It is also important that the system objectives must be defined in such a way that they can be easily achieved by the system. In addition, the system provides a measure of performance. In other words, the system objectives should be stated, as far as possible, in quantitative rather than qualitative terms.

3. Constraints identification

System constraints, also known as problem boundaries, are essential for the conceptual design of a system because the identification of constraints helps the system designer in considering the limitations that restrict the design of the system. These constraints help in designing a system that meets the specified objectives. In addition, a constant review of the objectives is necessary. System constraints can be classified into:

- **External constraints:** These constraints are external to an organization. This category includes constraints posed by the customers, government and suppliers.
- **Internal constraints:** The constraints that are internal to an organization are known as the internal constraints. The constraints within the organization include:

- o Non co-operation and lack of support from the top management
- o An unfavourable organizational policy
- o Resource constraints such as manpower, time, and money

4. Determination of information requirements

For an effective design of the information system, it is important to understand the information requirements of the users. This step focuses on the identification of the information requirement that helps the management of an organization in performing their functions. A user must specify the following requirements:

- What are the expectations of the user from an information system?
- The information required in achieving the predetermined objectives.

It is the responsibility of the system analyst to adopt an approach that can help in achieving the information requirements of the system. There are two approaches for extracting information requirements: direct and indirect.

The direct approach allows a system analyst to ask various responsibilities of the users. This is followed by certain information that is required to execute each of the specified responsibility. On the other hand, the indirect approach avoids direct questions. A system analyst in the indirect approach asks a user to describe the decision-making process that helps in the system development process. An indirect approach is considered to be simpler, as the user is familiar with his/ her job and can easily describe the decision-making process. Similar to the system analysis process, several approaches to system design include interviewing the users, using questionnaire, record review and observations. Also, it is required for the system analyst to arrive at a thoughtful decision for adopting the best approach.

5. Determination of sources of information

As the determination of the information requirement is essential, similarly, the determination of the information source is also important. The determination of information source identifies the input data along with the information, such as the timing and format of the information source. The main information required by most of the information systems can be managed within the organization. The information that can be managed within the organization includes internal records, books, statistical and accounting documents. A study of the existing system is quite helpful in determining the information source. The classification of information sources of a system includes:

- **Internal and external records:** Internal records can be in a written form such as files, inputs and outputs, reports and documentation. On the other hand, external resource may include trade publications and government statistics.

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- **Managers and operating personnel:** This classification is an important source for understanding input, output and data processing requirements of an information requirement. Information in this classification can be gathered by conducting interviews of the managers and the operating personnel.

After the information sources and information requirements are determined, the next step is to match the information requirements and sources. This can be done using a matrix diagram, which is considered as a valuable means for the integration of sub-systems and for the remaining system design process. Table 4.3 shows the information requirements and information sources matrix.

6. Development of designs

The next activity includes the development of different designs in the conceptual design process. In this activity, a system analyst must know the overall structure of the information system that has to be designed. It is important to note that a conceptual design provides an overview or a sketch of the structure of an information system. The conceptual design further guides and restricts the detailed design of an information system. The development stage of the conceptual design process defines the following areas:

- The decision points
- The flow of information
- The channels of information
- The role of users

Table 4.3 The Information Requirements and Information Sources Matrix

Information
Requirements



Annual requirements	X		
Consumption Rate		X	
Ordering Cost		X	
Delivering Cost	X		
Unit Price			X
	Production	Accounting	Purchasing

Information Sources

Based on these areas, the system analyst works on the combinations of input, storage, processing, communication and generates the output in terms of various conceptual system designs. Different conceptual designs are developed and then compared in order to select the optimum design. The selected design should meet the requirements of the users as well as the organization and must be cost-effective.

The development of various conceptual designs can be evaluated on the basis of the following criteria:

- **Economic basis:** Each alternative based on this criterion provides benefits in terms of cost analysis.
- **Performance basis:** Each alternative must be evaluated for the anticipated performance, in accordance to the system objectives.
- **Operational basis:** Each alternative must determine the strong and weak points in terms of the quality of the databases, the information and the potential breakdown points.

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7. Conceptual design documentation

After the selection of the final conceptual design, the design is documented in specific terms. The documentation of the conceptual design involves:

1. Overall system flow
2. System inputs
3. System outputs
4. Other documentations such as, activity sheet and system description.

8. Preparation of report

The next step to the documentation of the conceptual design is to get an approval from the management of the organization. Once an approval is given to the prepared document, a detailed design activity can be introduced. A proposal which involves the cost incurred and the probable organizational changes, is prepared in this stage. The report prepared in this stage should contain the following specifications:

1. A brief statement of the problem
2. A brief statement of the objectives
3. An overall view of the system
4. A simple justification for selecting a particular design among different designs
5. Other resources, such as, the time required for developing and implementing the system

The top management of the organization then reviews the submitted report. If the submitted report is approved, a detailed system design activity can be undertaken.

Check Your Progress

6. What are the objectives of system design?
7. What are the types of abstractions in system design?
8. How can you classify system constraints?

4.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

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1. The characteristics of a planning process are:
 - (a) Planning is anticipatory in nature. A decision must be made now as to what to do and how, before it is actually done.
 - (b) It is focussed on desired future results. Planning is a means of ensuring that the important organizational objectives are accomplished as and when desired.
2. The predetermined objectives of system analysis include:
 - (a) Knowledge of the system operation
 - (b) Identification of the user requirements in a proposed system
3. Max {component} signifies the highest possible number of iterations.
4. The Square symbol is used to specify the source or destination of system data.
5. Condition alternatives are used to answer questions that were asked in the conditions column of the decision table.
6. The objectives of the system design are: Practicality, flexibility, integrity, reliability and efficiency.
7. The abstractions in system designs at the lower level are: Procedural abstraction, data abstraction and control abstraction.
8. System constraints may be classified into external constraints and internal constraints.

4.6 SUMMARY

- Planning is a system of decisions. It involves a process of making decisions which will define what is to be achieved in the future and the formulation of action plans for achievement of goals.
- Management control is a systematic effort to set performance standards with planning objectives, to design information feedback systems, to compare actual performance with these pre-determined standards, etc.
- System analysis is a process in which data is collected and then interpreted to identify problems within the system.
- System analysis is really vital in the completion of the development process of a system. It may be possible that a user is aware of the problem but may not have the solution.
- The basic understanding of a system can be developed by analysing the requirements of the system. The requirements tell us the need for the system,

the users of the system, the problem that the system is being created to solve, etc.

- The requirement determination is the preliminary step of the system development activity and is also known as software requirement specification (SRS).
- There are certain strategies for requirement determination that allows a system analyst to understand the existing system and also to determine the information requirement.
- The information collected needs to be organized. Various tools that can be used for organizing information are known as structured analysis tools. These tools help a system analyst to document the system specifications of a system.
- System design is an important step in the system development process. This phase comes into existence after the system analysis is completed. This means the output of the system analysis phase provides an input to the system design phase.
- The conceptual design stage allows a system analyst to choose an effective information system from among different management information system designs. This design stage determines the feasibility of the management objectives that are accomplished.

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4.7 KEY WORDS

- **ANSI:** The American National Standards Institute or ANSI is a private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States.
- **Data Store:** It is a repository for persistently storing and managing collections of data which include not just repositories like databases, but also simpler store types such as simple files, emails, etc.
- **Metadata:** It is a set of data that describes and gives information about other data.

4.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the differences between planning and control?
2. How do interviews help with requirement determination?
3. What are the principles of system design?

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Long-Answer Questions

1. Evaluate the meaning of requirement analysis with its significance and process.
2. Describe the tools that can be used for structured analysis.
3. Discuss the stages involved in the conceptual design.

4.9 FURTHER READINGS

O'Brien, James A. 2001. *Management Information Systems*, 7th edition. New York: McGraw-Hill Education.

Murdick, Robert Gordon; Joel E. Ross; and James R. Claggett. 1984. *Information Systems for Modern Management*, 3rd edition. New Jersey: Prentice Hall PTR.

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BLOCK II
MIS ENTERPRISE AND STRUCTURE

*MIS Planning and
Development*

**UNIT 5 MIS PLANNING AND
DEVELOPMENT**

NOTES

Structure

- 5.0 Introduction
- 5.1 Objectives
- 5.2 Information Planning and Development
 - 5.2.1 Various Information System Plans
 - 5.2.2 Steps For Information Systems Planning
 - 5.2.3 Development Strategies for Information Systems
- 5.3 Answers to Check Your Progress Questions
- 5.4 Summary
- 5.5 Key Words
- 5.6 Self Assessment Questions and Exercises
- 5.7 Further Readings

5.0 INTRODUCTION

It is important to decide which information the management information system will convey to different levels of management. For this, planning the objectives of the system is done, which is followed by the analysis and design stage, and then by the coding, testing and implementation stage. Organizations take part in MIS planning for different reasons. MIS planning helps in decision-making, and for the coordination, control, analysis, and visualization of information in an organization. This unit will discuss the various information system plans and the steps taken for information systems planning. The different development strategy for information systems will also be explained.

5.1 OBJECTIVES

After going through this unit, you will be able to:

- Discuss the process of development of information system
- Examine the various information system plans
- Explain the development strategies available for information systems

5.2 INFORMATION PLANNING AND DEVELOPMENT

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One has to plan the information which the management information system will churn out for the different levels of management. The report structures, information flow, storage, information capture and its strategy, network, applications and security are all planned and designed before the system is created. Normally, the stages of MIS development conform to a stage-wise development approach, with planning of the system being the first activity followed by analysis and design which in turn is followed by coding, testing and implementation. However, even though the broad stages may be used for most MIS development, the order is sometimes tweaked. Each of the activities given above for development of MIS is a difficult and intellectually stimulating set of tasks requiring technical and managerial skills. In some of the activities, the users are actively involved in arriving at the design of the system. Normally, the system analyst and his team will be responsible for the majority of the stages in developing the management information system. This is required as the development process requires knowledge of both management and technology which most line manager's lack.

Planning for MIS is probably the most important task in the entire development process. It is the activity which if done wrongly may lead to huge cost and time overruns in the development process. The planning process involves amongst other things the aligning of objectives of an organization with the objectives of the MIS. This activity requires strategic management orientation and a macro view of the needs and growth aspirations of the organization among other skills as the system will have to be relevant to the organization in the near future. If the organization outgrows the MIS, then the MIS will have to be redeveloped. This being costly, in both time and financial dimensions is to be avoided.

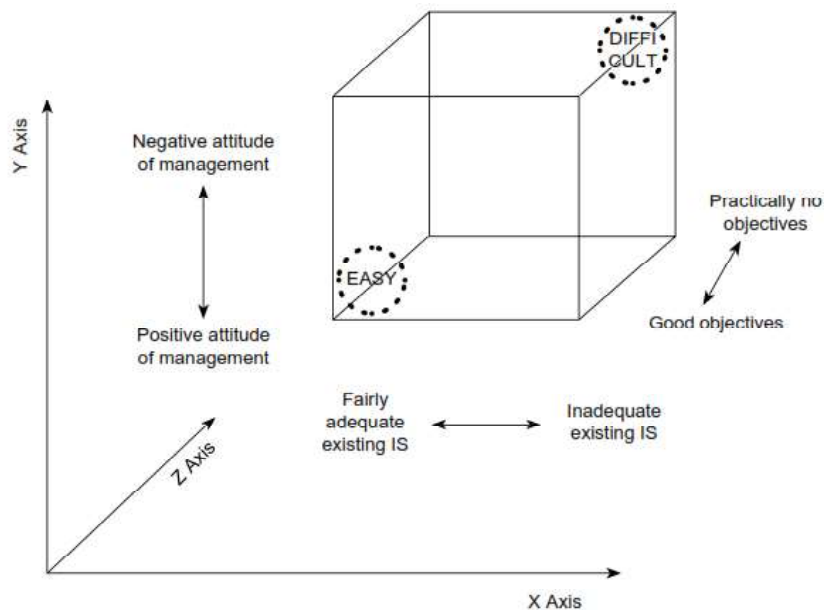


Fig. 5.1 Problems of IS development

However, before we embark on planning, we must have an understanding of what we are getting in to. For this, it is very important to understand that Information Systems (IS) development for which the planning is being done can be difficult or easy depending on a few factors. If the IS development according to the assessment of the factors is easy, planning will be done accordingly and if the assessment of the factors is such that the IS development is likely to be difficult then planning has to be detailed and management has to be involved more in the planning process. The factors also must be explained to the top management and the possible difficult areas must be clearly identified and monitored in the entire development process. The planning for all this then becomes a part of the IS planning process.

The above figure clearly depicts the problems of IS development. Information systems development becomes easy if there is:

- A supportive management with a positive attitude
- The existing IS is adequate
- The objectives for the new IS is good and clear

In such a scenario, the IS development becomes easy and the IS that is developed delivers value and becomes acceptable to employees easily. However, if any or all of the above factors are not in favour, i.e., management is not supportive or has a negative attitude towards IS or if the objectives of the new IS are bad or if the existing IS is inadequate or all of the factors are together not in favour, then the IS development becomes very difficult. One must factor in these issues before commencing with the information systems planning process.

The Process of Development of Information System

The process of development of information systems in an organization may vary from case to case but ideally the stages of development can be clearly demarcated. The process of development of information system involves the following stages:

- **Planning**—planning is required as without planning the outcome will be below expectations. Planning sets the objectives of the system in clear and unambiguous terms so that the developer may conform to a well laid set of deliverables rather than a high-sounding statement that may mean little to him. Planning also enables the development process to be structured so that logical methodology is used rather than working in fits and starts. It ensures user participation and helps in greater acceptability and a better outcome from the development process. It leads to a system that is well balanced in both the managerial and technical aspects.
- **Analysis**—is an activity of technical representation of a system. Over the years many methods have been developed of which the structured analysis and object oriented analysis are most widely used. This step or activity is the first technical representation in abstract terms of the system.

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- **Design**—is the stage where the model or representation of an entity or a system is done (in detail). It is based on the idea that the developer will be able to develop a working system conforming to all the specifications of the design document which would satisfy the user. It is a concept which has been borrowed from other branches in engineering where the blueprint of a system or entity to be built later is first created on a piece of paper or digitally to help developers in conceptualization of the system and to understand the specifications of the system.
- **Coding**—is the actual stage of writing codes to develop the application software according to the specifications as set by the design document. The programming done at this stage to build the system is dictated by the needs of the design specifications. The programmer cannot go beyond the design document.
- **Testing**—is the testing of the system to check if the application is as per the set specification and to check whether the system will be able to function under actual load of data. The testing is also done to remove any bugs or errors in the code.
- **Implementation**—is the stage when the system is deployed in the organization. This is a process which often is a difficult one as it involves some customization of the code to fit context specific information in the system.

Before commencing IS planning, one must also identify the need for a new information system. Figure 5.2 gives a flow chart to find out if the existing IS is fulfilling the objectives of the organization with respect to IS. Sometimes, an existing IS can be tweaked or redesigned to align it with the changing objectives and business needs of the organization but sometimes, that become too costly or technically infeasible, in which case, one has to start the process for a new IS. The above flowchart also gives us a tool to use to understand whether our existing IS is relevant for our business operations.

5.2.1 Various Information System Plans

Planning is the key to success in developing a good IS. IS planning brings to focus the reason for existence of the IS and helps the developers to undertake the task of development of IS in a structured manner. Organizations undertake planning for IS for several reasons. Typically IS plans have a hierarchy with different levels of management handling different plans.

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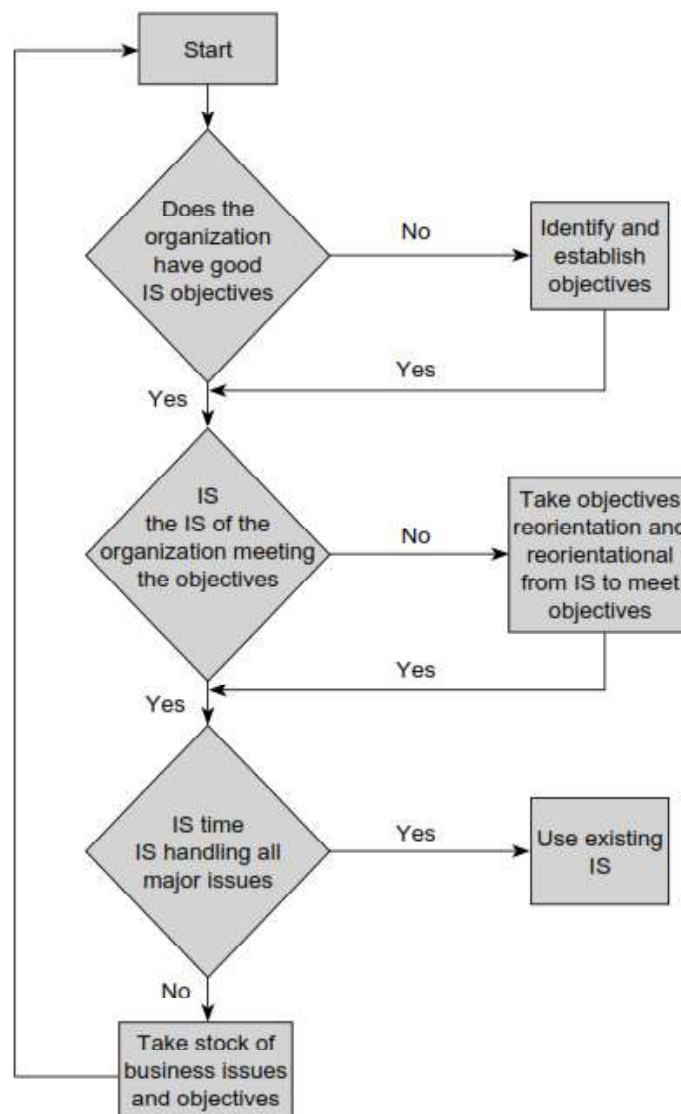


Fig. 5.2 Flow Chart to Identify the Need for a New Information System

1. Strategic Information Systems Planning

This is the first plan of information systems within an organization. It is foremost for defining the role information systems will play in the overall scheme of things. Typically, top management formulates a charter for information systems or the CIO formulates the charter and gets approval of the top management. With the charter, the mission of information system in the organization is also formulated. Thereafter the constraints and environment in which IS is to be implemented is analysed. In this, the strategic objectives, policies, human resource, maturity of IS usage of the organization and the present and future information needs of the organization in view of changes in technology is analysed. Following the broad mission and analysis of environment and constraints, concrete objectives of information systems is laid down along with the plan of achieving the objectives. The plan will include broad

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guidelines on allocation of resources, mechanisms of control of the process of information system development and other guidelines for implementing the strategies of the plan.

2. Long Range Information System Planning

This is the second stage of planning done primarily to understand the user needs and objectives. This sort of plan does not go into project specific details but rather focuses on the expectations of users from the system. Typically, this kind of planning is done with a time horizon of five to ten years in mind. Broad characteristics of information systems based on the needs of the users are dealt with in this plan along with the technology trends in the information technology space and long-term objectives of the organization. The long-term plan requires greater detailing than a strategic plan and is normally prepared by senior executives in the organization which is then approved by the top management. Ideally, senior executives from different departments are involved in this process. The following step-wise course of action is normally taken to prepare a long-range information systems plan:

Collecting background data

All kinds of data that helps in creating a background or perspective for the planning with regard to the technology scenario, organization objectives, changing needs of the users, competition scenario, potential set of information services in future, availability of resources in future, suitability of organizational culture, etc., is collected and presented as a background.

Analysing the broad long-term needs

Based on the prepared background, analysis of the overall long-term information system need of the organization is defined. This entails an analysis of demand on resources for such information systems and the means to provide them.

Developing the long-range plan document

Formally documenting the above steps into a plan of action results in the creation of this document. This document typically contains information about the objectives, resources to be made available for the IS, future trends in demand for information within the organization, risks and opportunities in developing the IS and organizational issues pertaining to installation of such IS.

3. The medium-range information systems planning

This is a very important plan for developing the IS. It looks to satisfy the present information needs of the organization by implementing a portfolio of projects. The planning time horizon is one to two years and the focus is on the present. It normally contains the plan of action for the portfolio of IS projects, resource requirements for each, procurement of necessary resources for implementing the projects, staffing

needs analysis, budgeting and funding issues, priority setting of the projects under development. This process of planning, resulting in the information systems, master plan document containing details on:

- The present IS situation with regard to usage, technology, work force and other resources.
- Analysis of the present IS situation.
- Plan of action including prioritization of projects aligns it with the long-term plan of IS.
- Policies under several operational heads like training, procurement, hiring, outsourcing, and security are given in these documents.
- Financial implications.
- Risk to projects.
- Process of development and present status of each project under development.

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4. The short-range information system planning

The time horizon for such a plan ranges from a few months to a year. Operational details and short-term goals and objectives are detailed out in this document. Normally the personnel of the information systems department are involved in the preparation of such a plan. It includes maintenance plan for existing systems, development plans for top priority systems, technical support required for the development, operations plan, training plan, staffing plan and financial plan containing practices and procedures for relevant issues, all in the short-term of about a year.

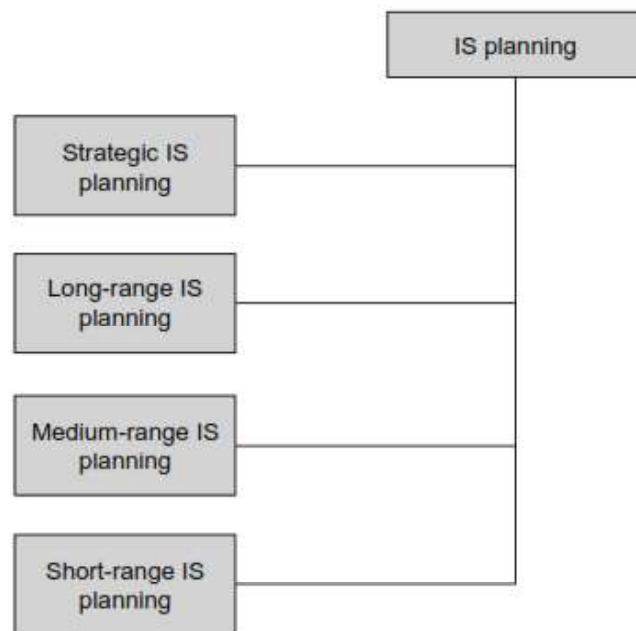


Fig. 5.3 Different Information Systems Plans

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Four Stage Model of Information Systems Planning

Information systems are planned often on the basis of the four-stage information system planning methodology, in which there are four stages as given below:

(a) Strategic planning—in this stage the strategic planning for the information system is done. This strategic plan is integrated with the business strategy of the organization to get better value from information system. In the strategic planning stage, the following issues are dealt with.

1. What strategic value will the information system deliver?
2. What will be its strategic role?
3. What business objectives are to be fulfilled by such information systems?
4. What will the information system achieve to enable the organization to compete better in the market?

The strategic planning is done by the top management and communicated downwards.

(b) Information requirement analysis—in this stage an assessment is made of the information requirement for making operational the strategic plan. This is done by the middle management.

(c) Resource allocation—in this stage the resource allocation is done in terms of men and money for making operational the strategic plan and based on the information requirement analysis.

(d) Project planning—in this stage the project planning is done to ensure that the system is developed within the timeframe and money as allocated and that the system performs as planned.

5.2.2 Steps For Information Systems Planning

The critical success factors/steps for information systems planning are:

Create Mission Model/Strategic Goal

It is very important for the IS planners to know the mission or strategic goal of the IS. Without a clear and well-defined mission, the IS will fail as the organization will have little understanding of what to expect and what not to expect from the IS as developed from such planning. This step is therefore of vital importance, as it sets the objectives of the IS and clearly lays down the set of deliverables as far as information requirement is concerned from the IS.

Build the High-level Data Model

This is another vital step that has to be done properly for the IS to succeed. In this, the high-level data requirements for the IS are crystallized. The interdependencies of the data are mapped and relationships established between data stores. This later sets the stage for the creation of databases for the information system.

Conceptualize and Create (Ordered) Resources and the Resource Life Cycles (RLC) and Allocate Resources to Projects

*MIS Planning and
Development*

IS requires resources. All resources required for the development of IS should be made available. A clear understanding of such resources is therefore required for its allocation. In this step, such resource requirements are understood and mapped with the IS project life cycle, so that a resource crunch does not happen. If this step is omitted, the smooth management of IS development and implementation may be even seemingly unimportant resources have the potential to cause delays in the completion of projects.

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Schedule Activities using Project Management Techniques

This is another important step in IS planning. Planning of schedules and sequencing of activities for smooth project management is one of the key factors in successful IS planning. Without detailed scheduling of activities, it may be impossible to manage large IS development projects.

Execute and Adjust the IS Plan

This is an important factor in IS planning. The IS plan is not a static entity that remains frozen in time. Instead, it is a dynamic and living entity that requires adjustments.

5.2.3 Development Strategies for Information Systems

Discussing about information systems development strategies is always a tricky business. Several successful strategies exist for development of information systems and it is important for the organization to analyse the suitability of one strategy and then stick to it. A strategy for development of information systems is required because of the diverse and complex set of activities to be performed in order to develop an information systems. If the development process is not synchronized, the outcome will inevitably be unsatisfactory. Before we go into the details of successful development strategies let us have an understanding of the inappropriate approaches towards IS development

The Ad Hoc approach

This approach towards development of information systems is the worst possible approach as people in the development process are in the process of perpetual fire fighting. There is no plan available and the development work is carried out as per wishes of the developer based on his understanding of what the needs of the user should be. The outcome of this kind of approach is a set of systems that are not synchronized or synergized into one system but a host of systems that work in isolation.

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The Data Collection Approach

In this approach, all possible data about the need for the system and about the system is collected. This approach assumes that information systems are best developed based on data from all quarters. This results in lack of focus and understanding as the systems development process gets mired unnecessarily into other issues like projecting the future information requirement in granular detail by the user.

The Organization Chart Approach

In this approach the information system is developed with the organization structure in mind. It assumes that information strictly flows on the basis of organizational structures. Junctions of information exchange are made on an ad hoc basis, complicating the flow of information and bringing in redundancy in the system.

Now that we know how not to approach IS development in an organization, let us discuss the appropriate approaches for IS development.

The Top-down Approach

The top down approach is used to develop IS with the objectives in focus. The objectives of the IS become the most important priority. The objectives are clearly defined in the first step, followed by identification of the activities of the organization. This in turn is followed by the third step in which the decision-making needs of managers within the organization are analysed and the necessary information flow for facilitating information delivery to managers for decision-making is understood in detail. Once all the details are available the application is developed. In this type of system, the objectives become the mainstay of the system. However, for this kind of system the requirements from the systems have to be clearly understood upfront to avoid any problems in the development process. This is because the strategy of development is such that the design is not adequately dynamic.

The Bottom-up Approach

In the bottom up approach, we find out the type of information that is produced in the operational subsystem and then work backward to integrate this with the entire IS structure to have an organization-wide impact. In this design, there is more flexibility to change the information system deliverables even during the development process, as the individual subsystems are not designed according to the demands of the upper layers as in the case of top down approach. On the contrary, here the upper layers are integrated with the lower layer subsystems to create the IS. Thus, bottom-up systems can expand in response to real-world changes and needs of the organization.

Check Your Progress

1. List the factors that eases the process of Information systems development.
2. What does the Strategic Information Systems Plan include?
3. What is the time duration of a short-range information systems plan?
4. Why is it important to schedule activities in IS planning?
5. Mention the disadvantages of the Ad Hoc approach.
6. State the disadvantage of the organization chart approach.

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5.3 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Information systems development becomes easy if there is:
 - o A supportive management with a positive attitude
 - o The existing IS is adequate
 - o The objectives for the new IS is good and clear
2. Strategic Information Systems Plan includes broad guidelines on allocation of resources, mechanisms of control of the process of information system development and other guidelines for implementing the strategies of the plan.
3. The time horizon for a short-range information systems plan is from a few months to a year.
4. It is important to schedule activities in IS planning as without detailed scheduling of activities, it may be impossible to manage large IS development projects.
5. The Ad Hoc approach towards development of information systems is the worst possible approach as people in the development process are in the process of perpetual fire fighting. There is no plan available and the development work is carried out as per wishes of the developer based on his understanding of what the needs of the user should be. The outcome of this kind of approach is a set of systems that are not synchronized or synergized into one system but a host of systems that work in isolation.
6. In the organizational chart approach, the information system is developed with the organization structure in mind. It assumes that information strictly flows on the basis of organizational structures. Junctions of information exchange are made on an ad hoc basis, complicating the flow of information and bringing in redundancy in the system.

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5.4 SUMMARY

- One has to plan the information which the management information system will churn out for the different levels of management. The report structures, information flow, storage, information capture and its strategy, network, applications and security are all planned and designed before the system is created.
- Normally, the stages of MIS development conform to a stage-wise development approach, with planning of the system being the first activity followed by analysis and design which in turn is followed by coding, testing and implementation.
- Planning for MIS is probably the most important task in the entire development process. It is the activity which if done wrongly may lead to huge cost and time overruns in the development process.
- The process of development of information systems in an organization may vary from case to case but ideally the stages of development can be clearly demarcated. It involves planning, analysis, design, coding, testing and implementation.
- Before commencing IS planning, one must also identify the need for a new information system. Sometimes, an existing IS can be tweaked or redesigned to align it with the changing objectives and business needs of the organization but sometimes, that become too costly or technically infeasible, in which case, one has to start the process for a new IS.
- Strategic Information Systems Planning is the first plan of information systems within an organization. In this, the strategic objectives, policies, human resource, maturity of IS usage of the organization and the present and future information needs of the organization in view of changes in technology is analysed. The plan will include broad guidelines on allocation of resources, mechanisms of control of the process of information system development and other guidelines for implementing the strategies of the plan.'
- Long Range Information System Planning is the second stage of planning done primarily to understand the user needs and objectives. This sort of plan does not go into project specific details but rather focuses on the expectations of users from the system.
- The following step-wise course of action is normally taken to prepare a long-range information systems plan:
 - o Collecting background data
 - o Analysing the broad long-term needs
 - o Developing the long-range plan document
- The medium-range information systems planning is a very important plan for developing the IS. It looks to satisfy the present information needs of

the organization by implementing a portfolio of projects. The planning time horizon is one to two years and the focus is on the present.

- The short-range information system planning includes maintenance plan for existing systems, development plans for top priority systems, technical support required for the development, operations plan, training plan, staffing plan and financial plan containing practices and procedures for relevant issues, all in the short-term of about a year.
- It is very important for the IS planners to know the mission or strategic goal of the IS. Without a clear and well-defined mission, the IS will fail as the organization will have little understanding of what to expect and what not to expect from the IS as developed from such planning.
- Building the High-level Data Model is another vital step that has to be done properly for the IS to succeed. The interdependencies of the data are mapped and relationships established between data stores.
- IS requires resources. All resources required for the development of IS should be made available. A clear understanding of such resources is therefore required for its allocation.
- Scheduling activities using project management techniques is another important step in IS planning. Planning of schedules and sequencing of activities for smooth project management is one of the key factors in successful IS planning.
- Executing and adjusting the IS plan is an important factor in IS planning. The IS plan is not a static entity that remains frozen in time. Instead, it is a dynamic and living entity that requires adjustments.
- The Ad Hoc approach towards development of information systems is the worst possible approach as people in the development process are in the process of perpetual firefighting. There is no plan available and the development work is carried out as per wishes of the developer based on his understanding of what the needs of the user should be.
- In the Data Collection Approach, all possible data about the need for the system and about the system is collected. This approach assumes that information systems are best developed based on data from all quarters.
- In the organizational chart approach, the information system is developed with the organization structure in mind. It assumes that information strictly flows on the basis of organizational structures.
- The top down approach is used to develop IS with the objectives in focus. In this type of system, the objectives become the mainstay of the system.
- In the bottom up approach, we find out the type of information that is produced in the operational subsystem and then work backward to integrate this with the entire IS structure to have an organization-wide impact. In this design, there is more flexibility to change the information system deliverables even during the development process, as the individual subsystems are not designed according to the demands of the upper layers as in the case of top down approach.

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5.5 KEY WORDS

- **Budgeting:** It is the process of estimating revenue and expenses over a specified future period of time.
- **Outsourcing:** It is an agreement in which one company hires another company for an activity that is or could be done internally, and sometimes involves transferring employees and assets from one firm to another.
- **Resource allocation:** It is the process of dividing money, skills, etc. between departments of an organization.

5.6 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short note on Strategic Information Systems Planning.
2. Briefly mention the four stage model of Information Systems Planning.
3. What is the Data Collection Approach?
4. What are the approaches that should be adopted as Information Systems development strategy?

Long-Answer Questions

1. Discuss the steps involved in the process of development of information systems.
2. Explain the step-wise course of action taken to prepare a long-range information systems plan.
3. Examine the development strategies for Information Systems.

5.7 FURTHER READINGS

- O'Brien, James A. 2001. *Management Information Systems*, 7th edition. New York: McGraw-Hill Education.
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UNIT 6 MIS AND BPR

Structure

- 6.0 Introduction
- 6.1 Objectives
- 6.2 Business Process Re-Engineering: Current Focus
 - 6.2.1 Improving a Process in BPR
- 6.3 Object Oriented Methodology
- 6.4 Answers to Check Your Progress Questions
- 6.5 Summary
- 6.6 Key Words
- 6.7 Self Assessment Questions and Exercises
- 6.8 Further Readings

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6.0 INTRODUCTION

Business process reengineering (BPR) entails the redesigning of the entire business process to improve the productivity and performance of the organization. It can therefore be said that BPR is a scientific exercises that involves a series of small steps. It should be ensured that BPR is done systematically rather than on an ad hoc basis. This unit will discuss the relevance of business process reengineering in Management Information System. The advantages and disadvantages of object oriented software development will also be explained.

6.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain business process reengineering (BPR)
- Understand the activity of improving a process in BPR
- Discuss object-oriented software development

6.2 BUSINESS PROCESS RE-ENGINEERING: CURRENT FOCUS

Sometimes in order to develop a good information system that will serve the purpose of management even in the future, it becomes very essential to have a relook at the way business processes are conducted in a firm. The rationale for this is that the manner in which business is conducted changes with time and an information system that is designed over such out dated business processes would not provide any worthwhile value to managers.

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Business organizations are a continuing entity but the products or services that they offer change with time. Even the manner in which it conducts business changes with time. New ways of doing business emerge over time. New markets emerge. New products and services emerge. New geographies emerge. New technologies emerge. All this changes the organization fundamentally. If however, the organization continues to engage with its customers (internal as well as external) in the same way as it had been doing in the past then it risks losing business and efficiency. It has to change its process to remain competitive. However, organizations cannot change individual processes on an ad hoc basis and neither can they change the processes in isolation. Concerted efforts are required and a complete scientific exercise is required to change processes of doing business and to ensure, at the same time, that the business does not suffer from this changed effort. This scientific exercise of overhauling the process of doing business is called business process reengineering (BPR). For example, we are all aware of the process of drawing money from banks. In earlier times, if we needed money, we had to deposit a signed cheque at the bank counter and the counter clerk would give a token then after some time he would announce the token number for the particular token holder to collect the cash. The time spent in between is used by some other clerks who physically check whether the signature on the cheque is that what is recorded against your account. If they get a perfect match, the counter calls the token number and you get your cash. Now, this process of checking of the signature on the cheque and comparing it against the officially recorded version to find out whether it is one and the same is easily done if an information system which is made available to the counter clerk. If the system is so designed that the clerk can himself check the authenticity of the signature by comparing it against the digital picture of the official signature of the account holder on a computer screen in front of him then this process can be done away with. The clerk can just take the cheque from the customer and check the authenticity of the signature on the system and if found correct can deliver the cash to the customer. We can see here that the process of cash delivery has been reengineered due to the introduction of technology. This change or rather improvement in the actual business process by the introduction of technology or otherwise is called re engineering and the process by which this is done is called BPR. Sometimes BPR is resorted to even when there is no immediate trigger for change in the business process. Most BPR exercises are conducted when a system is being designed for the business. Sometimes, in order to develop a good information system which will serve the purpose of management even in the future, it becomes very essential to have a relook at the way business processes are conducted in a firm. The rationale for this is the manner in which business is conducted changes with time and the information system designed over such dated business processes would not provide any worthwhile value to managers.

The principles around which BPR activities are performed are:

- Focus on outcomes. In BPR the focus should be on the outcomes rather than activities or functions. A broader view of the process is required.

- Keep users of process outputs/outcomes in the BPR team. This will ensure that real-life issues are taken care of.
- Link parallel activities. Treat parallel activities by linking them instead of integrating them to get the full measure of the processing rather than having a simplistic view.
- Capture data once. This is very important as in most cases duplication of data capture happens. This can be avoided by capturing data at the source.
- Eliminate geographical segregation. This is another important concept. This means that a process may be physically distributed in different geographies but in cyberspace, this has little meaning. We must therefore create a virtual space incorporating this geographical diversity and then conduct BPR. This will help reduce a lot of complexity.

BPR is sometimes seen as an algorithm of tasks to conclude that ensures better efficiency. Hence, models have been designed to perform BPR.

BPR Model

As is evident, BPR is a scientific exercise comprising a set of logical micro tasks. Therefore, it may be worthwhile to define the BPR exercise in the form of a model.

- Business objective definition—In this the goals of the business are crystallized. The goals may be cost reduction, time reduction, etc. Essentially in this stage the BPR team must identify the major driver for the processes in the overall business perspective.
- Process identification—In this stage the critical process that helps in the attainment of the business objectives are identified and ranked according to their perceived importance in the overall business.
- Process evaluation—In this stage the process is examined in detail by first pictorial depiction the process (that may be done after actually passing through/ seeing the process in action) and then finding out the areas that are redundant or can be made redundant after adequate use of managerial or technological intervention. In this stage the process is examined from a cost and time perspective which helps to understand the efficiency of the process. In most cases, this exercise results in process improvement.
- Process specification—In this stage process specifications are plotted in a process diagram.
- Prototyping—In this stage, a working model of the software that mimics the process is created in collaboration with the developers and the customers. This prototype acts as the basis for further development.
- Refinement—The feedback on the prototype is factored in the new design and a process of refinement of the prototype starts. This step may involve several stages of refinement to arrive at a fully functional system.

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This is a broad template that ensures that the BPR exercise is done systematically and not on an ad hoc basis.

6.2.1 Improving a Process in BPR

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Process improvement—It is the activity of critically examining a process with the objective of making it more efficient. In most cases, it involves the shortening of the process, reduction of people handling the process, intervention of technology, changing the manner of doing tasks within the process, reduction of cycle time of tasks in the process and reduction in the cost of conducting the process. This is achieved by first examining the process and passing through it. Then a process map is created and bottlenecks and redundancies identified. These areas are then worked upon to make the process more efficient.

Check Your Progress

1. What is business process reengineering?
2. What do you mean by process improvement?

6.3 OBJECT ORIENTED METHODOLOGY

Object-oriented software development is fundamentally different from classical software development techniques. Object-oriented development holds the promise of reduced time, cost and resources of development. It aims to reusing code. The reused code not only reduces development time but also reduces testing time, thereby, reducing development time further. Object-oriented design (OOD) helps development teams to adopt component-based methods of software development. Several frameworks for such component based object oriented development exist. The development of software systems based on object-oriented development methodology also increases flexibility of the system and helps in allowing an easier platform for changing the system at a later date when its requirements change. The modular approach of object-oriented development helps to identify those objects that need redesign and redevelopment, thereby, leaving the rest of the system unchanged. This is also a major advantage. All these benefits make OOD a popular option as a development strategy. However, often OOD is adopted with unrealistic expectations which create tensions in the development team and result in chaos.

Benefits of Object-Oriented Design

OOD has major advantages over conventional development methodologies. OOD results in the following:

Reduced Development Time: OOD methodology helps the development team to reduce the time of development. However, in some cases, the reduction in

time may only be marginal. The reduction in development time is more when a large body of reusable objects is available within the development organization/team. In such cases, the reduction in time is impressive.

Reuse of Code: OOD relies heavily on reusing code that was written for some other application (however, that application must also have been prepared with OOD) but is available for reuse as object-oriented approach is being used in both applications. This is a great benefit but requires careful planning and fine tuning to ensure that the reused code gels in with the other objects and that no loose ends are kept unattended (like dangling pointers, threads, and so on) which may lead to a security threat or result in an abnormal behaviour of the system at a later date. Thus, reusing code is not as easy as it is made out to be by some. It requires expert handling.

Improved Quality: OOD results in improved quality as most of the code is reused (which are already tested products). Thus, if most of the application is being built with already proven components/objects, then the quality of the end product will also be good. The developer needs to focus only on the objects that have been developed from scratch and does not have to worry about the reused objects.

Modular Architecture: OOD uses modular architecture, which helps in quicker development and also helps in making changes in the system in a much faster manner.

The following are the problems associated with object-oriented development:

Experts: OOD requires experts to handle the development process. Experts alone can make plans to break up the system into modules, and then to fit it in reusable code and objects. This kind of expertise is difficult and costly to get in the market.

Conceptual Problem: Developers need to understand that they are dealing with objects and a clear starting and ending point for such objects. Rather than focus on the macro picture of the end product, they have to focus on the objects. This requires training as conceptually object-oriented approach is totally different from conventional approach.

However, not all projects are suitable for OOD. Projects for which predeveloped objects are not available may require more time to develop with OOD than conventional approach.

Check Your Progress

3. How does OOD led to an improvement in quality?
4. What are the advantages of using modular architecture in OOD?

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6.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

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1. Concerted efforts are required and a complete scientific exercise is required to change processes of doing business and to ensure, at the same time, that the business does not suffer from this changed effort. This scientific exercise of overhauling the process of doing business is called business process reengineering (BPR).
2. Process improvement is the activity of critically examining a process with the objective of making it more efficient. In most cases, it involves the shortening of the process, reduction of people handling the process, intervention of technology, changing the manner of doing tasks within the process, reduction of cycle time of tasks in the process and reduction in the cost of conducting the process.
3. OOD results in improved quality as most of the code is reused (which are already tested products). Thus, if most of the application is being built with already proven components/objects, then the quality of the end product will also be good.
4. OOD uses modular architecture, which helps in quicker development and also helps in making changes in the system in a much faster manner.

6.5 SUMMARY

- Concerted efforts are required and a complete scientific exercise is required to change processes of doing business and to ensure, at the same time, that the business does not suffer from this changed effort. This scientific exercise of overhauling the process of doing business is called business process reengineering (BPR).
- Sometimes, in order to develop a good information system which will serve the purpose of management even in the future. It becomes very essential to have a relook at the way business processes are conducted in a firm.
- BPR is sometimes seen as an algorithm of tasks to conclude that ensures better efficiency. Hence, models have been designed to perform BPR.
- BPR is a scientific exercise comprising of a set of logical micro tasks. Therefore, it may be worthwhile to define the BPR exercise in the form of a model. The BPR model includes business objective definition, process identification, process evaluation, process specification, prototyping and refinement.

- Process improvement is the activity of critically examining a process with the objective of making it more efficient. In most cases, it involves the shortening of the process, reduction of people handling the process, intervention of technology, changing the manner of doing tasks within the process, reduction of cycle time of tasks in the process and reduction in the cost of conducting the process.
- Object-oriented software development is fundamentally different from classical software development techniques. Object-oriented development holds the promise of reduced time, cost and resources of development. It helps development teams to adopt component-based methods of software development.
- OOD has major advantages over conventional development methodologies. It leads to reduced development time, reuse of code, improved quality, etc. The use of modular architecture is another advantage.

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6.6 KEY WORDS

- **Business Process Reengineering:** It is a business management strategy that focuses on the analysis and design of workflows and business processes within an organization.
- **Process improvement:** It is the activity of critically examining a process with the objective of making it more efficient.
- **Object-oriented Design:** It is the process of using an object-oriented methodology to design a computing system or application.

6.7 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. State the principles around which BPR activities are performed.
2. How can a process in BPR be improved?
3. Mention the problems associated with object-oriented development.

Long-Answer Questions

1. Discuss the BPR model in detail.
2. Explain the advantages of Object-Oriented Design.

6.8 FURTHER READINGS

NOTES

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UNIT 7 MIS ORGANIZATIONAL STRUCTURE

*MIS Organizational
Structure*

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Structure

- 7.0 Introduction
- 7.1 Objectives
- 7.2 MIS at Management Levels
- 7.3 Strategic Level Planning
 - 7.3.1 Operational Level Planning
- 7.4 Economic and Behaviour Theories
 - 7.4.1 Economic Theories
 - 7.4.2 Behaviour Theories
- 7.5 Answers to Check Your Progress Questions
- 7.6 Summary
- 7.7 Key Words
- 7.8 Self Assessment Questions and Exercises
- 7.9 Further Readings

7.0 INTRODUCTION

With four levels of information resources, MIS has been identified as a pyramidal structure. The information levels would be decided by the organizational structure. At the highest level of management, the top level of management promotes strategic planning and policymaking. For management control, the second level of information resources aid operational preparation and decision-making. The third level is responsible for day-to-day activities and management. The information for transaction processing is processed at the lowest level. As a result, since decision-making occurs at different levels of an organization's hierarchy, the information requirements at each level differ. In this unit, we will discuss the MIS at management levels, along with the strategic and operational level planning. We will also focus on economic and behaviour theories.

7.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the MIS at management levels
- Discuss the strategic and operational level planning
- Describe the economic and behaviour theories

7.2 MIS AT MANAGEMENT LEVELS

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An organization consists of several managers each of them have different information needs. For example, the chairman of a company may need information regarding new policies and procedures, whereas regional manager may need daily report of the employees working in the eastern zone office. Thus, there must be an organized way for the management of information among several managers within the organization.

In any organization, three organizational (or managerial) levels have been introduced on which managers exist, and the information is addressed according to their roles. A management theorist, Robert N. Anthony, had given names to three management levels as top, middle and lower levels as shown in Figure 7.1. For an effective decision-making, it is important for those designing information systems that the requirements of each of these levels must be met. The three organizational levels and the information they cover are discussed as follows.



Fig. 7.1 Levels of MIS

Top level

Top level managers include those individuals who exist at the top of the organizational hierarchy, such as the president, vice-president, chairman, CEO, head of the major department, etc. This level is also known as the strategic planning level because the managers at this level need strategic information for planning and decision-making. Their decisions will have a remarkable effect on the entire organization.

The information at this level is environmental (such as, policies and procedures, plans, online information, budgets, etc.) and must be in summarized form. For example, suppose top-level managers are planning to launch a new product that will bring a drastic change in the industry. The information required for this plan must be related to external environment, such as competitors, sales, cost, quality, trends, etc. For successful change in the industry, all the requirements must be met.

Middle level

Middle level managers include head of division, product director, regional manager, service unit. This level is also known as management control level or tactical level because the managers at this level need tactical information for transforming the

plans made at the top level into actions in order to meet the goals. Thus, middle level managers are responsible for expanding, classifying and operationalizing the goals, schemes and policies of organization. Their main aim is to converge the top and lower levels.

The information at this level is concerned with the current affairs of the organization (that is, no futuristic information required) and is shared within various teams, divisions and units. The information is related to day-to-day activities of the organization (such as, revenue, profit, duration of meeting, business unit specific content, etc.), required by middle level managers, but is not relevant to other organizational members. For example, suppose middle level managers are planning to launch new tools that will cut off the cost of product. The information required for this plan is expenses, schedules, sales, etc.

Lower level

Lower level managers include those individuals who exist at the base of the organizational hierarchy, such as section officers, office managers, superintendents, supervisors, and project leaders. This level is also known as operational level or supervisory level because the managers at this level need operational information in order to implement the actual operations of the organization. Lower level managers are responsible for attaining the plans defined by the upper level managers. That is, day-to-day decisions that keep the company functioning are considered over here.

The information at this level is internal (or personal) to the organization such as daily reports of staff members, spreadsheets and correspondence. Moreover, the information must be in detailed form. For example, suppose lower level managers are required to schedule the employees and to make order for a specific product. For this, the information required is human resource management, stock list, transactions, services, etc. Thus, it must be stated that the three management levels are required for a successful management of information, existing inside and outside the organization.

Check Your Progress

1. Who has classified management levels into top, middle and lower levels?
2. Why is top level also known as the strategic planning level?

7.3 STRATEGIC LEVEL PLANNING

Business strategy is long-term planning of organizations that determine what products (or services) they provide, the market they compete in, their customers and suppliers, their future plans, etc.

Strategies are often discussed and finalized in a process called **strategic planning process**. Almost all the organizations are involved in this process yearly

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or sometimes more frequently. The output of the process is the strategic plan that depicts all the strategies of the organization. The plan is then handed over to the managers of the organization to achieve the planned goals. Note that changes in the surrounding environment affect the organization's goals, and the plan must adapt to these changes. Generally, strategy takes place at the following three different levels.

- **Business:** Business is a set of related products and services. Information systems assist firms in becoming low-cost developers, distinguishing products and services and serving new markets. The strategy at this level is mainly concerned with how to compete efficiently in a particular market.
- **Firm:** A firm is a business organization. Information systems enhance services by combining together the operations of different business units so that they can operate as a whole or can share the knowledge across various business units.
- **Industry:** Several firms that constitute an industrial environment is called an industry; for example, automotive industry, television broadcasting, etc.

7.3.1 Operational Level Planning

Operational plans are the responsibility of lower level management and involve unit supervisors, foremen and so on. These are short range plans covering a time span of about one week to one year. These plans are more specific and they determine how a specific job is to be completed in the best possible way. Most operational plans are divided into functional areas such as production, finance, marketing, personnel and so on. For example, production plans would require an analysis and decisions covering inventory levels of raw materials as well as finished product, flexibility of current production facilities, plans for coping with changing production technology and so on. These plans are relatively stable and are linked with the planning objectives of the middle management and top management.

7.4 ECONOMIC AND BEHAVIOUR THEORIES

Let us now discuss economic and behaviour theories pertaining to organizations.

7.4.1 Economic Theories

Organizational economics entails the employment of economic logic and approaches to comprehend the existence, nature, design, and performance of organizations, especially managed ones. It is primarily concerned with the obstacles to coordination of activities inside and between organizations (firms, alliances, institutions, and market as a whole). It is useful in developing a firm's human resource management policies, determining how an organization should be organized, examining business risk, implementing rewards systems and making, analyzing

and improving management decisions. Applying organizational economics can disclose both the weaknesses of a current management approach and ways to effect change.

7.4.2 Behaviour Theories

The models of organizational behaviour have developed through the historical development of management thought. In India, behaviour models differ from organization to organization and industry to industry. Varying degrees of these models are used even in one organization. For example, the finance department uses supportive models, while the production department concentrates on an autocratic model. There may be different types of organizational models, viz. feudal model, autocratic model, custodial model, supportive model, collegial model, human value model and contingency model.

- **Feudal model:** The feudal model treated employees as inferior elements in an organization. The employees were treated sternly. The hire and fire principle was applicable in the organization. Leniency in work and performance was liable for stern punishment. A fear psychosis was prevalent in the minds of employees. People's desires and values were not considered for management purposes. It was well known as Theory X wherein actions, policies and procedures were considered superior to human beings. The carrot (money) and stick (threat of retrenchment) approach was used for motivation. It concentrated on formal organization and ignored human and social values.
- **Autocratic model:** The autocratic model believes in the power and authority of the manager. Employees have to obey the manager's orders. Only the minimum needs of employees were met. It believes that higher salaries given to employees are wasted as they use them for unproductive purposes. Managers have position and official authority which is used to control employees' activities to get at least the minimum work done by them. Managers are considered superior and their orders are final. Employees are driven to work as this model assumes that nobody wants to work unless he is forced to work. Managers are given the maximum power to hire, fire and dominate all the employees. Managers are considered natural born leaders who are obeyed and respected in all areas. The autocratic model proved to be a successful management practice in developed countries like the U.S.A., England, Canada, etc. Even today, this model is used to manage trouble-ridden organizations. During an organizational crisis, it becomes the only resort of the management. The autocratic model has however proved to be ineffective in many cases because of increasing education and realisation of human values by sociologists and philanthropists. After human rights

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commissions were established in almost all countries, the autocratic model has been reduced to the level of following the rules, regulations and instructions of an organization.

- **Custodial model:** The custodial model as given by the trusteeship model of Mahatma Gandhi has acquired popularity in recent years. Here owners and managers are considered custodians of resources and are bound to look after the welfare of employees to the maximum possible extent. It considers that capital and capacity are not only the monopoly of managers and industrialists, they belong to employees too. Employees are given opportunities to redress their problems, and can bring insecurities, frustrations and other problems to the notice of managers who undertake to solve their problems. Employees are entitled to security and benefits. They depend on the organization for their security and welfare. Trade unions developed the custodial approach depending on economic resources. The organization plans for pensions, adequate wages and bonus for increasing productivity. The employees get fair wages rather than subsistence wages. They depend on the organization rather than on the boss. They will be devoted to the development of the organization because the organization looks after the employee's welfare while in service and also after the retirement. Employees are interested in economic rewards and benefits. They contribute passively because money is the only motivating factor offered to the employees. Direct cooperation is not sought. Employees get satisfaction and security but psychological motivation is not used. Employees' values, preferences and attitudes are not given due consideration for motivation. Money is considered the most effective motivator, although in many cases they are not influenced by money alone. However, the custodial model is a more useful model for the development of an organization.
- **Supportive model:** The supportive model believes in a supportive relationship. An organization develops leadership to ensure the maximum use of resources for achieving organizational goals. The leaders are responsible for the success and failure of an organization because money and power have very little impact on performance as discussed already in the custodial and autocratic model. Employees are considered active workers who have their own desires and preferences. Leaders use the attitudes and values of the employees for motivating them. It is assumed that the employees are not passive by nature, but that they do not get a favourable atmosphere to demonstrate their worth. It is for the leaders to support them and utilise their capacities for a better performance. If the employees are given opportunities, they would develop their capacities. The management has to provide and support the developmental activities of the employees. It is not only the benefits to employees but supportive activities for the development

of employees, which can increase productivity of the organization as a whole. The psychological treatment of the employees, the sense of belonging with the organization and a feeling of participation help in the development of employees. An employee if developed contributes significantly to the growth of the organization. The supportive model does not believe in monetary support but lays emphasis on work support.

It has been observed that the supportive model has developed employees and managers. It is an accepted fact that the supportive approach is essential for organizational behaviour. Many organizations have developed as a result of the supportive model. The supportive model of organizational theory helps in the development of individuals, groups and structure. The supportive model is more effective in developed countries because of the developed attitudes of management and employees. However, the supportive model is not very useful in developing nations because of the restrictive social and cultural environment. Many big houses have successfully adopted the supportive model because of their affordable capacities to develop individuals and groups. Employees get opportunities of status recognition. They have awakened drives and positive attitudes. The managers and the employees participate together in the development of the organization while developing their individual capacities and efficiencies. Job performance is the real job satisfaction.

- **Collegial model:** The basis of the collegial model is the partnership of employees and owners of an organization. The management works with the employees as a team. Employees are given responsible and trustworthy jobs. They are self-disciplined and self-motivated. Team spirit is observed in management. Collegial means a body of persons having the same objective. They have similar activities, work environments and understanding. Managers are co-workers and are not considered to be superiors than the employees. They contribute jointly rather than as leaders or bosses. They have to develop a team with employees and stress upon quality and complete performances. Their combined functions contribute to the success of an organization.
- **Human value model:** Organizations should appreciate the human values of employees rather than economic values. People work in an organization not only for fulfilling their economic needs but devote time there for the purpose of getting satisfaction and fulfilling their social and psychological needs. They have great regard for human dignity. Economic value refers to the economic well-being of people. It is allocative; that is, the economic resources are to be allocated in such a way so as to give maximum physical satisfaction. Human values are incremental, i.e. self-generating and developing. The natural process of behaviour, i.e. stimulus, organism, behaviour and

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consequences, are observed under human values model. It is briefly known as the SOBC model. The organization should provide appropriate stimuli for their change into consequences. The environment of the organization, inter and intra-personal relations, cognitive behaviour, monetary and supportive stimuli are exercised for influencing the organisms of employees. The need of identification, prediction of behaviour and person's cognition are used to influence individual behaviour. The stimuli may be either overt (external) or covert (internal). They may be physical, social, cultural and technological operant. It identifies the best variables causing positive consequences. Organisms influenced by stimuli may be physiological and mental to express overt and covert responses.

- **Contingency model:** The contingency model of organizational behaviour assumes complex variables influencing the behaviour of individuals, groups and structures. Contingent solutions are designed to meet the challenges of growth, conflict, complexities and structural changes. Human attitudes and organizational processes are interviewed through communication, power and goal setting. Theory Z was developed by Abraham Maslow to demonstrate the contingent model. It is also known as the hybrid model wherein long-term employment and promotions are guaranteed. Individual responsibility and non-specialised careers are prevalent. Control systems are less formal. It fosters close cooperation, trusting relationships between managers and employees, and team work. This theory creates a humanistic philosophy and tries to meet multiple employee needs.

Check Your Progress

3. What is business strategy?
4. How is organizational economics useful?

7.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. A management theorist, Robert N. Anthony, had given names to three management levels as top, middle and lower levels.
2. The top level is also known as the strategic planning level because the managers at this level need strategic information for planning and decision-making.
3. Business strategy is long-term planning of organizations that determine what products (or services) they provide, the market they compete in, their customers and suppliers, their future plans, etc.

4. Organizational economics is useful in developing a firm's human resource management policies, determining how an organization should be organized, examining business risk, implementing rewards systems and making, analyzing and improving management decisions.

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7.6 SUMMARY

- With four levels of information resources, MIS has been identified as a pyramidal structure. The information levels would be decided by the organizational structure.
- An organization consists of several managers each of them have different information needs.
- In any organization, three organizational (or managerial) levels have been introduced on which managers exist, and the information is addressed according to their roles.
- Top level managers include those individuals who exist at the top of the organizational hierarchy, such as the president, vice president, chairman, CEO, head of the major department, etc.
- Business strategy is long-term planning of organizations that determine what products (or services) they provide, the market they compete in, their customers and suppliers, their future plans, etc.
- Organizational economics entails the employment of economic logic and approaches to comprehend the existence, nature, design, and performance of organizations, especially managed ones.
- The models of organizational behaviour have developed through the historical development of management thought. In India, behaviour models differ from organization to organization and industry to industry.
- The autocratic model believes in the power and authority of the manager. Employees have to obey the manager's orders. Only the minimum needs of employees were met.
- The supportive model believes in a supportive relationship. An organization develops leadership to ensure the maximum use of resources for achieving organizational goals.
- Organizations should appreciate the human values of employees rather than economic values. People work in an organization not only for fulfilling their economic needs but devote time there for the purpose of getting satisfaction and fulfilling their social and psychological needs.

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7.7 KEY WORDS

- **Human Resource Management:** It is the strategic approach to the effective management of people in a company or organization such that they help their business gain a competitive advantage.
- **Stock List:** It is a publication listing a retailer's stock of goods with current prices.

7.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the three levels at which strategy takes place?
2. Write a short note on operational level of planning.

Long-Answer Questions

1. Explain the three levels of MIS.
2. Describe the significance of different behavioural theories.

7.9 FURTHER READINGS

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UNIT 8 ENTERPRISE RESOURCE PLANNING

Enterprise Resource
Planning

NOTES

Structure

- 8.0 Introduction
- 8.1 Objectives
- 8.2 Basics of ERP: Benefits and Challenges of Enterprise Systems
 - 8.2.1 Advantages of ERP Systems
 - 8.2.2 Implementation of ERPs
 - 8.2.3 Evolution of ERP
- 8.3 Enterprise Systems in Large Organizations
 - 8.3.1 Difference between Custom Built Information Systems and ERP
 - 8.3.2 Developing and Implementing a Custom Built Information System
 - 8.3.3 ERP Implementation Life Cycle
- 8.4 Answers to Check Your Progress Questions
- 8.5 Summary
- 8.6 Key Words
- 8.7 Self Assessment Questions and Exercises
- 8.8 Further Readings

8.0 INTRODUCTION

It was in the 1970s that Material Requirements Planning (MRP) took the centre stage for managing the production and control of the manufacturing industry. MRP evolved from a mere production management system to a system that can be used for personnel and distribution planning. It came to be known as Manufacturing Resource Planning-II (MRP-II). After being introduced, MRP-II functions like human resources, distribution management and accounting were clubbed in one category. This system covered all areas of the enterprise business and thus, it became popular as Enterprise Resource Planning (ERP). The first forms of ERP came into existence in the Gartner Group in 1990. The best period for ERP growth was in the 1990s, as companies started moving from traditional to ERP systems. Nowadays, ERP has evolved into a new generation practice. It allows Web-based access to the data to the employees and people outside the enterprise, irrespective of the time and location. In this unit, we will discuss the basics of ERP, along with its benefits, challenges, and evolution. We will also focus on enterprise systems in large organizations.

8.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the basics of ERP

- Discuss benefits, challenges, and evolution of ERP
- Describe the enterprise systems in large organizations

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8.2 BASICS OF ERP: BENEFITS AND CHALLENGES OF ENTERPRISE SYSTEMS

Enterprise Resource Planning (ERP) is a self-sufficient, closely knit system used for managing different resources within and outside the enterprise (vendors, etc.) in order to improve the overall efficiency of the enterprise. ERP is a computer based system that can be used for finance, HR or material resource management. It has the capability to bring various functions of an enterprise under a single umbrella. It is possible to have the entire ERP system running on a single server or in clusters of multiple servers, connected in a local area network. Using the second approach often simplifies things and provides more stability and robustness to the system.

ERP was developed keeping the manufacturing industry in mind and was limited to a few functions, such as sales, production and finance. But these days more functions are covered by the latest ERP systems since these systems are being adopted by a large number of industries. A sample illustration of an ERP system is displayed in the Figure 8.1.

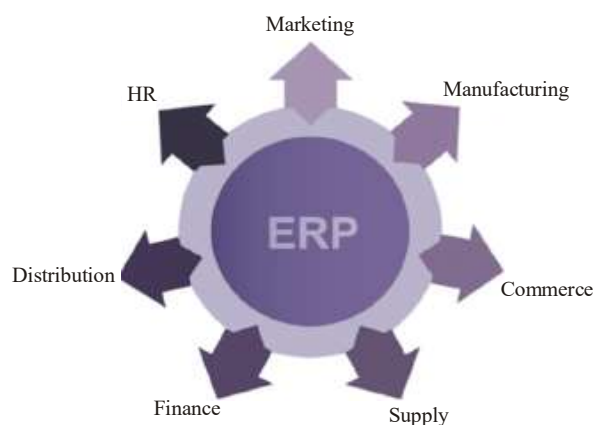


Fig. 8.1 The ERP System

We can think of ERP software as that which automates major business processes, like manufacturing and distribution. Not all ERP system implementations are successful. At times the legacy software would prove to be better as it can be written to suit the specific needs of an organization and it can also be tailored better to suit its needs. So, care should be exercised while going for the implementation of an ERP system within the enterprise.

The first question that arises at this point of time is ‘Why are the companies willing to change their legacy business systems for ERP?’ ERP has been in demand in recent times and the reasons for the continuous growth of the ERP market are:

- Better performance by businesses: The time for a complete cycle reduces, the business becomes more agile and orders can be taken care of faster.
- Facilitation in the growth of business: The same ERP system can support multiple languages, currencies, new products and new customers.
- It helps improve the overall response time in an organization and hence facilitates faster decision-making.
- It is more efficient than the legacy systems as it solves various issues such as scalability, data loss prevention and faster data processing.

ERP vendors have commendable bank accounts owing to the popularity of the ERP systems. Gradually, the focus is moving towards ERP implementations in smaller and medium enterprises as well. There are a number of players in the arena competing to get a larger share of the profits. As the competition increases, the customers get better prices and services.

8.2.1 Advantages of ERP Systems

ERP systems have manifold advantages. They enhance the efficiency of an organization, help in the decision-making processes and speed up the response time. In addition to these, there is an increase in the number of satisfied and repeated customers. We discuss more about the most visible benefits of using ERP systems:

- **Integration of business processes:** Earlier, various business units in an organization had their own information systems. Exchange of information amongst them was not only tough but a challenging task as well. In large organizations, exchange of data amongst the various departments is more frequent. The ERP system plays a key role here, as after implementation of this system, data updated for a single transaction at one location, simultaneously gets updated at multiple locations. This helps in the integration of various business processes across the organization.
- **Flexibility:** A single ERP system is able to cope with different languages and currency values across the globe, for a company. Hence ERP systems help in creating a truly global environment for organizations. This flexibility of the system helps in management of the organization in a better manner and it also aids the maintenance and development of systems across the organization.
- **Better insight:** ERP systems help organizations to plan better. They can provide a runtime data analysis on the basis of various parameters defined in the system. They help the management by providing a better insight and the ability to take decisions in a shorter span of time.
- **Technological advancements:** ERP systems grow better day by day with advancements in the software used to run them. The technological advancements are always advantageous to ERP vendors and help make the systems more adaptable and flexible for further development and a better user experience.

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- **Lower turnaround times:** A successful ERP implementation helps in reduction of time in receiving and the completion of the order (this time is also known as lead time). Using ERP systems the demand can be anticipated well in advance and the production managers can be ready with the materials needed to meet the demand. The shortage of materials can also be estimated well in advance and they can be ordered before they are actually exhausted, in order to meet the targets on time. In today's world, the number of raw materials needed by an organization is huge and maintaining the inventory for such a large number of materials manually is practically impossible. This is where ERP implementation comes to the rescue of the management.
- **On-time shipment:** In today's changing times, customers have become more demanding and manufacturers have to be a step ahead to remain in competition, by enabling themselves to be able to fulfill the needs of the customers in a better and more efficient time frame. Using technology, ERP systems help to simulate different production scenarios and we can select the best one out of all available production methods. This helps to be able to ship the finished product at the earliest.
- **Better utilization of resources:** ERP systems can provide good estimates of the amount and quantities of materials required for manufacturing a product. This helps in reducing the wastage of raw materials and hence helps in better utilization of resources. Various modules of an ERP system (manufacturing, material management, maintenance, sales and distribution, etc.) work together to ensure that the wastage of raw materials is minimal and the machine down time is low.
- **Better customer satisfaction:** The increased efficiency of the organization in production and shipping times, using the ERP system, helps the organization in increasing customer satisfaction. The customers are better satisfied when the products delivered to them contain the features they had requested for. The company's response should be timely and satisfactory and the final product delivered should be usable and free from defects. If there is a Web based ERP system, customers can actually place, track and check status of their order in the comfort of their homes. Since the ERP systems consolidate all resources at a single place, resolving customer-care queries becomes easier for the support departments.
- **More accurate information and better decision-making:** Information management has become very important in an organization's lifecycle to be able to compete in the current scenario. ERP systems enable an organization to manage huge amount of data, extract relevant information from it and collate the necessary information to be presented to the user. The availability of information in a timely and prompt manner helps in making better decisions. ERP systems provide great integration of various systems and help in better collation of information from different sources to enable the

employee or the management to take better decisions. Before ERP came into existence, all departments used to function independently in an organization. Now, with ERP in place, the production department can enter their requirement, which when seen by the procurement department, enables them to procure materials earlier. The entry of the procurement department enables the finance department to manage finances accordingly, for that month.

Using ERP systems over conventional systems has its own advantages. Firstly, ERP systems are not restricted to a single business function, rather, they span to multiple departments across the organization. Secondly, they are flexible enough to be used by small or large enterprises. And thirdly, the support for multiple languages and currencies makes ERP more viable for the organizations.

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8.2.2 Implementation of ERPs

Before jumping into the ERP bandwagon there are a number of factors that an organization has to look out for. There should be some well set deadlines and schedules to be adhered to for successful ERP implementations. Making wrong estimates should be avoided. It should always be kept in mind that an implementation of this scale is very different in comparison to an in-house development of some information system. There are huge costs involved in consulting and customizing the system to suit the needs of the organization. After implementations, a training needs to be imparted on how to use the systems. The training and education process is itself quite expensive, as experts of the field need to be called in-house to impart such trainings.

To avoid such problems, a thorough analysis of the company's requirements and that of the package's offerings should be done. Instead of making such critical estimates, experts of the field should be consulted and their advice be solicited before going ahead with the decision to implement ERP systems. The primary objectives behind the ERP implementation should be well defined and clear to the management.

8.2.3 Evolution of ERP

The emergence of this type of system started with the material resource planning which was later broad based to MRP II concept. The concept of MRP and MRP II was linked with the idea of 'Just in Time', a Japanese concept, very effective in reducing inventory. The just in time production systems worked in a way such that the materials required for producing the product would be made available to the firm only at the time of its requirement. It would not be dispatched from the vendor's plant earlier than its actual requirement in contrary to the materials lying there in the organization as inventory, as was the custom; rather it would be delivered in a way that it reaches the organization just in time for the production. Not early, not late, but the materials would arrive just in time for the production to take place. This

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was difficult to achieve, but the Japanese companies showed that it could be done by following strategies:

- **Vendor development:** The Japanese firms would create their own network of vendors who would supply the components (raw materials), going into the production of a product at a precise time agreed upon through joint production scheduling. They would nurture these vendors and assure them of a quantum of order so that the vendors remain interested in the firm. However, the only criterion for the vendors to continue to receive this kind of patronage would be the conditions of zero defects and supplying the components just in time to the firm for production.
- **Clustering:** The firm that wanted to follow the just in time policy of production creates a cluster approach to industrial production. There would be a 'mother' plant by the main firm and this 'mother' plant would be surrounded by smaller plants of the vendors who wanted to go for just in time. Thus, the vendor plants would be setup next to the mother plant so that there was no delay by the vendor in transporting the components to the mother plant. Hence, the schedules set by the main firm could be perfectly synchronized with the production schedules of the vendors and since there is practically no delay in the transportation, as transportation is only between two factories that are situated next to each other.
- **Joint production scheduling:** The firm and its vendors actually embark on a joint production schedule, with the vendors producing a little more than the consumption of the mother plant so accounting for any inadvertent delay in the vendor production process. This way, the mother plant will get the components as per schedule just in time for its production.
- **Multiple Vendors:** Another strategy adopted in such systems is to develop multiple vendors for the same component, so that if one vendor has a problem delivering the component in time, another vendor may chip in and deliver the component so that the mother plant production schedule is not disturbed.

MRP, MRP II and ERP

All the above strategies ensure that components are on time and only on time, neither late nor early. This way the firm saves the money that normally is held up in acquiring inventory. This additional saving results in better efficiency for the firm. This however, is not possible without the support of a dedicated information system, which would not only provide information about the mother plants production schedule but also will automatically synchronize the production schedules of vendors and monitor them for any shortfalls in the actual production process. If any changes are noted in the vendors production process, the system will trigger an alert and based upon predetermined rules will source additional components (the short fall due to problems in the production process at the vendor's plant), from another vendor. A high degree of planning and monitoring on a minute-to-minute basis is required for such MRP systems to be successful.

Manufacturing management systems have evolved in stages over the past 30 years from a simple means of calculating materials requirements to the automation of an entire enterprise. In the 1970s Material Requirement Planning (MRP) was developed as a mechanism for manufacturing companies to calculate more precisely what materials they required, at what time and in optimum quantities.

Manufacturing Resource Planning (MRP II) evolved from MRP, because many companies realised that as well as the need to calculate their material requirements precisely, they also required detailed capacity planning, scheduling, shop floor control and other calculations. MRP II introduced the closed-loop model, which uses a centrally held data file to record, monitor and report on various company activities. By comparing forecasts with actual data, companies can analyse performance and improve processes to achieve better efficiency. Caliach MRP is Caliach's established MRP II system for managing core manufacturing activities.

To illustrate the MRP and MRP II concept, let us assume that a firm making motor bikes decides to apply this modern technique of just in time. The firm decides correctly that in order to implement a just in time system of manufacturing, it must have a MRP II system to integrate the mother plant with its vendor daughter plant and also to take up the tasks of planning and monitoring in an integrated manner. Let us assume that the mother plant is an assembly plant only and all components are sourced from vendors that have set their plants adjacent to the mother plant. Now the production planning of the mother plant will be determined by the market demand. Let us assume that the market demand is such that there is scope to build 240 bikes per day. Now if we assume a three-shift operation, this translates into ten bikes per hour. Hence, every hour the mother plant would need ten headlights, ten engines, ten seats, twenty brakes, twenty wheels, twenty tires, ten oil tanks, etc., from the vendors, as these component go into the production of a bike. Now the concept of just in time means that the mother plant has no inventory. Therefore, it does not have any warehouses to stock these hourly needs for components. Now as per the concept of just in time, these components reach the mother factory as per requirement of the mother plant as per predetermined requirement. This means that if an hourly schedule of delivery is agreed to by all parties, then the vendors would supply the required number of components to the mother plant on an hourly basis. This means, that the vendor who supplies the headlights will supply ten headlights per hour to the mother plant. In turn, it will tune its production process in such a way the it produces no more than ten, head lights per hour and likewise for other vendors. This ensures that the inventory of the firm becomes zero and all the financial resources locked up in maintaining inventory get unlocked resulting in better performance of the company.

The information system that enables this process and helps the management to ensure that the production process is unhindered even when there is no inventory is called a MRP or MRP II system. The primary characteristics of such systems are:

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- **Centralized production and materials data management:** This ensures that there is only one version of the truth. Inconsistency is avoided and concurrency control is maintained.
- **Networking with vendor systems:** This ensures that some control is exercised on the vendor process and if some changes are noticed in that process, indicating deviation from the laid down schedule then corrective action follows.
- **Integrated module for materials and production planning:** In MRP II, which is an improvement on the earlier MRP system, production process and material requirements are planned in an integrated manner. This ensures that there is no information loss in the planning of these activities.
- **Integrated module for production and material scheduling:** This module is required to create production schedules and material requirement schedules.

Thus, we can see that these systems are specialized systems, which contribute to the lowering of expenditures of a firm. Enterprise resource planning systems are an improvement over these kinds of MRP and MRP II systems. They have taken this concept of management of resource (material resources in MRPII systems) and applied it to all the functions of management. Thus, an enterprise resource planning system, if applied to the entire organization has several modules like:

- Sales and Marketing
- Production and Operations
- Finance
- Human Resource
- Quality

Each module focuses on the efficient management of the resource at its disposal. However, even though the enterprise resource planning systems might have several distinct modules, some fundamental parameters remain the same, which are:

- **Centralized data management:** This is required for version control. Data gets generated and updated in the enterprise in multiple locations but if these updates are not reflected across all the different functional modules then the entire rationale for the adoption of the system gets violated. Hence, this is a very important feature.
- **Customization of business processes:** ERP implementation is different from developing and implementing customized system solutions. In such customized solutions, the systems are built around the business process. In ERP, the process of doing business is also tailored to fit into the ERP mould. This is done to accommodate the best practices that come with the ERP package. An ERP package is bought off the shelf (that includes the software and the best practices on that industry in which that ERP system is to be

implemented), then customized for the use of a firm. This is precisely the reason behind the huge cost of implementing ERP.

- **Clear rules of access:** In ERP systems, information is supplied on a need to know basis. The need for a person to know certain facts is determined by the access username and password that the user uses to log into the system. Thus, roles are set for each type of user and access is limited based on such roles.
- **Audit trail:** This is a log of all transactions and it is maintained for future use. This helps in identifying rogue transactions and helps in tracking unauthorized access.
- **Data integrity:** Data is considered sacrosanct in such systems and replication / duplication of data is not allowed. In fact, specific rules of data entry and data updating are allowed. Data deletion and updating access is granted to only senior people and a transaction log of all such deletions, updating is maintained.

As one can see, the ERP system is a comprehensive system and is the most modern MIS system being used in organizations. In classification terms, an ERP system is considered a transaction processing system as it maintains a record of all transactions between the organization and its internal and external customers. Several ERP software are available in the market, like SAP, Navision, and Baan, etc., of which SAP is the most popular.

ERP successes and benefits

An American academic and author, Thomas H. Davenport (1998), has discussed the successes and failures of organizations that implemented ERP systems and has shown that firms need to fully understand the inherent organizational needs which the new ERP system must service and hence carefully choose and implement an ERP system that would benefit the firm by enabling it to meet its own typical needs rather than implementing an ERP system to imitate the competition. Benefits from ERP use range from increasing productivity by enabling greater cooperation among organizational entities by linking them seamlessly, providing organizational design and process improvement through reengineering, operational improvements through faster and better decision-making throughout the organization, to supporting strategic goals of the organization.

Check Your Progress

1. What do you understand by the term ERP?
2. Mention any two reasons for the continuous growth of ERP.
3. When was MRP developed?
4. List the modules of ERP system, if applied to the whole organization.

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8.3 ENTERPRISE SYSTEMS IN LARGE ORGANIZATIONS

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Enterprise Resource Planning (ERP) developed MRPII even further to embrace all business functions, not just those concerned with actual manufacturing. ERP encompasses materials planning, efficient production, profitability and customer satisfaction - almost every aspect of business.

ERP also incorporates the principles of global supply chain management, in which the value of every activity in the supply chain is analyzed, along with the growing development of the Internet or Web-enabled procurement.

ERP system is responsible for real time integration of management information by controlling the flow of information across an entire organization. Typically, its implementation involves an enterprise-wide database and a collection of application modules to support day to day business operations and management processes. Commonly known application modules include finance, accounting, logistics, sales, marketing, project planning, manufacturing, human resource, Customer Relationship Management (CRM), Supplier Relationship Management (SRM) and more.

8.3.1 Difference between Custom Built Information Systems and ERP

Custom built information systems replicate the entire manual process into a computerized environment without tinkering with the business processes of the organization. However, when an organization is buying a ERP system, the organization is not only buying a set of lines of code but also the best practices of business organization in that particular industry and hence, the organization that is buying the ERP system may have to go through a process of business process reengineering to suit its existing processes to the ERP system and not vice versa. This is an area of significant difference between a custom built system and an ERP system.

8.3.2 Developing and Implementing a Custom Built Information System

Normally, custom built IS (Information System) development conform to a stage-wise development approach, with planning of the system being the first activity followed by analysis and design, which in turn is followed by coding, testing and implementation. Each of the activities given above for development of MIS is a difficult and intellectually stimulating set of tasks requiring technical and managerial skills. In some of the activities, the users are actively involved in arriving at the design of the system. Normally, the system analyst and his team will be responsible for the majority of the stages of the management information system development. This is required, as the development process requires knowledge of both management and technology that most line manager's lack. Planning for MIS is probably the most important task in the entire development process. It is the activity, which if done wrongly may lead to huge cost and time overruns in the

development process. The planning process involves amongst other things, the aligning of objectives of an organization with the objectives of the custom built IS. This activity requires strategic management orientation and a macro view of the needs and growth aspirations of the organization among other skills, as the system will have to be relevant to the organization in the near future. If the organization outgrows the custom IS then the custom built IS will have to be redeveloped. This being costly (not only in terms of the actual cost of development of the system but also in terms of the missed opportunities and cost of inefficiency of the organization), in both time and financial dimensions, is to be avoided. The process of development of a custom built information system in an organization may vary from case to case but ideally, the stages of development can be clearly demarcated. The process of development of information system involves the following stages:

- **Planning:** Planning is required as without planning the outcome will be below expectations. Planning sets the objectives of the system in clear and unambiguous terms so that the developer may conform to a well laid set of deliverables rather than a high-sounding statement that may mean little to him. Planning also enables the development process to be structured so that logical methodology is used rather than working in fits and starts. It ensures user participation and helps in greater acceptability and a better outcome from the development process. It leads to a system that is well balanced in both the managerial and technical aspects.
- **Analysis:** It is an activity of technical representation of a system. Over the years many methods have been developed of which the structured analysis and object oriented analysis are most widely used. This step or activity is the first technical representation in abstract terms of the system.
- **Design:** It is the stage where the model or representation of an entity or a system is done (in detail). The idea is that based on this design the developer will be able to develop a working system conforming to all the specifications of the design document thereby satisfying the user. It is a concept, which has been borrowed from other branches in engineering where the blueprint of a system or entity to be built later is first created on a piece of paper or digitally, to help developers in conceptualization of the system and to understand the specifications of the system.
- **Coding:** It is the actual stage of writing codes to develop the application software according to the specifications as set by the design document. The programming done at this stage to build the system is dictated by the needs of the design specifications. The programmer cannot go beyond the design.
- **Testing:** It is the testing of the system to check if the application is as per the set specification and to check whether the system will be able to function under actual load of data. The testing is also done to remove any bugs or errors in the code.
- **Implementation:** It is the stage when the system is deployed in the organization. This is a process, often a difficult one as it involves some customization of the code to fit context specific information in the system.

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8.3.3 ERP Implementation Life Cycle

ERP system implementation does not involve any full scale development of software after analysis and design, keeping in view the requirements of the client organization. It does not involve any software development, rather ERP systems are bought off the shelf depending on the analysis of the need of the client organization and then the ERP system is customized as per the unique needs of the client organization.

However, for implementation of the ERP system the following steps are to be followed:

- **Strategic Planning:** It is used to clearly understand the strategic objectives to be served by the ERP system. In this stage the strategic planning for the ERP system is done. This strategic plan is integrated with the business strategy of the organization to get better value from system. In the strategic planning stage, the following issues are dealt with:
 - What strategic value will the information system deliver?
 - What will be its strategic role?
 - What business objectives are to be fulfilled by such information systems?
 - What will the information system achieve to enable the organization to compete better in the market?

The strategic planning is done by the top management and communicated downwards.

- **Review of procedures:** In this stage an assessment is made of the information requirement and process readiness for fulfilling the objectives of the strategic plan.
- **Pre-Evaluation screening:** When the organization has decided to implement an ERP system, a search for a suitable package that will serve the organization are needed and it should be within the expenditure budget of the organization.
- **Selection of ERP software and implementing agency:** In this phase an ERP package is selected for implementation in the organization. The selection process involves a thorough evaluation of many suitable ERP software packages and then selecting the best package that suits the maximum needs of the organization. It is normally done through a process of evaluation of the potential ERP systems and through a selection committee so that individual bias does not come in the way of selecting the best system for the organization. Evaluation is done on the basis of a selection criteria decided upon by the selection committee. Some important points for evaluating ERP software include:
 - Functional fit with the company's business process.
 - Degree of integration.
 - Acquisition Cost.

- Flexibility and scalability.
 - User friendliness.
 - Implementation complexity.
 - Operating Cost.
 - Reputation and experience of the implementation agency.
 - Analysis of installation of ERP in competitors.
 - Networking facilities.
 - Effective outputs.
 - Sustainability.
- **Project implementation planning phase:** It is the series of action-oriented steps planned for making smooth implementation. It normally involves the following steps:
 - Creating a master schedule of the implementation activities.
 - Setting timelines for critical and non critical activities.
 - Identifying major bottlenecks and their solutions.
 - Communication of the plan.

These steps are required to help the user community and implementers to understand the time frame for installation of the new system. Communication plays a vital role in the implementation and without proper communication especially from the top management on the installation and implementation of the ERP system the change management will be difficult. Resistance to change related issues will come to the fore making the difficult task of implementation even more difficult. Communication of the plan of implementation to the user community helps the users to prepare for the change and makes them mentally prepared for it. The communication is required to be formal so that rumours cannot be spread about the system. The communication process may itself be in several phases. The top level management can communicate the general intent of the new system and then detailed briefings to staff may be left to the division heads. The communication process also indicates (indirectly) the role that each employee is required to play in the implementation process. The resources to be used for the implementation are decided upon and a schedule is prepared for it and the key people who will lead the implementation are identified and briefed. Planning for contingencies and metrics for monitoring the progress of the implementation is also decided at this stage. A project planning committee is usually constituted for conducting this exercise, which consists of the team leaders responsible for the implementation group and is headed by the CIO.

- **Gap-Analysis:** In this phase of the implementation process the organization creates a model of where they want to be after the ERP implementation with respect to their present.

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- **Business process re-engineering and process improvement:** Sometimes in order to develop a good information system that will serve the purpose of management even in the future, it becomes very essential to have a re look at the way business processes are conducted in a firm. The rationale for this is that the manner in which business is conducted changes with time and an information system that is designed over such dated business processes would not provide any worthwhile value to managers. Business organizations are a continuing entity, but the products or services that they offer change with time. Even the manner in which it conducts business changes with time. New ways of doing business emerge over time. New markets emerges. New products and services emerges. New geographies emerges. New technologies emerges. All these changes the organization fundamentally. If however, the organization continues to engage with its customers (internal as well as external), in the same way as it had been doing in the past then it risks losing business and efficiency. It has to change its process to remain competitive. However, organizations cannot change individual processes on an ad hoc basis and they cannot change the processes in isolation. Concerted efforts are required and a complete scientific exercise is required to change processes of doing business and to ensure, at the same time, that the business does not suffer from this changed effort. This scientific exercise of overhauling the process of doing business is called Business Process Reengineering (BPR). For example, we are all aware of the process of drawing money from banks. In earlier times, if we needed money, we had to deposit a signed cheque at the bank counter, the counter clerk would give a token, then after some time he would announce the token number, when one would get the cash. The time spent in between is used by some other clerks who physically check whether the signature on the cheque is that what is recorded against your account. If they get a perfect match, the counter calls the token number and you get your cash. Now, this process of checking of the signature on the cheque and comparing it against the officially recorded version to find out whether it is one and the same can be easily done if an information system is made available to the counter clerk. If the system is so designed that the clerk can himself check the authenticity of the signature by comparing it against the digital picture of the official signature of the account holder on a computer screen in front of him, then this process can becomes easy. The clerk can just take the cheque from the customer, check the authenticity of the signature on the system and if found correct can deliver the cash to the customer. We can see here that the process of cash delivery has been re engineered with the introduction of technology. This change or improvement in the actual business process by the introduction of technology is called re engineering and the process by which this is done is called BPR. Sometimes BPR is resorted to even when there is no immediate trigger for change in the business process. Most BPR exercises are conducted when a system is being designed for the business. Sometimes, in order to develop a good information system, which will serve

the purpose of management even in the future, it becomes very essential to have a re look at the way business processes are conducted in a firm. The rationale for this is that the manner in which business is conducted changes with time and the information system designed over such dated business processes would not provide any worthwhile value to managers.

The principles around which BPR activities are performed are:

- **Focus on outcomes:** In BPR, the focus should be on the outcomes rather than activities or functions. A broader view of the process is required.
- **Keep users of process outputs/outcomes in the BPR team:** This will ensure that real-life issues are taken care of.
- **Link parallel activities:** Treat parallel activities by linking them instead of integrating them to get the full measure of the processing rather than having a simplistic view.
- **Capture data once:** This is very important as in most cases duplication of data capture happens. This can be avoided by capturing data at the source.
- **Eliminate geographical segregation:** This is another important concept. This means that a process may be physically distributed in different geographies but in cyberspace, this has little meaning. We must, therefore, create a virtual space incorporating this geographical diversity and then conduct BPR. This will help reduce a lot of complexity.
- **Process improvement:** It is the activity of critically examining a process with the objective of making it more efficient. This may sometimes be part of the BPR activity or may even be a standalone activity for ERP implementation. In most cases, it involves the shortening of the process, reduction of people handling the process, intervention of technology, changing the manner of doing tasks within the process, reduction of cycle time of tasks in the process and reduction in the cost of conducting the process. This is achieved by first examining the process and passing through it. Then a process map is created and bottlenecks and redundancies are identified. These areas are then worked upon to make the process more efficient. This helps the organization in getting the maximum value from installing ERP system as its process becomes optimized for peak performance.
- **Implementation team training:** The implementation team has also got to be trained in the processes of the organization so that they have a good understanding of the processes of the organization. Without the training the team would configure the ERP system wrongly, which would lead to major losses for the organization.

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- **ERP configuration:** This is the main part of the ERP implementation in which the software package is configured for use. The main focus here is to synchronize existing business processes to the ERP rather than tweak with the ERP source code to customize it to the organizations requirement. However, in some cases the customization may also have to be done to make the system useful for the organization. This task is easily performed if the BPR exercise has been done thoroughly and all process maps are available and processes have been optimized for efficient functioning.
- **Testing:** In this stage the system is tested for proper functioning. First level of testing is done with dummy data and then with real data of previous years. Once the performance is as expected, the system is then declared to be ready to go live. In this phase the ERP system is fine-tuned by measuring the performance of the system with the expected performance. Some of the testing performed are:
 - **Unit testing:** In this testing small incremental functionality in a business process is tested.
 - **Integration testing:** in this testing end-to-end testing of all processes, and this testing customizations are conducted.
 - **Security testing:** In this testing all the user roles and authorizations are tested to check for access and functionality.
 - **Performance load testing:** In this testing which the software is loaded with data and simulated to work at peak performance to measure the impact of data load on performance of the system.
- **End user training:** In this phase the end users are trained so that they can work with the ERP system without any problems. This is very important as the end users may have been used to working in a certain mode which will now change and hence, the new mode of working has to be adopted by the end users. This is a crucial activity as in many organizations ERP implementation is followed by restructuring and downsizing so many end users may not take to the new system with enthusiasm. The training in the new ERP system will make them empowered users and will help the organization in smooth transition to the new system.
- **Going live:** In this phase the system goes online and deals with regular organization data. In most cases the earlier system is also allowed to function simultaneously so that the transition to the new system is not abrupt. The system is expected to perform as per expectation and then after a period of time the old system will be withdrawn.
- **Post-Implementation (Maintenance mode):** The organization must have their own IT department trained in basic ERP maintenance and must also have a maintenance contracts with an agency that has the necessary skills to maintain ERP systems.

Check Your Progress

5. What is the difference between ERP implementation and implementing customized system solutions?
6. Why is strategic plan necessary in implementation of an ERP system?
7. What is unit testing?

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8.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Enterprise Resource Planning (ERP) is a self-sufficient, closely knit system used for managing different resources within and outside the enterprise (vendors, etc.) in order to improve the overall efficiency of the enterprise. ERP is a computer based system that can be used for finance, HR or material resource management.
2. ERP has been in demand in recent times and the reasons for the continuous growth of the ERP market are:
 - (a) It helps improve the overall response time in an organization and hence facilitates faster decision-making.
 - (b) It is more efficient than the legacy systems as it solves various issues such as scalability, data loss prevention and faster data processing.
3. Material Requirement Planning (MRP) was developed in the 1970s.
4. An enterprise resource planning system, if applied to the entire organization has several modules like:
 - (a) Sales and Marketing
 - (b) Production and Operations
 - (c) Finance
 - (d) Human Resource
 - (e) Quality
5. ERP implementation is different from developing and implementing customized system solutions. In such customized solutions, the systems are built around the business process. In ERP, the process of doing business is also tailored to fit into the ERP mould. This is done to accommodate the best practices that come with the ERP package.
6. Strategic plan is necessary to clearly understand the strategic objectives to be served by the ERP system.
7. Unit testing is a process in which small incremental functionality in a business process is tested.

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8.5 SUMMARY

- Enterprise Resource Planning (ERP) is a self-sufficient, closely knit system used for managing different resources within and outside the enterprise (vendors, etc.) in order to improve the overall efficiency of the enterprise.
- ERP is a computer based system that can be used for finance, HR or material resource management. It has the capability to bring various functions of an enterprise under a single umbrella.
- ERP was developed keeping the manufacturing industry in mind and was limited to a few functions such as sales, production and finance.
- ERP vendors have commendable bank accounts owing to the popularity of the ERP systems. Gradually, the focus is moving towards ERP implementations in smaller and medium enterprises as well.
- A successful ERP implementation helps in reduction of time in receiving and the completion of the order (this time is also known as lead time).
- ERP systems can provide good estimates of the amount and quantities of materials required for manufacturing a product. This helps in reducing the wastage of raw materials and hence helps in better utilization of resources.
- ERP systems enable an organization to manage huge amount of data, extract relevant information from it and collate the necessary information to be presented to the user. The availability of information in a timely and prompt manner helps in making better decisions.
- The concept of MRP and MRP II was linked with the idea of 'Just in Time', a Japanese concept, very effective in reducing inventory.
- In the 1970s Material Requirement Planning (MRP) was developed as a mechanism for manufacturing companies to calculate more precisely what materials they required, at what time and in optimum quantities.
- MRPII introduced the closed-loop model, which uses a centrally held data file to record, monitor and report on various company activities. By comparing forecasts with actual data, companies can analyse performance and improve processes to achieve better efficiency.
- Enterprise Resource Planning (ERP) developed MRPII even further to embrace all business functions, not just those concerned with actual manufacturing.
- Normally, custom built IS (Information System) development conform to a stage-wise development approach, with planning of the system being the first activity followed by analysis and design, which in turn is followed by

coding, testing and implementation.

- ERP system implementation does not involve any full scale development of software after analysis and design, keeping in view the requirements of the client organization.
- ERP system does not involve any software development, rather ERP systems are bought off the shelf depending on the analysis of the need of the client organization and then the ERP system is customized as per the unique needs of the client organization.

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8.6 KEY WORDS

- **Customization:** It is done when there is a unique need in any process of an organization that cannot be met by configuring the ERP system.
- **Configuration:** It is one of the major tasks in the implementation of ERP system in which the setting of the ERP system are adjusted to suit the organization.

8.7 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What factors need to be considered while implementing ERP?
2. Briefly explain the strategies followed by Japanese company to achieve their 'Just in Time' approach.
3. Write a short note on implementing a custom built information system.

Long-Answer Questions

1. Discuss the benefits of ERP in detail.
2. Describe the relationship between MRP, MRP II and ERP.
3. Explain the steps followed in the implementation of the ERP system.

8.8 FURTHER READINGS

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BLOCK III
E-ENTERPRISE-TRENDS IN MIS

E-Enterprise System

UNIT 9 E-ENTERPRISE SYSTEM

NOTES

Structure

- 9.0 Introduction
- 9.1 Objectives
- 9.2 Managing the E-Enterprise
- 9.3 Organization of Business in an E-Enterprise
- 9.4 E-Business and E-Commerce
 - 9.4.1 E-Commerce Practices
 - 9.4.2 Administration, Business and Consumer Models of E-Commerce
 - 9.4.3 Business-to-Business (B2B) Models
 - 9.4.4 Consumer-to-Consumer Model
 - 9.4.5 Peer-to-Peer Model
- 9.5 E-Communication
 - 9.5.1 E-Collaboration
- 9.6 Answers to Check Your Progress Questions
- 9.7 Summary
- 9.8 Key Words
- 9.9 Self Assessment Questions and Exercises
- 9.10 Further Readings

9.0 INTRODUCTION

Information technology has played a huge role in the operation of the firms and the way they brand and market their products. Changes in the organization has precipitated the need for new methods to improve the work flow and improve business processes. With the rise of e-commerce, we can also see an emergence of global economy. As such, every organization needs to think globally in order to survive in the tough business environment. Information technology has also paved the way for increased communication. There has been an increase in the demand of information on an anytime-anywhere basis. It has further facilitated electronic collaboration among different individuals. This unit will discuss the role of information technology in e-enterprise. The importance of e-commerce and e-communications will also be explained.

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9.1 OBJECTIVES

After going through this unit, you will be able to:

- Understand the importance of information technology in a firm
 - Explain the concept of e-commerce and e-business
 - Examine the consumer models of e-commerce
 - Discuss the concept of e-communication and e-collaboration
-

9.2 MANAGING THE E-ENTERPRISE

In this section we will discuss what a digital firm is, the various aspects of information systems and the factors that decide the organizational need for an information system(s).

What is a Digital Firm?

Traditionally, firms have been relying on human to human interaction for most of its activities. The Information Technology revolution introduced widespread changes in how firms operate, brand themselves, and market their products. National boundaries and the time constraints of an eight-hour work day are no longer relevant as firms opt for digitizing their activities on a global scale so employees can work wherever they are located, at a time that suits them best. This has increased productivity manifold. Clients and customers are also global, with majority of the transactions carried out over the Internet.

Competitive Business Environment

In the last 40 years, the following four changes have altered the business environment:

1. Information technology has been instrumental in making local economies into a global one. An organization may have virtual teams working on a project and the team, suppliers and customers may be located across different political and geographical boundaries. A manufacturing organization imports raw material or semi-finished products from vendors who give the best price and the required quality. IT helps in locating resources and their price, checking quality and tracking imports. US companies provide 24x7 support to their customers through their customer support offices located in India. Manufacturing organizations set up their manufacturing plant where market and trained manpower is available and the political environment is conducive. They manage their remote setups through IT. Organizations that are able to think globally are the only ones likely to survive in this era of a global economy.

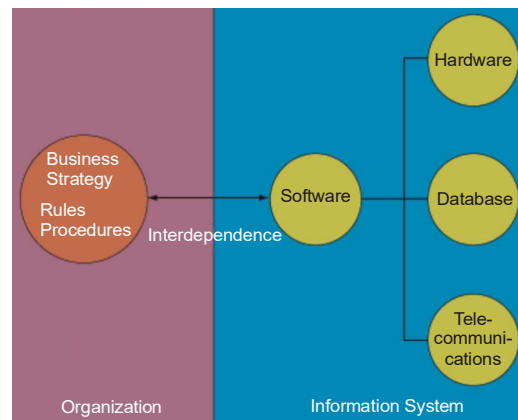


Fig. 9.1 The Interdependence between Organizations and Information Systems

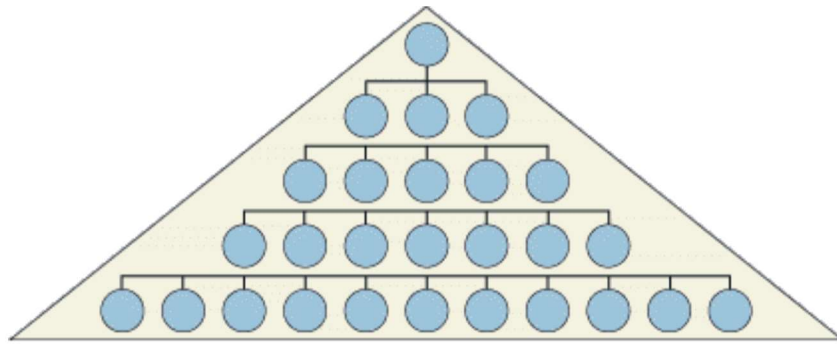
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2. Manufacturing is no more the dominating component of the economy. Knowledge- and information-based services constitute a major part of the economy. Companies are introducing new services and products to meet the requirements of the information economy. The lead time to introduce a new product or service has shortened and competition has increased. One of the reasons for increased competition is that the service industry requires less time and capital to be set up. India has been able to do better in the IT sector for this very reason. The product life has also become shorter.

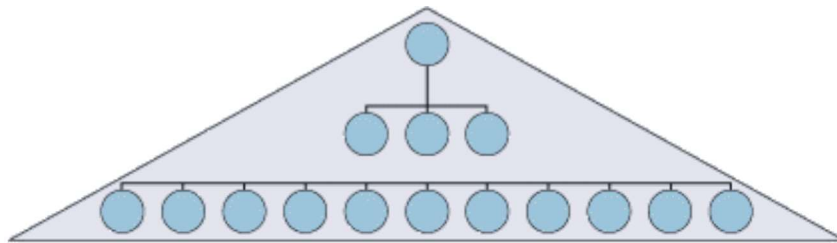
Earlier, the main activity of manufacturing organizations was mass production. Today, vendor management, sales and marketing and customer management have become important activities. Many services have become popular and IT has played an important and crucial role in this. One can look around and find that a large number of people are employed by the service industry such as insurance, banking and education. IT plays a very critical role in providing services. Earlier, one had to remember when one's car insurance expired or when the car needed to be serviced. But now insurance and car service companies keep track of their customers and issue them reminders using IT tools.

3. IT has transformed organizations in multiple ways. Organizations now have fewer hierarchical levels than before. Earlier, an organization relied on fixed procedures that were often people-centric. The top management communicated the targets to the next level of management who then translated them into operational plans. Their operational plans reached the operational staff in terms of production schedules. The operational staff did not understand the importance of their work in the organization's overall objectives. A close supervision at each level was required because the operational staff played no role in decision-making and had very narrow job profiles.

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A Traditional Hierarchical Organization with many Levels of Management



A Modern-day Organization with Fewer Layers of Management

Fig. 9.2 Comparison of a Traditional Hierarchical Organization with a Modern day Digitalized Organization

The scenario has subsequently changed. The job profiles at each level have become broader. Everyone is expected to make use of IT to access the information related to his job and understand his role, monitor his own progress and ensure quality in his work. Each employee knows his targets and makes a plan to achieve his goals. This is in contrast to earlier times when a plan was communicated to workers to simply execute. Any deviation in the plan required intervention of the management. Now the goals are known and employees are expected to adjust their plans to achieve their goals with minimum supervision. IT facilitates dissemination of information in a controlled manner.

4. IT has become an integral part of companies; it was introduced to the non-academic world in the 1960s in the US where it was accepted immediately to keep track of business transactions. Later, management information systems (MIS), followed by decision support systems (DSS), came into existence. Now, firms use IT to change their core business processes, manage their customers and suppliers and manage themselves and their employees. These firms are known as digital firms. They rely on IT to a great extent. Look at our railways system that relies on IT for making reservations, scheduling, freight management, introducing new policies and trains and many more functions. They manage their human resources through IT as

well. Their salaries, other benefits, their skill sets and the various training programmes they have undergone are all maintained in an easily accessible database. A firm uses a supply chain management (SCM) system to manage and interact with its vendors. An SCM system helps an organization to plan its supplies and vendor-related activities. Another system called customer relation management (CRM) system helps an organization to perform its customer-related activities. To manage the business processes within the organization, an Enterprise Resource Planning (ERP) system is used. These systems integrate with each other. A customer order entered into the ERP system is instantly visible to the production unit and a production plan is automatically generated or the existing one is revised. If the raw material is required to be ordered, a purchase order is created, which becomes available to the supplier through the SCM system interface. The customer can track his order through the CRM system interface.

Many service providing companies in India have become digital firms. Many government services such as the Passport offices have become almost completely digital.

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Check Your Progress

1. What are the main activities of manufacturing organizations in the present time?
2. What are digital firms?

9.3 ORGANIZATION OF BUSINESS IN AN E-ENTERPRISE

Nowadays, every organization uses IT. A medicine shop one finds around every corner in India may dispense around 25,000 medicines. The new regulations hold the seller accountable for selling any outdated or expired medicines. Therefore, most medicine shops now use a simple database system to keep track of their stocks and serve their customers better. One can clearly see that such a small system also requires domain business process knowledge.

The Widening Scope of Information Systems

An MIS integrates business strategy, processes and the governing rules with hardware, software, database and communication systems. If the technology or business strategies change, the MIS will also have to change. It is also important to design the system in such a way that it can adapt to changes. The life span of an MIS is approximately five to ten years. When designing an information system, organization requirements for the next 5–10 years should be taken into account.

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An organization usually defines its strategic goals for about five years, so it is possible to assess the direction of change that will be required. The strategy may be to introduce a new product, increase market reach in terms of a new customer segment or new geographical area, or improve business processes to improve the quality of its products and services.

The role of the MIS may also change in the organization. At first, an organization uses IT to keep track of basic transactions such as sales, purchases, salaries, etc. As they gain confidence and feel comfortable, they start using this consolidated data to make their decisions and check for any deviation from what was planned. As the usage of the information system increases, its spread and penetration in the organization also increases. The higher-level management starts using it for strategic decision-making and managing suppliers, customers and internal business processes.

Real-time communication via the Intranet and Internet has increased the scope of information systems' functions. A number of services and products have emerged due to the Internet technology. Businesses such as online shopping, online auction, comparative price checking, etc. are built on the Internet technology.

Building, using, managing and obtaining productivity enhancement using IT are challenging tasks that require the involvement of management as well as employees.

Flattening Organizations and the Changing Management Process

Information systems make information available to all employees but with different levels of access. They are groomed and trusted to make decisions at their level using the required information. They can monitor their progress against targets using information in real time and take corrective measures or seek help if required. IT has been instrumental in empowering employees. Management can also access information and get a consolidated picture using information systems for which they had to earlier depend on middle management. Organizations today have fewer layers of management and have therefore become flatter. The span of control and management is now across locations.

Algorithms from mathematics, statistics, operations research and computer science have been integrated with information systems. These algorithms help management analyse data scheduling and strategic planning.

Separating work from location

Employees, especially knowledge workers, can work from anywhere. Nowadays, organizations work with virtual teams. They have a very small team of just a couple of persons at the client's site to interact with the client, and the remaining team is located where it is most economical.

Paperless offices are fast becoming a reality. A bank in Japan scans every paper that enters its programmes and files it away for legal purposes only. The digital images of papers and documents are electronically filed in a database. There is absolutely no paper anywhere in the bank, so no papers can be lost or misplaced!

Reorganizing work flows

Since all documents are available in electronic form, parallel processing is possible. A loan application in a bank requires about ten different people to examine it and give their feedback. A paper-based sequential process takes about 21 days whereas an electronic document with parallel processing takes one day to approve a loan. IT has had a tremendous impact on work flow in organizations. It has led to extremely efficient processes.

An organization starts out small with simple people-centric and ad-hoc processes. As the organization grows, the processes also grow – but in an ad-hoc manner. These processes are often time inefficient and do not integrate well with other functional units in the organization. IT provides an opportunity to organizations to critically evaluate their processes and improve them.

Increasing flexibility of organizations

Flexible manufacturing and mass customization have been possible due to information technology. IT helps organizations collect data on changing market trends and requirements, analyse data and often customize products on a mass scale. Information systems have added flexibility to manufacturing and production processes. Inventory purchase and production schedules can today be fine-tuned to customer requirements. Customized products and solutions can target specific market segments. This kind of marketing is known as micro-marketing. If you visit Big Bazaar in three different states in India, you will notice that the products they carry are different and take local requirements into account.

Redefining organizational boundaries: New avenues for collaboration

Networks and IT have made organizational boundaries less rigid. E-commerce has integrated financial institutions seamlessly with buyers and sellers. Lead times and transaction costs have come down and cash flows have improved. The cycle time to procure requirements and to develop, manufacture and market a new product has become significantly shorter.

Check Your Progress

3. How does information technology impact work flow in organizations?
4. How has information technology increased flexibility of organizations?

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9.4 E-BUSINESS AND E-COMMERCE

E-commerce is a form of commerce or business through which consumers are able to buy or sell products or merchandise electronically over the Internet. E-commerce takes place between organizations and between organizations and their customers. It includes transaction of goods and other materials, and includes accessing information, trading goods and electronic materials.

E-Commerce Definitions (From Various Perspectives)

1. **From an Interface Perspective:** E-commerce includes various information and business exchanges between a consumer and an organization.
2. **From Communications Perspective:** E-commerce is a way by which a user can supply items, information or transactions via networks.
3. **From an Online Perspective:** E-commerce provides an electronic environment that makes it possible for the purchasing and selling of items on the Internet, such as furniture, books and electronic items.
4. **As a Market:** E-commerce is a global set of connections.

In a nutshell, e-commerce is a form of commerce or business through which users are able to buy or sell items electronically over the Internet.

9.4.1 E-Commerce Practices

E-commerce practices depend on the following factors:

Role of E-Commerce

These days, e-commerce uses electronic technology for its high growth; thus there is a high demand for the latter. It is well-known that computer increases our capacity to store, search and retrieve information. With the tremendous growth in computer usage for communication and other purposes, people from various fields are forming virtual society on the Internet. The concept is quite simple; if one has access to a Personal Computer (PC) and can connect it to the Internet with a browser he/she can do an online business. You have to just get on the Web, open an online store and watch your business grow. This wired world of business, where technology, human talent and a new method of doing business, make up today's growing worldwide economy. The backbone of this electronic commerce is the Internet. E-commerce is not only about technology; it is also about information, decision-making and communication. Use of e-commerce refers to purchase or sale, advertising and servicing of goods or services over the Internet. Currently though not big enough as compared to traditional peer markets, E-commerce is expected to grow in the near future.

According to a survey, the e-commerce industry in India is expected to grow very quickly. The total number of Internet users are rising very rapidly. Worldwide, the growth of e-commerce has gained popularity due to online shopping

but this has not happened in the case of the Indian market. Here, it is mainly concentrated on online travel and the banking sector.

However, growth of the industry is expected to go up very high in the near future that will include both the Internet and mobile banking users.

E-Commerce, E-Business and E-Transaction

E-Commerce: E-commerce can be:

- Business-to-business selling and purchasing.
- The security of business transactions.
- E-retailing with online catalogues.
- The assembly and use of demographic data through the Web.
- Business-to-business exchange of data through Electronic Data Interchange (EDI).
- E-mail and fax (e.g., with the help of newsletters).

E-Business: E-business refers to business with customers, vendors and suppliers via the Internet. E-business provides an environment to enhance businesses and also provides an interface between businesses and customers. E-business conducts business on the Internet, not only by selling and purchasing, but also by providing services to customers and collaborating with business partners.

E-Transaction: E-transaction means commercial transactions with anyone, anywhere and anytime. It provides new business opportunities that result in greater efficiency and effective transactions between customers and business partners.

Scale of E-Commerce

In E-commerce, the scale of work consists of communication and information exchange as follows:

- Exchange of secure documents, contents and values.
- Platforms for e-commerce communications.
- Navigation, advertising and exchange of catalogue.
- Negotiation and contract making protocols in interactions among consumers, businesses and public administration.
- Mobile technology based applications.
- Devices and protocols which support mobility.

Drivers of E-Commerce

The drivers of e-commerce are as follows:

1. Anytime, Anywhere, Anyone

Today, any user can access information anytime. E-commerce binds organization, business and other sectors with the help of video, multimedia, text and other technologies.

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2. Digital Revolution

With the help of digital revolution it is possible for digital devices to communicate with each another.

3. Increase in Access

Due to tremendous increase in the number of computers worldwide it has greatly increased the demand for information and communication for business as well as pleasure.

4. Organizational Changes

E-commerce makes it possible to change the approach of any organization. There is a tendency of owners and managers within the departments to develop a chain of relationships within the organization.

Basics of E-Commerce

The basic features of e-commerce are as follows:

- Business process that helps buying and selling items on the Internet.
 - Supplier, inventory, distribution, payment management.
 - Financial management, purchasing products and information.
- Customer purchasing on the Internet.
- Transactions conducted between businesses on the Internet.

Myths about E-Commerce

The following are some of the commonly noticed myths about e-commerce:

1. E-Commerce is Innovative

Unfortunately, many Internet retailers spend a disproportionate amount on the innovative tasks of Website construction and marketing and concentrate little on customer support and fulfilment of their requirements.

2. Creation of Website is Easy

This is true to some extent; however, ensuring availability and performance of the site is not an easy task. There is technology and networking infrastructure to consider for effective use of a Website.

4. Customers can be Lured

All companies know that customers can be lured with price promotions and giveaways. There are rarely loyal customers. The moment a competitor lowers the price, they click over to the site. The best customer can be lured only with quality service once an item has been purchased.

5. Everyone is Doing It

It is true, but a Web presence is not commerce.

Features of E-Commerce

E-Enterprise System

The following are features of e-commerce:

- The facility to retrieve orders from the Internet.
- The capacity to permit users to access accounting data securely over the Internet.
- The Web page catalogue in several cases is actually associated directly to the software data based on accounting. The main advantage is that the buyer observes real time information related to cost, quality and measure.
- The ability to send computerized information and data to users/groups of users.
- To get printouts of all reports in Web page (HTML) formats.
- Web-enabled accounting software's help menu is connected directly to pages on the Internet through the WWW.

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E-Commerce Framework

An **e-commerce framework** presumes that e-commerce applications will be built on the existing technology infrastructure—group of computers, communication networks and communication software to develop the information superhighway.

E-Commerce Architectural Framework

(i) *Main Platforms*

The risk to the Internet is through digital disorder, closed markets that cannot use each other's services, incompatible applications and frameworks that interoperate or build upon each other, and an array of security and payment options that confuse the consumers.

One solution to these problems is an object oriented architectural framework for the Internet commerce. Several vendors of e-commerce solutions have declared descriptions of such a framework. The most important platforms are:

- IBM commerce point.
- Microsoft Internet commerce framework.
- Netscape ONE (Open Network Environment).
- Oracle NCA (Network Computing Architecture).
- Sun/Javasoft JECF (Java E-Commerce Framework).

(ii) *General Model*

Recently, four of these companies have settled to hold a common distributed object model based on Common Object Request Broker Architecture Internet Inter-ORB Protocol (CORBA IIOP). For the commerce on the Internet to be successful, such systems must also interoperate at a business

application level. A consumer or business using one framework is supposed to be able to shop for, buy and make payments for products and services offered on dissimilar frameworks. This is not possible at present.

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(iii) *CommerceNet*

CommerceNet is a non-profit society that has been formed to help businesses and customers to utilize the Internet for buying and selling. It is a cross-industry effort to build a framework of frameworks, involving both e-commerce merchants and clients.

The victory of this development certainly depends on market leaders in each area who participate vigorously in their respective task forces. All users should use similar software because no single company can control what platform its customers will use.

Mechanics of E-Commerce

1. The Business Aspect of E-Commerce

The following are two bases and interactive business dimensions to e-commerce:

- (i) **The Customer Aspect:** This refers to placing refined goods with the final clients.
- (ii) **The Enterprise Aspect:** This is primarily an intercorporate or inter-organizational supply chain management, etc.

2. The Technological Aspect of E-Commerce

It can be classified according to the three basic functions of any market environment.

- (i) **Access Environment:** It makes use of private and public network technologies, such as the Internet, LAN and WAN.
- (ii) **Transaction Aspects:** These are EDI, point of sale device, credit, debit and smart card, automated Teller Machine (ATM) and Electronic Fund Transfer (EFT).
- (iii) **Support Aspects:** These are support services, such as card validation technologies, bar coding device, among others.

3. The Configuration of E-Commerce

E-commerce to become operational requires three things to happen.

- (i) **The Organizational Configuration:** Integrating business process electronically.
- (ii) **The Network Configuration:** Providing a backbone for e-commerce.
- (iii) **The Media Configuration:** Getting access to the electronic marketplace.

E-Commerce Applications

E-Enterprise System

By using online business one can place goods or products online. A well-made application in e-commerce provides all the information to satisfy the customers' needs. This provides a sensible amount of product with the purchase ability to the customers. It is important to note that a Website must be product specific and it must also support the transaction process when business is being done. Some of these consist of:

- A. 1. Search Capability for the Product:** It provides a way through which a consumer can search products of their interest and switch directly to the interested product over the Internet.
- 2. Data Sheets can be Downloaded:** Consumers can download products and other supporting information and make their purchase decision.
- 3. Support for Customers Online:** It allows staff to focus more on customer services issued online.
- 4. FAQ Based on Products:** Once the customer buys the product then they expect that their problems be sorted out directly without having to communicate through the use of quality sites.
- 5. Message Board to Support Customers:** Message board provides customers access to information anytime they need. New customers can benefit from the questions and solutions provided by the message board.
- 6. Product Newsletters:** These allow customers to be up-to-date with product information. Users can easily subscribe mailing lists for product information in which they are interested.
- 7. Support Sales Process:** E-commerce sites support the sales process through purchase and also provides the necessary information to the customer.

B. E-Commerce Communication Mechanism

Nowadays, the Internet is the finest means of communication between businessmen and clients. Due to various advance technology oriented concepts, purchasing and selling of goods through Website has become popular. Online business is growing speedily through a variety of software that helps consumers to learn the tricks of buying and selling. Online business works by the following methods:

- Shopping cart software.
- Online e-telephony.

Let us discuss these methods.

Shopping Cart Software

Shopping cart software is the means of online presentation of goods for sale. It provides the idea of goods to choose from, online payment facility, joint selection

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of goods in the form of list, etc. By putting all the chosen goods in the cart and paying for all the selected items, shopping cart software has become the simplest way of shopping online. There are many features provided by this software, such as:

- Credit card adequacy.
- Simple navigation system for the consumers.
- Consumer account ability.
- Order management ability.
- Web-based administration ability.
- Flexible shipping and tax options.
- Built-in site optimization tools.
- Inventory management ability.

Online e-telephony

One of the finest ways to communicate regarding business is online telephony. It is the technology used to convert voice signals into data packets which are then transported to a data network runs on the Internet Protocol (IP). It allows the consumer to call through the same phone line which he uses for the Internet connection. It is cheaper than making calls on the basic telephone line. This online communication technology is known in the Web world as Voice Over IP (VOIP).

Benefits

- A user is able to distinguish calls as business calls, personal calls or consumer service calls even as they are on same line.
- A user can direct the calls to a particular department and take automated orders.
- A user can screen the callers without any information to caller.
- A user can get forwarded calls from all over the world.
- There will be no busy line problems.
- Voice mails can be received on the computer.

In addition to these, there are many other facilities which can be availed by using e-telephony. Thus, communication on the Internet provides numerous facilities to ease business complexities and raise profits.

9.4.2 Administration, Business and Consumer Models of E-Commerce

The e-business life cycle starts from the moment a customer buys a product on a Website to the moment the product is actually delivered to the customer. The following are the three major e-commerce applications used in the e-business life cycle:

- (i) Business-to-Consumer (B2C), through the Internet.
- (ii) Business-to-Business (B2B), through the Internet.
- (iii) Business-within-Business, through intranet.

Table 9.1 shows the main elements of the Internet, extranet and intranet.

Table 9.1 Main Elements of the Internet, Extranet and Intranet

Element	Internet	Extranet	Intranet
E-commerce	Business-to-consumer(e.g., mail order via the Web)	Business-to-business(procurement and fulfilment)	Internal procurement and processing
Access	Unrestricted (anyone can access a URL address)	Restricted to company employees, staff and business partners	Restricted to company customers, employees and staff
Security	Generally minimum, expect for verifying credit cards and financial transaction integrity	Firewalls and restricted access to data and applications	Firewalls to eliminate non-company employees
Payment Method	Credit card or electronic cash	Predefined credit agreement between business	Within business charges

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Business-to-Consumer (B2C) Model

The use of the seller's Website by customers is the central focus of attention of e-commerce applications. Consumers can order online from any place and at anytime. This approach is the representation of the conventional shopping experience in stores. A shopping cart, for example, is used to hold items or goods until the customer is ready to sign out. Checkout is order and payment processing. B2C is similar to conventional mail order or telephone based ordering system.

Applications in B2C

The followings are the applications in business to consumers:

I. E-Banking

E-banking is a way through which users can do their transactions electronically or online over the Internet. In spite of traditional banking, e-commerce plays an important role nowadays. The following services can be availed through e-banking:

(i) Payment of Bills

Through e-banking various types of bills, such as mobile phone bills, credit card bills, electricity bill, insurance premium, and so on can be paid. The bills can be of different utility organizations, service providers, etc., all over the country. If a user wants to pay a bill, all has to do is to complete an easy one time registration for each bill provider. A customer can also give a standing online instruction to pay his/her recurring bill automatically. The bank may nominally charge customers for online payments.

NOTES**(ii) Fund Transfer**

Customers can transfer their funds from one bank to another. They can send money from one place to another. To do this, the customer has to log on to his account, which mentions his bank account number. The amount is transferred within a day however, in the traditional system it could take three working days.

(iii) Credit Cards

Customers can not only pay their bills online with the help of the Internet banking, but also obtain a loan facility. If the credit card is lost, it can be reported online so that it is blocked, and no one misuses it.

(iv) Railway Pass

For the common passengers, Indian Railways have tied up with different banks; so customers can buy passes online for local trains. The banks deliver the passes at their homes.

(v) Investment through Internet Banking

An FD (Fixed Deposit) account can be opened online through funds transfer. This is done by investors opening a dematerialized (demat) account in a bank and trade in the stock market. The amount is automatically deducted from his/her account in the bank and shares are allocated to his demat account. At the same time, banks also give the facility to purchase mutual funds online.

These days, major banks have the facility of online banking and also provide demat facility. If a customer has his/her demat accounts with independent share brokers, then he needs to fill a form which helps to combine different accounts.

(vi) Recharging Prepaid Phone

Now, customers can recharge their mobile phones through the Internet. The steps include select the name of the operator and enter the recharge amount. Within a few seconds the prepaid phone gets recharged.

(vii) Shopping

A customer can shop for any product online including buying air or railway tickets through the Internet. The amount is deducted from his account.

Advantages of the Internet Banking

As per the Internet and Mobile Association of India's report on online banking 2006. 'There are several advantages of online banking. It is suitable, it isn't bound by operational timings, there are no environmental barriers and can offer services at a miniscule cost.'

Through the Internet banking, users can check their transactions at any time and number of times they want. Whereas in the traditional banking, banks provided

only quarterly statements to their customers. They could charge outstation fee for transferring amount to outstation or where it may not have a branch. However, this is absolutely free in online banking.

II. E-Trading

Electronically trading in stocks, securities and funds is called **e-trading**. It needs an extensive communication network and infrastructure to clear transactions. However, the saving over the conventional stock brokers is substantial. It has been calculated that 40 per cent of trading transacted by individual stock brokers are done electronically, i.e., through an online broker. Online buying and selling of stock, securities, etc., has grown tremendously because of the secure nature of the online trade.

Stock brokers were earlier known for their ‘full service’ account management. This included personalization services, individual risk management, liberal financial advice, etc. All these came with a hefty commission. Discount brokers charged a flat rate for each transaction completed. However, these simple discount brokers have grown into ‘electronic brokerages’, by permitting a person to place online orders from anywhere in the world.

III. E-Auction

In trading valuable goods, such as a painting or other such merchandise, where the price of the goods cannot be easily determined, the process of auction is adopted. Its objective is to select a fair price for the goods by choosing buyers who need them the most. These auctions are also called forward auctions. In this type of auctions, the purchasers compete with each other by bidding for the goods to be sold.

9.4.3 Business-to-Business (B2B) Models

Different models have been developed for B2B e-commerce, which is based on the control of market, buyer, supplier, etc.

E-Distributor: E-distributors are organizations that supply products and services directly to individual business firms. Generally, e-distributors are owned by one company that tries to serve many customers, e.g., grainger.com.

B2B Service Provider: B2B Service Provider is concerned with industrial marketing; among the processes it handles are fulfilment and procurement. When you make an online purchase and payment is allowed through a credit card clearance, a message is generally displayed saying. ‘Thank you for your order’. The amount is transferred from your account. The moment the message is displayed on the customer’s monitor, an electronic order is sent to the vendor to fill the order and ship or transport it directly to the customer. Performing this electronically means reduced inventory and quick service. Intranet plays an important function as a corporate and product information centre and is strictly a ‘within company’

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type of information exchange. This interlinked environment is restricted to internal employees and customers, with firewalls to keep out non-employees. E-mail replaces paper for communication of messages, order acknowledge and approvals and other forms of correspondence within the organization.

In intranet, there is no true payment process. Transfers of funds or charges against budget accounts are purely an accounting transaction as part of the intra-company billing procedure. Thus, intranet becomes a facilitator for the exchange of information and services among the departments or divisions of a large company.

Benefits of B2B

Some of the benefits of B2B are: you can outsource the unprofitable parts of your business; quicken your product development activities; or reduce time to the market; improve business and market intelligence; understand your market better than your competitors; clone your business in future markets; improve the speed of communication; facilitate communication between your customers and suppliers; reduce wastage through additional sales channels; improved ability to experiment and learn; higher customer retention rates; lower customer acquisition costs; and reduced costs can be passed on in favourable pricing. Besides these, B2B also provides exclusive benefits, such as fewer human interventions, less overhead expenses, fewer inadvertent errors, more efficiency, more advertising exposure, new markets and new physical territories equated to an intelligent method of mutual business. It is a win-win situation for both the buyer and the seller.

These are just few of the advantages of B2B e-commerce. It has been proved beyond doubt that doing business on the Internet is profitable. The actual return on the initial investment is very good. There is bound to be more profits for the business.

Thus, while transacting business-to-business e-commerce, it is necessary to remember the following two points:

(i) Supply Chain Management (SCM): In the late 1980s, different management concepts, such as just-in-time, design for manufacturing, stockless production, lean manufacturing, and so on were developed. These helped to properly manage the operating costs of manufacturing. There were noticeable reductions in the operating cost in all areas of operation, such as transportation, inventory costs, overhead and finally direct labour costs. All these have the potential to save cost to the tune of crores of rupees. This can only happen when business organizations engage in the efforts of supply chain management.

(ii) Electronic Procurement System: In this system, the two basic processes to handle are distribution of goods from distributors to

buyers and to remove the complex manifold paper and process labour intensive process. Thus, the business run more efficiently and purchase managers get sufficient time to focus on supplier negotiation and complex acquisitions. At the same time, it should reduce cost and hassle. The electronic procurement system, should also give extensive management control, besides integrating with the existing systems.

Just-in-Time Delivery: Just-in-time delivery is very important from customers' viewpoint. This phase of B2B is critical because customers want delivery of good, items and products are delivered just when they are required. It means savings in terms of time and money.

9.4.4 Consumer-to-Consumer Model

Consumer-to-Consumer (C2C) involves the electronically-facilitated transactions between consumers with the help of a third-party. Online auction is a common example, in which a consumer posts an item for sale and other consumers propose to buy it; the third-party generally charges a commission or flat fee. The sites are only intermediaries, just there to match consumers. They do not have to check the quality of the products being offered, for example eBay, Craigslist, Amazon.com, etc.

This type of e-commerce is expected to increase in the future, because it cuts out the costs of using another company. It could change in the sense that some one can send an advertisement regarding a sale to your Global Positioning System (GPS).

Universities

Consumer to consumer models are becoming popular among students in universities, because these are large organizations in the same environmental area which are low on cost. So they look for deals very often and these kinds of Website offer them. Universities themselves identify spaces for the students to sell books and other items to various students; users can also advertise that they are subletting their apartment. An example of this is Tiger Books and Dalhousie University classifieds, both of which are put together by the Dalhousie Student Union (DSU) for the students.

9.4.5 Peer-to-Peer Model

Many attempts have been made by different companies to utilize the P2P (Peer-to-Peer) architecture for making money. However, to date, the only successful business model is based on benevolent users, donating their CPU resources for scientific work, although some content sharing software client developers do provide functionality enhancements based on a fee as well as display third-party advertisements in the client console in order to finance the client programming

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projects. A P2P model for mega-scale business is yet to be developed. The main obstacles in P2P model are of security and rating.

There is a lack of responsibility inherent in the privacy and anonymity of P2P environment. A lack of a central authority makes it difficult to enforce contracts. In addition, there is no true P2P payment mechanism so far which facilitates exchanges without depending on some sort of intermediate authority and without affecting the privacy.

An individual rating system can help to solve the trust and contract enforcement problem, while an electronic payment mechanism (incorporating a card reader and e-cash) is designed to resolve the issue of payment. In addition, some variant of escrow may be applied to P2P architecture in order to ensure smoothness of transactions.

Table 9.2 Benefits and Drawbacks of Peer-to-Peer Network

Benefits	Drawbacks
Users have the authority to control their own shared resources.	Network security is applied to one computer at a time.
It is easy to install and configure.	Every time a computer in the network is accessed, performance suffers.
Inexpensive to purchase and operate.	Back up is performed on each machine separately to protect shared resources.
No dependence on a dedicated server.	Users have to use a separate password on each computer in the network.
Ideal for small businesses of ten users or fewer.	No centralized set-up to locate, manage, or control access to data.
All you need to set up this network is an operating system and a few cables.	
No need for a full-time network administrator.	

Check Your Progress

5. Define e-commerce.
6. What is CommerceNet?
7. Mention any two benefits of online e-telephony.

9.5 E-COMMUNICATION

The word telecommunications is derived from two Greek words: *Tele*, which means ‘distance’ and *communicara*, which means ‘the ability to share’. Thus, telecommunications means the ability to share information over long distances.

Earlier, to communicate over long distances, smoke, signals, flags, pigeons, ambassadors, etc., were used. Slowly, other methods for communication developed, including the postal method, which is still used widely. However, with

the advancement of technologies, the electronic devices, such as telephone, radio, television, etc., have been developed that enable communicating information over long distances effectively and efficiently. The use of these electronic devices has brought the new revolution in telecommunications.

In the late 20th century, the development of computer networks (especially the Internet) enabled almost everyone to communicate with anyone in this world through e-mail at a negligible cost. Organizations have developed their private networks using a variety of technologies, such as fibre optic, wireless, and digital technology. Satellites have been launched, antennas have been set up for radio or microwave transmission, and many other advanced technologies have been developed. Nowadays, telecommunications has become an important part of all organizations in the world.

The Marriage of Computers and Communications

With the Communication Act of 1934, the American Telephone and Telegraph (AT&T) Company became the only company to provide the telecommunications services in the whole of the US. At the time, the Congress, who gave the right to AT&T, regulated the prices that the company could charge for the services and required to provide telecommunications services in all the regions of America, including the rural areas, at a very reasonable price.

The monopoly of AT&T Company prompted the US Department of Justice to start an antitrust action in 1974 to end the company's monopoly and to promote competition in the telecommunications market. As a result, the AT&T Company broke up into seven independent Regional Bell Operating Companies (RBOCs). RBOCs were also ordered to permit long-distance competitors to provide services to local customers. Such orders promoted competition in the market. This competition increased with the Telecommunications Act of 1996, which permitted long-distance companies to provide services to local customers and ordered RBOCs to lease lines to long-distance competitors at a reasonable rate.

The Information Superhighway

There is a continuous increase in the demand of information on a anytime-anywhere basis. With the advancement in technology, one obvious way to fulfill this demand is to provide information electronically. Several paths or high-speed digital networks, including the Internet, have emerged to provide instant access to information electronically. Information superhighway is the term used to refer to all these high-speed digital networks, since they provide vast volumes of data and information to virtually everyone in the world. Due to the high bandwidth of information superhighway, the transmission of text, images, audio, or video is done in real time without any delay. This feature enhances information sharing among organizations as well as individuals regardless of their geographic distance. Multimedia also plays an important role in information sharing. Many organizations today conduct

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their meetings with the help of videoconferencing that eliminates the need for all the individuals to be present at the same location.

Components and Functions of a Telecommunications System

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When a message is transmitted from a machine (source) to another machine (destination), it travels over a communication medium in the form of signals and passes through a variety of components.

Telecommunications System Components

A telecommunications system consists of hardware and software components that help in transmitting text, voice, or video. The basic components of a telecommunications system are as follows:

- **Terminals:** These are any input/output device that sends or receives data over the telecommunications network; for example, a telephone, a personal computer, an ATM, etc.
- **Computers:** Computers of different types and sizes are attached through the telecommunications network to process information. For a large network, for example, a powerful computer, such as a mainframe, may be used as a host computer and small mid-range computers may serve the task of front-end processors.
- **Telecommunications processors:** They are used between the terminals and the computers to provide support for the transmission and reception of data. They perform many functions in the telecommunications network, such as converting data from analog to digital and vice versa, controlling the speed of flow of data, directing the packets towards their destination, etc. Modems, switches, multiplexers, routers, bridges, etc., are examples of telecommunications processors.
- **Telecommunications channels:** These are mediums over which data travels between the source and the destination device. The telecommunications system uses a variety of media as channels, including twisted pair wire, coaxial cable, fibre optics, or any wireless system.
- **Telecommunications control software:** It is needed to control the input/output activities and manage the functions of the telecommunications networks. Network operating systems, browsers, etc., are examples of telecommunications control software.

Note that regardless of the size of the telecommunications network, each telecommunications network must have these basic components to transmit information from the source to the destination. To make these components of telecommunications network work together, some common set of rules, called **protocol**, are required using which they communicate with each other. Each

component of the network must be able to interpret the protocol of other components in the network.

Functions of the Telecommunications System

To transmit information from the source to the destination machine, a variety of functions are performed by the telecommunications system which are transparent to the users at either end. One important function of the telecommunications system is to establish the connection between the sender and the receiver. Once the connection is established, all the data between the sender and the receiver can be transmitted. The telecommunications system also ensures that the message is delivered to the right receiver efficiently and securely. To deliver the message efficiently, the router performs a major role. It directs the data towards the path through which the message can reach its destination most efficiently. The telecommunications system also checks for errors in the data that may occur during transmission. Finally, the system is responsible for preventing a fast sender from overflowing a slow receiver. That means it controls the flow of data and a buffer may be maintained at the receiver's side so that some data can be stored in it until consumed by the receiver.

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Analog and Digital Signals

Data can be transmitted from one point to another by means of electromagnetic signals. These signals may be in the form of analog signals or digital signals. Based on the form of signal used, data transmission can be *analog transmission* or *digital transmission*.

(a) Analog transmission

The type of data transmission that uses analog signals to transmit data is called **analog transmission**. An analog signal is a continuous waveform that changes smoothly over time. An important application of the analog signals is the transfer of data across telephone lines. Analog signals are mostly used for carrying data, such as voice or sound.

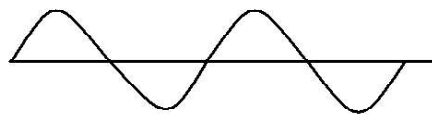


Fig. 9.3 Analog Signal

(b) Digital transmission

The type of data transmission that uses digital signals for transmitting the data is called **digital transmission**. In a digital signal, the data is represented in the form of 0s and 1s. A digital signal has two points—a high point and a low point. When

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the signal is at a high point, the value of the signal is 1, and when low, the value of the signal is 0. The important property of a digital signal is that it is not affected by noise or attenuation and does not require to be amplified while transmitting data over long distances.

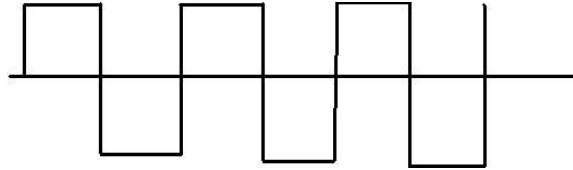


Fig. 9.4 Digital Signal

Communications Channels

Communications channel (transmission media) refers to the physical media through which communication signals (data and information) are transmitted. In a network, different types of transmission media are used for data transfer. Transmission media can be broadly classified as guided and unguided media.

(a) Guided media

The guided transmission media use a cabling system that guides the data signals along a specific path. A cable is the medium through which information usually moves from one network device to another. A cable can be of various metals, such as copper, tin or silver. Since the data signal in a guided medium is bound by the cabling system, the guided medium is also known as a **bound medium**. There are three basic types of guided media, namely *twisted pair cable*, *coaxial cable* and *optical fibre*.

Twisted pair cable

A twisted pair cable or wire is the oldest and the most common cable used for data communication. It consists of two identical 1mm thick copper wires insulated and twisted together. The twisted pair cables are twisted in order to avoid the interference that results in cross connections and data loss. The twisted pair cables are usually used for telephone networks. They are relatively cheaper as compared to other guided media, due to which they are also used in a network for short and medium length connection.



Fig 9.5 Twisted Pair Cable

Twisted pair cables are of two types, namely *unshielded* and *shielded twisted pair cable*.

- *Unshielded twisted pair (UTP) cable*: This cable is the most common type of telecommunications medium. It comprises pairs of twisted wires bound together by an outer insulator. A UTP cable may have twenty-five or more pairs of twisted wires covered by the outer insulator. These cables are cheap and can send signals up to 100 metres without the help of a repeater. The main application of these cables is in electronic communications.

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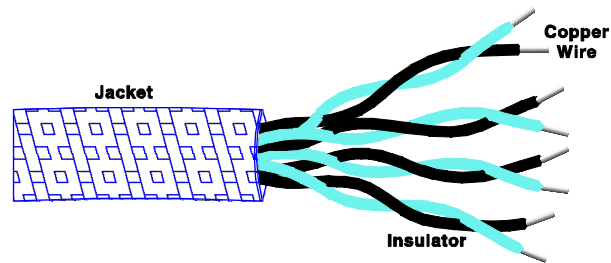


Fig 9.6 Unshielded Twisted Pair Cable

- *Shielded twisted pair (STP) cable*: This cable is similar to the unshielded cable, except that the shielded cable has a layer of wire mesh shielding around it. The mesh coating around the wire protects it from external interference but also makes it expensive as compared to the unshielded cable.

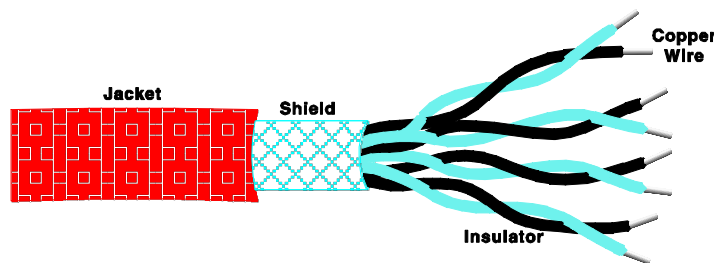


Fig 9.7 Shielded Twisted Pair Cable

Advantages of twisted pair cable

- It is easier to install and maintain.
- It is an inexpensive medium.
- It can be used for transmission of analog as well as digital signals.
- It is easy to extend or add new nodes.

Disadvantages of twisted pair cable

- It can transmit data up to a certain distance.
- It is sensitive to noise.

- It is not suitable for broadband applications due to low bandwidth capacity.
- The signal has to be amplified in about every five kilometres.

Coaxial cable

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A coaxial cable, commonly known as **coax**, comprises two conductors that are parallel to each other or are on the same axis. The centre conductor in the cable is a copper wire which carries the high electrical signals at a high speed. Outside the copper wire is a plastic-like non-conducting material. The outer conductor is a fine braided mesh made from copper. It is used to shield the cable from electromagnetic interference (EMI) and prevents noise and crosstalk. Outside the copper mesh is the final protective cover. The coaxial cables are used in the transmission of television signals, long distance telephone lines, closed circuit TV, etc.



Fig 9.8 Coaxial Cable

Depending on the measure of the cable thickness and resistance, coaxial cables are of two types, namely *thinnet* and *thicknet*.

- *Thinnet*: This form of a coaxial cable transmits data at 10 Mbps. The wire segments of thinnet are connected with a BNC connector.
- *Thicknet*: This form of coaxial cable is thicker than the thinnet and can transmit data at the same rate as the thinnet cable for up to 500 metres.

Advantages of coaxial cable

- It is capable of transmitting digital signals at a very high speed.
- It has a better data transmission capacity as compared to twisted pair cable.
- It is more immune to noise.

Disadvantages of coaxial cable

- It is comparatively more expensive than twisted pair cable.
- It is difficult to manage and reconfigure.
- It is not compatible with other cables, such as twisted pair cable.

Optical fibre

An optical fibre consists of thin glass fibres that can carry information in the form of visible light. A typical optical fibre consists of a very narrow strand of glass called the **core**. The core is covered by a concentric layer of glass called the **cladding**.

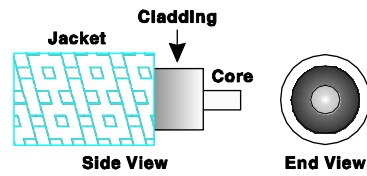


Fig 9.9 Optical Fibre

The data is transmitted through an optical fibre using the optical transmission system that comprises the following three parts.

- *Transmission medium*: A thin glass fibre.
- *Light source*: A light-emitting diode (LEDs) or laser diode (LDs).
- *Detector*: A photo diode that generates electric pulses when light falls on it.

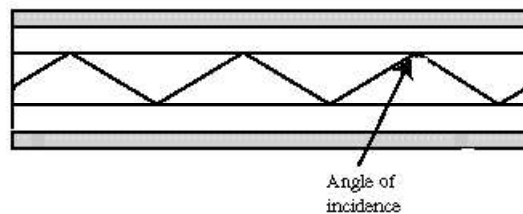


Fig 9.10 Signals carried over an Optical Fibre

The light rays incident at a certain angle are trapped inside the fibre and propagated for many kilometres with virtually no loss of signal.

Advantages of optical fibre

- It can transmit data over long distance with high security.
- The speed of data transmission is high.
- It provides better noise immunity.
- The bandwidth is up to 10 Gbps.
- It is lighter than other guided media.

Disadvantages of optical fibre

- It is expensive as compared to other guided media.
- It needs special care while installation.

(b) Unguided media

The unguided media, such as air, water and vacuum, facilitate data transmission at a much faster rate and provide wide area coverage. Technically, in the unguided media, the earth's atmosphere provides the path for data transmission. The commonly used types of unguided media are radio waves and microwaves.

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Radio wave transmission

The transmission in which radio waves are used is termed as **radio wave transmission** or **propagation**. Radio frequency (RF) or the radio wave ranges from 10 KHz to 1 GHz. The radio waves penetrate into objects easily, due to which they are used for long distance communication. Radio waves are omnidirectional, that is, the waves can be broadcast in all directions. In radio wave transmission, the signal is carried over carrier waves (waves that carry signals over them), which have frequencies in the range of radio frequency spectrum. The radio waves are transmitted into the air using a device called the **transmitter** at the source end, and at the destination end, the radio waves are captured using a device called the **receiver**.

Advantages of radio wave transmission

- The communication via radio waves is cheaper than laying cables over long distances.
- The radio wave transmission facilitates mobility.

Disadvantages of radio wave transmission

- The transmission is affected by weather changes, such as rain, thunder, etc.
- The transmission may require frequency licensing.

There are three types of radio wave transmission, namely *ground wave propagation*, *ionospheric propagation* and *line of sight propagation*.

- *Ground wave propagation*: This propagation follows the curvature of the earth. They have carrier frequencies of up to 2 MHz. An example of ground wave propagation is AM radio.
- *Ionospheric propagation*: In this propagation, waves bounce off from the earth's ionosphere layer in the upper atmosphere to the station on the earth. It operates in the frequency range of 30 to 85 MHz. Since this propagation depends on the earth's ionosphere, it is affected by the changes in the weather.
- *Line-of-sight propagation*: This propagation takes place exactly in the line of sight. In this propagation, the receiving station must be in the line of sight of the transmitting station. It is limited by the curvature of the earth for the ground-based stations. Examples of line-of-sight propagation include microwave and satellite transmission.
 - o *Microwaves transmission*: Microwave signals travel at a higher frequency than radio waves and are popularly used for transmitting data over long distances. Microwave communication uses parabolic antennas (satellite TV dish antennas) that are mounted on the tower, which could be tens of kilometres away, but in line of sight. Microwave uses repeaters at

regular intervals in between the transmitter and the receiver to boost the signal frequencies. Normally, the distance between the repeaters goes up roughly with the square root of the tower height. For a 100 metre high tower, for example, repeaters can be spaced at 80 km apart.

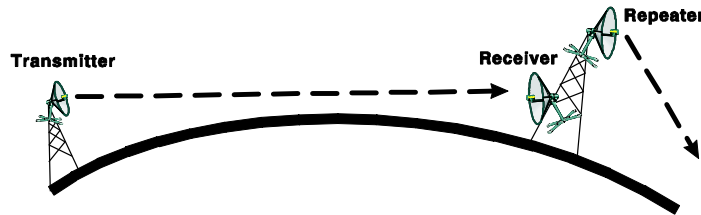


Fig 9.11 Microwave Transmission

Advantages of microwave transmission

- It is cheaper as no cables are to be laid over long distances.
- It facilitates easy communication in mountainous areas and over oceans.

Disadvantages of microwave transmission

- The line of sight due to earth's curvature is only 50 kilometres. Thus, repeaters are to be used to travel distance more than 50 kilometres.
- o Satellite transmission: The satellite transmission is used to transmit signals throughout the world. Satellites are set in the geostationary orbits directly over the equator, that is, at 36,000 km above the earth's surface. These satellites rotate in synchronization to the earth and, hence, they look stationary from any point on the earth. Satellite dishes on the earth are used to send signals to the satellite that sends these signals back to the receiver's dishes on earth.

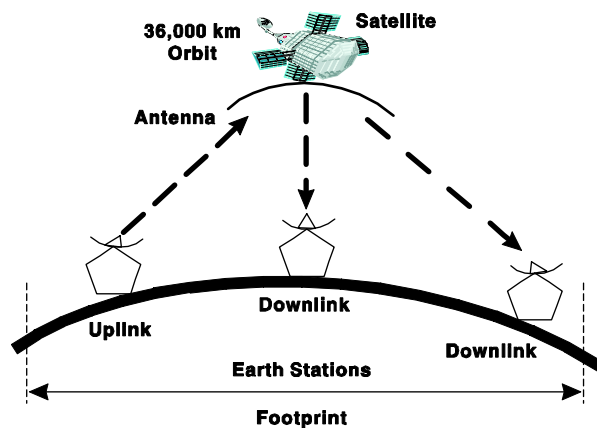


Fig. 9.12 Satellite Transmission

Advantages of satellite transmission

- The area covered is quite large.
- There are no line-of-sight restrictions, such as natural mountains, tall building, towers, etc.

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- The earth station which receives the signals can be a fixed position or relatively mobile.

Disadvantages of satellite transmission

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- It is very expensive as compared to other transmission mediums.
- Its installation is extremely complex.
- The signals sent to the stations can be tampered by external interference.

9.5.1 E-Collaboration

According to Kock and D'Arcy, electronic collaboration is defined as collaboration using electronic technologies among different individuals to accomplish a common task. This is a broad definition that encompasses not only computer-mediated collaborative work, but also collaborative work supported by other types of technologies that do not fit most people's definition of a "computer," such as the telephone. Another example is the teleconferencing suite, whose main components are cameras, televisions and telecommunications devices. Working together in a collaborative way is identified by cooperation, shared commitment and common goal.

Check Your Progress

8. What are the three basic types of guided media?
9. Mention two advantages of twisted pair cable.
10. What are the three types of radio wave transmission?

9.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Today, vendor management, sales and marketing and customer management have become important activities of manufacturing organizations.
2. Firms these days use IT to change their core business processes, manage their customers and suppliers and manage themselves and their employees. These firms are known as digital firms.
3. IT has had a tremendous impact on work flow in organizations. It has led to extremely efficient processes. IT provides an opportunity to organizations to critically evaluate their processes and improve them.
4. Flexible manufacturing and mass customization have been possible due to information technology. IT helps organizations collect data on changing market trends and requirements, analyse data and often customize products on a mass scale. Information systems have added flexibility to manufacturing and production processes. Inventory purchase and production schedules can today be fine-tuned to customer requirements.

5. E-commerce is a form of commerce or business through which consumers are able to buy or sell products or merchandise electronically over the Internet. Ecommerce takes place between organizations and between organizations and their customers.
6. CommerceNet is a non-profit society that has been formed to help businesses and customers to utilize the Internet for buying and selling. It is a cross-industry effort to build a framework of frameworks, involving both ecommerce merchants and clients.
7. The benefits of online e-telephony are as follows:
 - A user is able to distinguish calls as business calls, personal calls or consumer service calls even as they are on same line.
 - A user can direct the calls to a particular department and take automated orders.
8. There are three basic types of guided media, namely twisted pair cable, coaxial cable and optical fibre.
9. The advantages of twisted pair cable are as follows:
 - It is easier to install and maintain.
 - It is an inexpensive medium.
10. There are three types of radio wave transmission, namely ground wave propagation, ionospheric propagation and line of sight propagation.

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9.7 SUMMARY

- The Information Technology revolution introduced widespread changes in how firms operate, brand themselves, and market their products. Firms have started digitizing their activities on a global scale so employees can work wherever they are located, at a time that suits them best.
- Information technology has been instrumental in making local economies into a global one. Organizations that are able to think globally are the only ones likely to survive in this era of a global economy.
- Manufacturing is no more the dominating component of the economy. Knowledge- and information-based services constitute a major part of the economy. IT plays a very critical role in providing services.
- IT has transformed organizations in multiple ways. Organizations now have fewer hierarchical levels than before. The scenario has subsequently changed. The job profiles at each level have become broader. Everyone is expected to make use of IT to access the information related to his job and understand his role, monitor his own progress and ensure quality in his work.

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- IT has become an integral part of companies; it was introduced to the non-academic world in the 1960s in the US where it was accepted immediately to keep track of business transactions. Later, management information systems (MIS), followed by decision support systems (DSS), came into existence. Now, firms use IT to change their core business processes, manage their customers and suppliers and manage themselves and their employees.
- An MIS integrates business strategy, processes and the governing rules with hardware, software, database and communication systems. If the technology or business strategies change, the MIS will also have to change. It is also important to design the system in such a way that it can adapt to changes.
- Information systems make information available to all employees but with different levels of access. They are groomed and trusted to make decisions at their level using the required information. Organizations today have fewer layers of management and have therefore become flatter. The span of control and management is now across locations.
- Employees, especially knowledge workers, can work from anywhere. Nowadays, organizations work with virtual teams. Paperless offices are fast becoming a reality.
- An organization starts out small with simple people-centric and ad-hoc processes. As the organization grows, the processes also grow – but in an ad-hoc manner. IT provides an opportunity to organizations to critically evaluate their processes and improve them.
- Flexible manufacturing and mass customization have been possible due to information technology. IT helps organizations collect data on changing market trends and requirements, analyse data and often customize products on a mass scale. Information systems have added flexibility to manufacturing and production processes.
- Networks and IT have made organizational boundaries less rigid. E-commerce has integrated financial institutions seamlessly with buyers and sellers. Lead times and transaction costs have come down and cash flows have improved.
- E-commerce is a form of commerce or business through which consumers are able to buy or sell products or merchandise electronically over the Internet. Ecommerce takes place between organizations and between organizations and their customers.
- An e-commerce framework presumes that e-commerce applications will be built on the existing technology infrastructure—group of computers, communication networks and communication software to develop the information superhighway.

- By using online business one can place goods or products online. A well-made application in e-commerce provides all the information to satisfy the customers' needs. It is important to note that a Website must be product specific and it must also support the transaction process when business is being done.
- Online business works by the following methods:
 - o Shopping cart software
 - o Online e-telephony
- Shopping cart software is the means of online presentation of goods for E-Enterprise System sale. It provides the idea of goods to choose from, online payment facility, joint selection of goods in the form of list, etc. By putting all the chosen goods in the cart and paying for all the selected items, shopping cart software has become the simplest way of shopping online.
- One of the finest ways to communicate regarding business is online telephony. It is the technology used to convert voice signals into data packets which are then transported to a data network runs on the Internet Protocol (IP). It allows the consumer to call through the same phone line which he uses for the Internet connection. It is cheaper than making calls on the basic telephone line.
- The e-business life cycle starts from the moment a customer buys a product on a Website to the moment the product is actually delivered to the customer. The following are the three major e-commerce applications used in the e-business life cycle:
 - (i) Business-to-Consumer (B2C), through the Internet
 - (ii) Business-to-Business (B2B), through the Internet.
 - (iii) Business-within-Business, through intranet.
- The followings are the applications in business to consumers:
 - o E-Banking
 - o E-Trading
 - o E-Auction
- Different models have been developed for B2B e-commerce, which is based on the control of market, buyer, supplier, etc.
- Consumer-to-Consumer (C2C) involves the electronically-facilitated transactions between consumers with the help of a third-party. Online auction is a common example, in which a consumer posts an item for sale and other consumers propose to buy it; the third-party generally charges a commission or flat fee.

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- Many attempts have been made by different companies to utilize the P2P (Peer-to- Peer) architecture for making money. However, to date, the only successful business model is based on benevolent users, donating their CPU resources for scientific work, although some content sharing software client developers do provide functionality enhancements based on a fee as well as display third-party advertisements in the client console in order to finance the client programming projects.
- In the late 20th century, the development of computer networks (especially the Internet) enabled almost everyone to communicate with anyone in this world through e-mail at a negligible cost.
- There is a continuous increase in the demand of information on a anytime-anywhere basis. With the advancement in technology, one obvious way to fulfil this demand is to provide information electronically. Several paths or high-speed digital networks, including the Internet, have emerged to provide instant access to information electronically.
- A telecommunications system consists of hardware and software components that help in transmitting text, voice, or video. The basic components of a telecommunications system are terminals, computers, telecommunication processors, telecommunication channels, and telecommunications control software.
- To transmit information from the source to the destination machine, a variety of functions are performed by the telecommunications system which are transparent to the users at either end. One important function of the telecommunications system is to establish the connection between the sender and the receiver. Once the connection is established, all the data between the sender and the receiver can be transmitted.
- Data can be transmitted from one point to another by means of electromagnetic signals. These signals may be in the form of analog signals or digital signals. Based on the form of signal used, data transmission can be analog transmission or digital transmission.
- Communications channel (transmission media) refers to the physical media through which communication signals (data and information) are transmitted. In a network, different types of transmission media are used for data transfer. Transmission media can be broadly classified as guided and unguided media.
- There are three basic types of guided media, namely twisted pair cable, coaxial cable and optical fibre. Twisted pair cables are of two types, namely unshielded and shielded twisted pair cable.
- The unguided media, such as air, water and vacuum, facilitate data transmission at a much faster rate and provide wide area coverage. Technically, in the unguided media, the earth's atmosphere provides the

path for data transmission. The commonly used types of unguided media are radio waves and microwaves.

- There are three types of radio wave transmission, namely ground wave propagation, ionospheric propagation and line of sight propagation.
- According to Kock and D'Arcy, electronic collaboration is defined as collaboration using electronic technologies among different individuals to accomplish a common task. This is a broad definition that encompasses not only computer-mediated collaborative work, but also collaborative work supported by other types of technologies that do not fit most people's definition of a "computer," such as the telephone. Another example is the teleconferencing suite, whose main components are cameras, televisions and telecommunications devices.

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9.8 KEY WORDS

- **E-commerce:** It is a form of commerce or business through which consumers are able to buy or sell products or merchandise electronically over the Internet. Ecommerce takes place between organizations and between organizations and their customers.
- **E-banking:** It is a way through which users can do their transactions electronically or online over the Internet.
- **Supply Chain Management:** It is the broad range of activities required to plan, control and execute a product's flow from materials to production to distribution in the most economical way possible.

9.9 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short note on the widening scope of information systems.
2. What are some of the common myths about e-commerce?
3. List the features of e-commerce.
4. What are the advantages of Internet banking?
5. State the benefits and drawbacks of Peer-to-Peer Model.
6. What are the components of a telecommunications system?
7. What is analog transmission?
8. Write a short note on radio wave transmission.

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Long-Answer Questions

1. Discuss the way Information Technology has altered the business environment.
2. Explain the mechanics of e-commerce.
3. Briefly mention the features of shopping cart software.
4. Examine the consumer models of e-commerce.
5. Discuss the services provided through e-banking.
6. Describe the classifications of guided and unguided media.

9.10 FURTHER READINGS

O'Brien, James A. 2001. *Management Information Systems*, 7th edition. New York: McGraw-Hill Education.

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UNIT 10 TRENDS IN MIS

Structure

- 10.0 Introduction
- 10.1 Objectives
- 10.2 Decision Support Systems (DSS)
- 10.3 Artificial Intelligence (AI)
- 10.4 Answers to Check Your Progress Questions
- 10.5 Summary
- 10.6 Key Words
- 10.7 Self Assessment Questions and Exercises
- 10.8 Further Readings

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10.0 INTRODUCTION

Decision support systems (DSS) not only helps in management decision making but also facilitates management operations and planning. One has to rely on decision support systems while dealing with unstructured or semi-structured problems. Decision support system also improves the quality of decision making, while expediting the problem solving process. The emergence of artificial intelligence has further added new dimensions to the field of computer science. Its contribution to robotics is noteworthy. This unit will discuss the characteristics and benefits of DSS. The applications of artificial intelligence will also be explained.

10.1 OBJECTIVES

After going through this unit, you will be able to:

- Examine the components of Decision Support Systems (DSS)
- Discuss the characteristics and benefits of DSS
- Understand artificial intelligence and its applications

10.2 DECISION SUPPORT SYSTEMS (DSS)

Work on using computers to solve complex analytical problems can be traced to the early days of computing in the 1960s. It became an established field of work for helping in management decision-making (Michael S. Scott Morton, 1971). This class of systems, loosely clubbed as decision support systems, changed the way in which MIS was conceived in those days (Gordon Davis, 1974) and laid

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the foundation of today's DSS. Little (1970), who observed that the biggest obstacle with management science/operations research based models was that people at the decision-making stage rarely used them and, thus, incorporated models inherently in, such, systems. The framework for decision support was however laid much earlier by Gorry and Scott Morton (1971), and also in the seminal works of both Simon (1977) and Anthony (1965).

Decision support systems, or DSS, are required when one has to take decisions on unstructured and semi-structured problems. This means that the problem itself is not clear and a lot of ambiguity is present in the problem and its possible decision path outcomes. Such decisions are more often required to be taken by the top management. In such cases, a lot of judgement, experience, intuition and expert knowledge is required to take decisions as one is treading a path no one has taken before. No precedent is normally available for such decisions. A decision support system is required in such a case. It is an information system class which works with a human to assist him to take decisions in the situation just explained. The system is robust and allows the user to create a host of alternative decision paths by analysing its data (internal data of the organization stored in a transaction processing system as well as external data), and then suggests the 'best fit' solution for the problem at hand. It only prompts the decision-maker to take the best solution, but does not decide on the decision-maker's behalf. All the while, the DSS helps the decision-maker by providing him with supporting information about each decision path. It is also very interactive. The easy-to-use user interface hides the layers of model housed in the system and the user stays oblivious to the complexities of the system. It must be pointed out that the decision-maker has control over the process of decision-making and makes choices at each stage of decision-making like choosing the database and so on. The interactive nature of the systems helps the decision-maker maintain control over the decision-making process. The system only works on data and provides alternatives to the user (and also hints at the best possible solution). According to Gory Scott Morton (1989), decision support systems 'couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. [They comprise] a computer-based support system for management decision-makers who deal with semi-structured problems'.

Components of DSS

Even though DSS can be of several types, fundamentally, each DSS will have the following components:

- **Interactive User–System Dialog Management Subsystem** – DSS requires continuous user interaction. Sometimes, the system should prompt the user to give an input at other times the user should be able to control the

process. A typical user-system dialog management subsystem will have the following elements:

- o *User Interface*: The user interface of a DSS has to be dynamic and GUI-based. It has to be an easy-to-use user interface as most of the people who will be using it are not technical experts but management experts (top management) and, hence, the interface should be minimalist in design. Also, the system should be able to interact with the user in an interactive mode and, hence, the user interface has to be dynamic.
- o *Request Constructor*: Since DSS works on an interactive dynamic mode, it needs a request constructor (incorporating aspects of Language Query Interface) which can convert the user's instructions into a model understandable form, and send the model's data request to the database, and the model's instructions/requests to the user.
- **Data Management Subsystem** – Data is the most important component of a DSS. Without data, a DSS cannot function. The data management subsystem manages data for a DSS. Data is accessed in a DSS in many ways like ad hoc basis, structured query basis, heuristic search basis, and so on. Hence, a strong data management subsystem is required to service the varied data requests from a DSS. The subsystem has the following elements:
 - o *Database Management System*: It is the data store for the DSS. It manages the data and performs all the functions that a typical DBMS package does. In fact, in most DSS, a commercial DBMS or RDBMS package is used to perform this task.
 - o *Query Control*: This is an element tailored to handle the query requirements of DSS. It may connect the database directly to the user interface or to the model base or both.
 - o *Meta Data*: This contains data/information about the data that is stored in the database. This helps the DSS in understanding the data in the database properly and helps in creating ad hoc queries.
- **Model Management Subsystem** – This is a unique feature of a DSS and makes the system special. However, this also makes the system very specific. There are very few examples of a generalized DSS as generalized models are not available. Those that exist, work on half-baked solutions. The model management subsystem may use different classes of models such as:
 - o Optimization Models
 - o Simulation Models

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- o Heuristic Models
- o Deterministic Models
- o Predictive Models

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Each class of model is used to solve a specific class of problems like (say) a routing problem or a scheduling problem or a combinatorial search problem and so on. Model and model management has several connotations in DSS literature and there have been wide-ranging definitions of these terms. The common strain that evolves from the plethora of definitions is that a model is conceived to consist of a solver and a model for solving a problem and data (Ramirez, 1993), where model represents relationships between variables, data represents the values of the variables under consideration and the solver is the tool that enables the computation of the variable values and their relationships. It has been also conceptualized in some literature as a procedure which works on the data to give an output after analysis.

The model management subsystem has the following elements:

- *Model Base Management System*: A model base or rather a model base management system is a software (is conceptually like what the DBMS is to data) which has the capability to manage a model so that it is useful for the decision-maker. It is the core of a DSS. It supports the generation of models, and works with data on one hand and user-supplied instructions on the other.
- *Model Command Processor*: It is the entity that processes the commands coming from the dialog management subsystem.
- *Model Executor or Solver*: It is the heart of the system. It is the process through which the model is solved (using some algorithm). It works with the model generated by the model base (with instructions from the user), the request constructor (dialog management subsystem in general) to get the parameters of the model from the user, and data from the data management subsystem. It then solves the problem and displays the results, and some variations of the best fit solution through the dialog management subsystem. The alternative solutions, as provided, help the user in decision-making.

Characteristics of DSS

The characteristics of DSS are as follows:

- It works in semi and unstructured environments rather than in a structured environment. In structured environments, DSS is not required as the problem (and environment) and information related to it is structured and available.

In most cases, structured decisions have precedence and, thus, have a reference point. DSS is required in unstructured and semi-structured environments.

- It plays a decision-support role. It does not replace the decision-maker but only helps him to take a better decision by:
 - o making more analysed data available to him
 - o processing the analysed data through a model and making available the possible decision paths
 - o enabling him to conduct ‘what if’ analysis in a simulated environment
 - o helping him put up a realistic picture of outcomes
- It can support individual users or a group of users. DSS can work in an individual or a group mode according to the needs of the organization. In case of group-based decisions, DSS can be tailored to work in groups.
- It supports all phases of the decision-making process.
- It focuses on effectiveness.
- It remains under the control of the DSS user. This is unlike an expert system, which can take action on its own. It also functions as per the users requirements.
- It uses underlying data and models because a DSS is useless without the underlying data. Most DSS work on an empirical platform rather than a theoretical one.
- It can provide support for multiple independent or interdependent decisions.
- It has a model as its core which helps it to solve complex decision problems. This model is the heart of a DSS. It gives a DSS the capability to solve unstructured and semi- structured problems.

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Framework for DSS

Simon laid out the most popular framework for decision support which consists of three linear phases: intelligence, design and choice. Van Grundy, Mintzberg and others have later on modified this framework to suggest that decision-making, as an activity, is too complex to find sufficient description in a linear model. They have gone on to give more comprehensive frameworks. These works led to models on the framework of problem solving. Sprague (1980) gives us a framework for DSS which has three components: database, model base and a dialogue management system.

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A DSS works normally in a client-server or 3-tier architecture environment where the client houses the model and interface, and the server houses the data. Many variations of this are possible. A schematic diagram of a DSS in a client-server environment is shown in Figure 10.1.

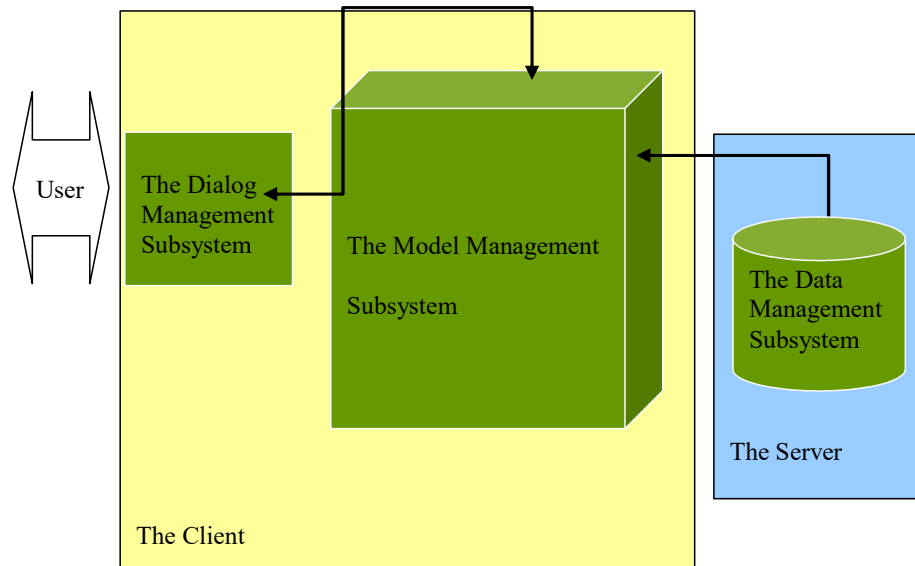


Fig. 10.1 Decision Support System within a Client-Server Framework

Benefits of DSS

DSS helps managements take complex and difficult decisions. It improves the quality of decision-making by helping the decision-maker make an informed choice. It, thereby, improves efficiency and performance.

By expediting problem-solving (mostly at the upper levels), it frees managers and helps them to concentrate on other tasks. Therefore, it helps managers become effective. It enhances the quality of decision-making and, thereby, helps the organization to build a competitive edge.

Check Your Progress

1. How should the user interface of a DSS be?
2. What is a database management system?
3. State the benefits of DSS.

10.3 ARTIFICIAL INTELLIGENCE (AI)

Well-known authors Elaine Rich and Kevin Knight (1991) defined artificial intelligence (AI) as ‘the study of how to make computers do things, at which, at

the moment, people are better'. Artificial intelligence is the study of developing human-like intelligence in computers to aid specific tasks. It is a branch of computer science engineering and the term artificial intelligence was first coined by John McCarthy. AI involves the use of high level mathematics and advanced computational techniques. It also involves, in some cases, the use of pattern recognition and natural language processing.

AI can be used to develop machines that can think and act like humans and hence are useful for decision-making purposes. It is mostly used to develop intelligent robots.

Intelligence or intelligent behaviour may be defined as the capability of:

- Learning from past experience
- Responding swiftly to different changes in the environment and situations successfully
- Deciphering correct meaning from ambiguous messages
- Using logical reasoning in solving problems
- Recognizing relative importance

AI attempts to mimic this kind of intelligence in computers/machines. However, researchers are far from achieving even a fraction of this level of intelligence in machines in the present, but research in this field is showing great promise. A test to determine whether a machine is intelligent was devised by British Computer Scientist Alan Turing and is called the Turing test. The test is administered by a human who converses with an intelligent machine and another human being. The trick is that the person carrying out this conversation does not know which of the two that he is conversing with are the machine and the human. The machine is considered intelligent when the human administering the test cannot tell one from the other.

AI has been a well-researched area of computer science and a lot of new frontiers of research are being reached in this area. Computer scientists are trying to make neural network systems mimic the basic working of human brain cells so that primitive kind of intelligence can be developed. These lead to the development of learning algorithms that further helps in cognition. Combinatorial optimization techniques, probabilistic methods of uncertain reasoning, classification techniques and fuzzy logic are also used in AI to bolster the logic and deductive capabilities in order to develop intelligence. When AI is used in conjunction with robotics, it becomes an even more powerful field.

If one compares artificial intelligence and natural intelligence, one would find artificial intelligence to be more permanent which is easy to duplicate and is

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much faster. However, artificial intelligence may never be able to match the creativity of natural intelligence.

Several other areas of commercial applications that rely on advances in artificial intelligence research are as follows:

- Expert systems
- Natural language processing
- Speech recognition
- Robotics
- Neural computing
- Computer vision

Amongst these application areas of artificial intelligence, the field of robotics is the most interesting. It is the field of knowledge in which advanced machines are developed to perform those tasks that are performed by humans. Unimate was the first robot to be digitally controlled and programmed and was put to use in 1961. The field of robotics borrows extensively from computer science, electrical, electronic and mechanical engineering disciplines. Robotics when used in association with artificial intelligence becomes a powerful and modern field of study. However, major success has not been achieved in this field even though some primitive intelligence can now be incorporated in a robot. There are ethical and legal debates associated with this issue. Popular writers and film makers have also been fascinated by the prospect of a robot that can think and act like humans. A lot of fictional work in literature and films has been based on this theme. However, a robot with human like intelligence will take several decades of research to develop, if at all. Hence, the subject remains in the realm of science fiction.

However, the field of robotics with primitive intelligence or without any intelligence is very much a practical field. Modern manufacturing makes extensive use of robots as robots can offer a level of quality not possible through human intervention. Robots are being used in painting, assembly line, manufacturing, and so on. Robots are also used for dirty or hazardous tasks like cleaning and transferring nuclear waste. They provide precise movement of such material. The International Organization for Standardization defines a robot as ‘an automatically controlled, reprogrammable, multipurpose, manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications.’

Check Your Progress

4. Who devised a test to determine the intelligence of a machine?
- 5 Which was the first robot to be digitally controlled and programmed?

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10.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The user interface of a DSS has to be dynamic and GUI-based. It has to be an easy-to-use user interface as most of the people who will be using it are not technical experts but management experts (top management) and, hence, the interface should be minimalist in design. Also, the system should be able to interact with the user in an interactive mode and, hence, the user interface has to be dynamic.
2. A database Management System is the data store for the DSS. It manages the data and performs all the functions that a typical DBMS package does.
3. DSS helps managements take complex and difficult decisions. It improves the quality of decision-making by helping the decision-maker make an informed choice. It, thereby, improves efficiency and performance. By expediting problem-solving (mostly at the upper levels), it frees managers and helps them to concentrate on other tasks. Therefore, it helps managers become effective. It enhances the quality of decision-making and, thereby, helps the organization to build a competitive edge.
4. A test to determine whether a machine is intelligent was devised by British Computer Scientist Alan Turing and is called the Turing test.
5. Unimate was the first robot to be digitally controlled and programmed and was put to use in 1961.

10.5 SUMMARY

- Decision support systems, or DSS, are required when one has to take decisions on unstructured and semi-structured problems. This means that the problem itself is not clear and a lot of ambiguity is present in the problem and its possible decision path outcomes. Such decisions are more often required to be taken by the top management.
- The DSS helps the decision-maker by providing him with supporting information about each decision path. It is also very interactive. The easy-

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to-use user interface hides the layers of model housed in the system and the user stays oblivious to the complexities of the system.

- DSS requires continuous user interaction. Sometimes, the system should prompt the user to give an input at other times the user should be able to control the process.
- The data management subsystem manages data for a DSS. Data is accessed in a DSS in many ways like ad hoc basis, structured query basis, heuristic search basis, and so on. Hence, a strong data management subsystem is required to service the varied data requests from a DSS.
- Model Management Subsystem is a unique feature of a DSS. The model management subsystem may use different classes of models such as Optimization Models, Simulation Models, Heuristic Models, Deterministic Models and Predictive Models.
- The model management subsystem has the following elements:
 - o Model Base Management System
 - o Model Command Processor
 - o Model Executor or Solver
- Simon laid out the most popular framework for decision support which consists of three linear phases: intelligence, design and choice. Van Grundy, Mintzberg and others have later on modified this framework to suggest that decision-making, as an activity, is too complex to find sufficient description in a linear model.
- Sprague (1980) gives us a framework for DSS which has three components: database, model base and a dialogue management system. A DSS works normally in a client-server or 3-tier architecture environment where the client houses the model and interface, and the server houses the data.
- Artificial intelligence is the study of developing human-like intelligence in computers to aid specific tasks. It is a branch of computer science engineering and the term artificial intelligence was first coined by John McCarthy.
- AI can be used to develop machines that can think and act like humans and hence are useful for decision-making purposes. It is mostly used to develop intelligent robots.

- Other areas of commercial applications that rely on advances in artificial intelligence research are expert systems, natural language processing, speech recognition, robotics, neural computing and computer vision.
- Amongst the application areas of artificial intelligence, the field of robotics is the most interesting. It is the field of knowledge in which advanced machines are developed to perform those tasks that are performed by humans. Unimate was the first robot to be digitally controlled and programmed and was put to use in 1961.

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10.6 KEY WORDS

- **Database Management System:** It is the data store for the DSS. It manages the data and performs all the functions that a typical DBMS package does.
- **Artificial Intelligence:** It is the study of developing human-like intelligence in computers to aid specific tasks.
- **Robotics:** It is the branch of technology that deals with the design, construction, operation, and application of robots.

10.7 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the elements of a typical dialog management subsystem?
2. Briefly mention the components of a model management subsystem.
3. Write a short note on the framework for DSS.
4. Define artificial intelligence (AI).

Long-Answer Questions

1. Examine the components of DSS.
2. Discuss the characteristics of DSS.
3. Explain the applications of artificial intelligence.

10.8 FURTHER READINGS

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UNIT 11 MIS: SUPPORT MODELS AND KNOWLEDGE MANAGEMENT

*MIS: Support Models
and Knowledge
Management*

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Structure

- 11.0 Introduction
- 11.1 Objectives
- 11.2 Philosophy of Modelling
- 11.3 DSS
 - 11.3.1 Deterministic Systems
- 11.4 Market Research Methods
- 11.5 Ratio Analysis for Financial Assessment
- 11.6 Operations Research or Management Science Models
- 11.7 Knowledge Management
 - 11.7.1 Knowledge Discovery in Database (KDD) and Data Mining
- 11.8 Procedural Models
 - 11.8.1 Project Planning and Control Models
 - 11.8.2 Cost Accounting Systems
 - 11.8.3 Mathematical Programming Techniques
- 11.9 Answers to Check Your Progress Questions
- 11.10 Summary
- 11.11 Key Words
- 11.12 Self Assessment Questions and Exercises
- 11.13 Further Readings

11.0 INTRODUCTION

Knowledge management (KM) is a discipline that explores methods and strategies for making knowledge explicit and allowing organizations to share their technical expertise and information resources. In this light, KM makes use of information technology resources to spread awareness and boost the productivity of work groups. Knowledge management systems (KMSs) manage both explicit and tacit knowledge by making data, documents, and information from various sources readily available. KMSs can use a variety of technologies drawn from various fields to achieve these objectives. In this unit, we will discuss the support models and knowledge management, along with the ratio analysis for financial assessment. We will also focus on market research methods and knowledge systems.

11.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the support models and knowledge management
- Discuss the ratio analysis for financial assessment
- Describe the market research methods and knowledge systems

*Self-Instructional
Material*

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11.2 PHILOSOPHY OF MODELLING

A model is an abstraction of something it represents (some phenomenon), called an entity. There are basically four types of models. These are, physical models, narrative models, graphs and mathematical models. Physical models are those that exist in three-dimensional form. Narrative models are those that are created through written descriptions. Graphs are two-dimensional diagrams while mathematical models utilize notations and mathematical equations to represent a system. The following steps should be followed to construct an MIS model:

- Define the problem and the factor that influence it.
- Choose criteria to guide the decision and establish goals.
- Formulate a model that helps management to comprehend the relationships between the influence factors and the goals the organization is trying to achieve.
- Assemble the relevant data while trying to avoid the incorporation of superfluous information into the model.
- Identify the alternatives and choose the best among them. Then implement the alternative.

The following are the advantages of MIS models:

- Can be a learning experience.
- Provides predictive power.
- Less expensive than trial and error method.
- Speed allows consideration of more options.

The following are the disadvantages of MIS models:

- Difficult to model a business system.
- High degree of mathematical skills required.

11.3 DSS

As we have already discussed in the previous unit, a Decision Support System (DSS) is an information system that helps in the decision-making process in a company or organization. DSSs help people make decisions about problems that are rapidly changing and not easily perceived in advance that is, unstructured and semi-structured decision problems at the management, operations, and planning levels of an organization. DSS may be entirely computerized, human-powered, or a hybrid of the two. While academics see DSS as a tool to help with decision-making, DSS users see it as a tool to help with organizational processes. Knowledge-based systems are used in DSSs. A well-designed DSS is an interactive software-based framework that assists decision-makers in compiling valuable

information from a variety of raw data, records, personal knowledge, and business models in order to identify and solve problems and make decisions.

11.3.1 Deterministic Systems

A system is deterministic if its outputs are certain. This means that the relationships between its components are fully known and certain. Hence, when an input is given the output is fully predictable. An example of a deterministic system is the common entrance examination for entry into IIM. All the entities in the system and their interrelationships are well known and given an input the output can be determined with certainty.

A probabilistic system is one where the output from the system behaves probabilistically, i.e., the output is predictable according to probability values. The portfolio investment systems of an asset management company that invests in the stock market will have a probabilistic output for a given input as the system and its entities behave probabilistically.

Random systems are completely unpredictable systems. One is completely unaware of the components and their relationships with each other and hence, the output is random. An example of random system is the transport system. Given an input one is not sure about the output.

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11.4 MARKET RESEARCH METHODS

Marketing is an activity of reaching out to customers, communicating the offerings of the organization to them, selling the product or service, thereby ensuring their satisfaction. An organization can keep its ears close to the pulse of the market, sell its products or services to customers and create long-term relationships with customers through the activity. Marketing information systems are used by the marketing department to help them to take decisions in the marketing domain. The information in this kind of system is mostly transaction level information. Marketing information system helps to manage effectively the marketing department within an organization. The primary role of the marketing information system is to provide managers within the marketing department, handling different marketing activities with relevant information, so that the department can function efficiently and effectively. The system should provide different reports to help the managers understand the ground realities so that they may take appropriate measures. The marketing information system may itself consist of several subsystems. Each of these subsystems performs a specific task and supplies specific information to the users. Some of the subsystems use advanced analytical models to provide information about ground realities in the present as well as the likely scenarios in the future. The subsystems that make up a marketing MIS are as follows:

- **Marketing intelligence subsystem:** This subsystem is responsible for gathering the necessary information from among transaction level data to

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help in the marketing process. Marketing intelligence subsystem is the input subsystem for the marketing MIS. It filters data and helps store critical information. Sometimes the input coming in to this subsystem comes from competitors. Competitor's transaction data and market related intelligence data is also collected and filtered in this subsystem. This subsystem works as a key information provider for other subsystems in the marketing MIS.

- **Market research subsystem:** This subsystem is also involved on the input side of the marketing MIS. The role of this subsystem is to gather data on consumers, markets and competitors from the open market by conducting surveys. The clandestine nature of marketing intelligence is not exhibited in this subsystem. Work of this subsystem is above board and ethical. It collects and analyses key data about the marketing process of the organization as well as the scenario of the market and competition.
- **Sales subsystem:** This provides information that helps the management in selling products or services of a firm. It is one of the most important activities of marketing MIS. Normally, the sale function deals with the management of the channels of sales, i.e., managing whole sellers, retailers, stockists, etc., ensuring that the product or service reaches the consumer. Marketing MIS, therefore, provides information about all such entities. Sales department is the department that is lying at the interface between the customer and the organization and hence, it generates a lot of data. This data is used as an input for the MIS. We can conceptualize the sales department as lying at the boundary between the organizational system and the environment of the customers. The sales subsystem in addition, provides forecasting kind of information to the sales department indicating the future sales, in both volume and revenue terms. It also provides product life cycle type of information indicating the stage at which the product or service is helping the department to organize and develop product strategies.
- **Promotion, advertising and publicity:** This subsystem gives information about the success of each medium of communication, like electronic or print medium and helps the department to formulate communication strategies based on the information of return on investment on each medium of communication. The information system in such cases gives detailed review reports on each Rupee spent on advertisement, promotion or publicity.
- **Product management:** In this subsystem, the marketing MIS provides information about the products, also how the products being received in the market. Exception reports are generated, if the product is not behaving as per expectations. .
- **Customer Relationship Management (CRM):** This is the subsystem of fostering loyalty of the customer towards a brand or product or a company. It encompasses activities that result in greater understanding and knowledge of the customer. The activity enables a company to have a

longer-term view of customers rather than having a short-term view. The activity of CRM is based on the understanding of the customer as a person who has a longer-term relationship with the organization rather than at the time of sale only. The CRM provides key likes and dislikes related information about the customer. The CRM also helps the department to organize customer specific strategies.

- **Pricing:** This is the subsystem, which uses advanced analytics to help the marketing department to take pricing decisions.
- **Packaging:** This is the subsystem, which gives information about packaging. The marketing MIS in this module will help the department by giving vital information about the likely sales for a particular packaging strategy. Decisions on SKU, etc. are done by using such information.

Check Your Progress

1. Mention any three advantages of MIS models.
2. What do you mean by a well-designed DSS?
3. What is the primary role of the marketing information system?

11.5 RATIO ANALYSIS FOR FINANCIAL ASSESSMENT

No organization can survive without the management of its finances. Finance is the function that manages the financial resource of the organization. It is responsible for management of receivables and payables, management of capital expenditure, costing and budgeting, accounting for all activities of the organization and management of taxes. In short, finance is the function that helps us measure the value of the organization in monetary terms using several accounting, costing and mathematical tools. Financial MIS helps the finance department to take financial decisions in a better manner. The financial MIS is linked with several other departments and in some instances; the basic data may not be created at the finance department at all. The MIS has the following subsystems:

- **Working capital management:** This is the subsystem for managing the working capital finances of the organization. Working capital is the capital required to run the organization on a regular basis. It is used to pay for salaries and materials. It normally is in the form of a short-term debt. The system provides information about the requirement for working capital and the ideal method of financing it.
- **Receivables and payables management:** The module of the financial MIS where the receivables and payables of a company are managed, it inevitably results in the management of creditors and debtors and helps the

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management to take suitable decisions about both set of people. This is a very important activity of finance and is done with due diligence. This module manages debtors and creditors by maintaining key information about them and their commercial terms and reference with the organization

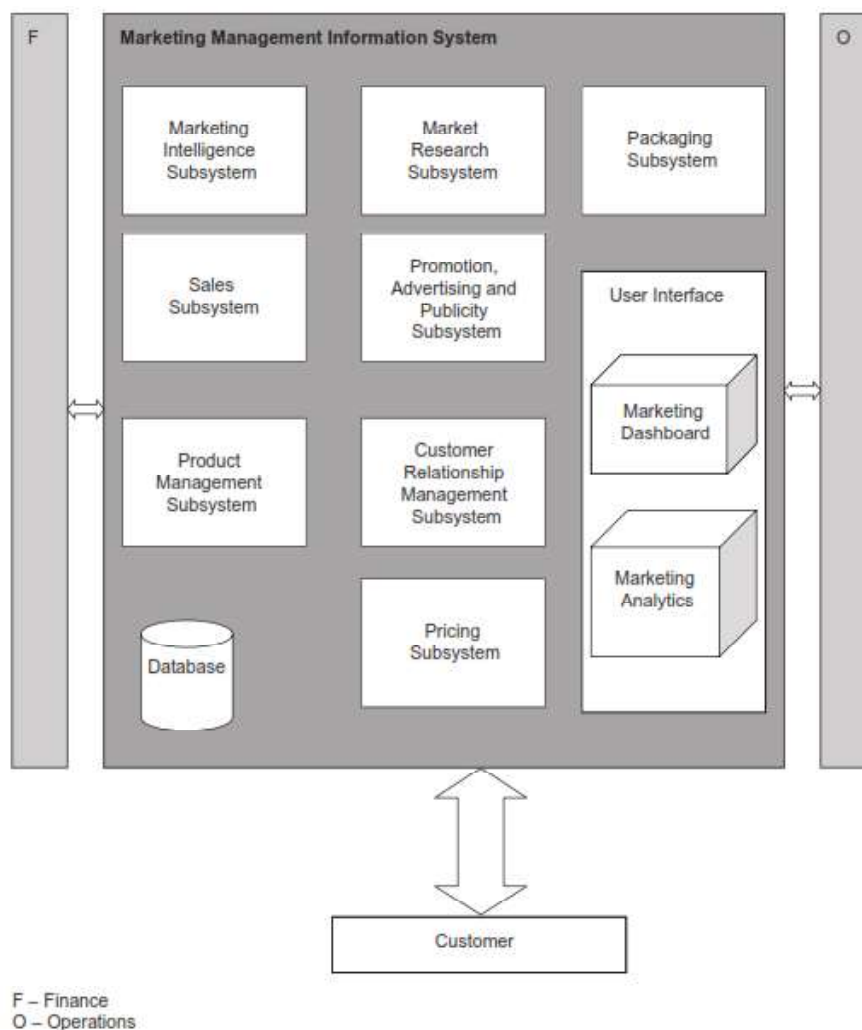


Fig. 11.1 Schematic Diagram of a Marketing MIS

- **Budgeting:** This is a strategic section of finance. The finance MIS offers tools that help the finance department in preparing the budget. The budgeting module also has tools for making projections of future needs of resources, so that the activity of budgeting can be performed well. The budgeting module helps the finance department take decisions on the quantum of money spent on each activity of the organization. This is a complex module and uses a lot of analytical tools.
- **Funds management (Managing borrowings/CAPEX management):** In this module, the finance MIS helps the department to take capital expenditure decisions better by providing relevant information. The module

helps decision makers in the finance department by giving them information about fund utilization, cost of funds and the most suitable fund management options, etc.

- **Interactive financial planning:** This module helps the decision makers in the finance department to plan for finances in the near future. It has interactive tools for scenario building and ‘what if’ analysis, which helps managers in planning for financial matters.
- **Financial control:** This subsystem module helps the finance department to keep a control on the finances, helping the department by giving control related information to the department.

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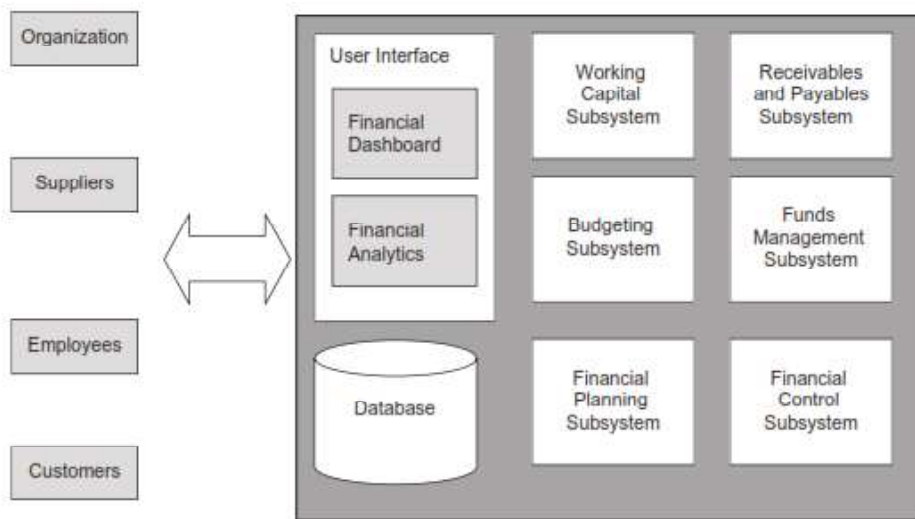


Fig. 11.2 Schematic Diagram of Financial Management Information System

11.6 OPERATIONS RESEARCH OR MANAGEMENT SCIENCE MODELS

All organizations pursue a goal or an objective and offer a service or a product. Operations management ensures the smooth running of all the activities related to the creation of a product or a service. The operations (production) management MIS helps in taking operations related decisions. The operations management MIS is connected to the financial MIS and the marketing MIS so that some basic data can be interchanged between the departments. The system has the following subsystems:

- **Production management subsystem:** It provides information for managing the production process of a firm. It provides information about production in different periods, the planning of capacities and monitoring of the production process so that control can be exercised over the production process. Capacity planning and production scheduling related information

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is also provided so that the operation managers can use this information for better decision-making.

- **Maintenance management subsystem:** It helps in managing the maintenance of machines in a firm. Different companies have different maintenance policies and the system must give the necessary information regarding such policies. The maintenance management subsystem will also have critical information regarding the performance of machines and their period of maintenance free-life.
- **Quality management subsystem:** It helps the quality team take quality-related decisions in a better manner. Quality check data are analysed in this module and information is passed on to the department for decision-making.
- **Project management subsystem:** It provides information about projects. This module has a facility for PERT/CPM (Program Evaluation and Review Technique/Critical Path Method) type analysis and crashing activities to fit the entire project within the cover cost and time schedules. The module on project management also has a lot of visualization and system of alerts to warn the manager of possible problem areas. This is a complex and advanced subsystem.
- **Inventory management subsystem:** It helps in taking decisions on ordering, optimum stock, inventory planning, vendor management and contracts management. This subsystem gives detailed information of all the above issues and helps the managers take decisions on the same. It is a complex subsystem and uses mathematical models.

Any organization succeeds by managing definite resources in a productive way. The traditional list of resources includes labour (manpower), money, material, managers, machines and facilities. Since the past two decades the information has been recognized as a vital resource that helps the management in decision-making. Information is a precious resource and hence it must be managed in a well-designed system so that managers can acquire relevant information in time for their decision-making processes.

Probably most of the manufacturing industries are using information about products by means of the information technology specifications. However, the information technology can be used to design effective management information systems to overcome the specific problems which are investigated and determined on the basis of research. The prime objective of such type of research is to establish the impact of Management Information Systems (MIS) and information technology on the success of manufacturing industries. During the research, the empirical data is collected using various research techniques, such as questionnaires. The collected data is analysed using frequency, correlation and multiple regression analyses. MIS has a significant role in manufacturing companies and also a positive impact on the success of their business. Following are some significant points that must be considered for production scheduling and data collection for research:

Production scheduling

- Simultaneous scheduling of resources and critical path warnings.
- Powerful event tracking functionality.
- Effective ‘what if’ scenarios to observe effects of new equipment or business
- Ability to plan human resource requirements.
- Full reporting including available capacity, sold hours, run lists and actual performance.

Data collection

- Direct job loading using scheduling and estimating.
- Real-time planned vs. actual in scheduling to allow better decisions.
- Eliminating errors from out of date information.
- Monitoring of resources.
- Time management.
- Production material and job reporting standard.
- Workflow tracking and management.

Consider an example of hotel industry which is an important aspect of tourism and which in turn is a vital source of revenue for any country, especially India. The researches have made the conclusion that use and implementation of IT has revolutionized both the hotel and tourism industries. From a tourist’s point of view the information available before travelling is incredibly helpful in terms of making travel plans. Over the Internet, one can get information about tourist spots, hotel locations, room availability and price details as well as pictures of hotels and locations. IT can play a crucial role for the hotel industry because of its potential of creating customer relationships and the flow of information between the industry and its customers. Information technology is widely used in the hotel industry; some common instances of use of IT in hotel management are as follows:

- **Computerized Records:** A hotel can track and record all the interactions between a guest and the hotel, from the booking of the room to the check in and all transactions, such as meals, drinks and services provided during their stay. This data can be used to calculate bills and receipts or to help identify particular client types in order to cater to their needs better in future. The data regarding room bookings can be used in a larger hotel management system to track the number of guests at the hotel at a particular time and can also be used in an online booking facility.
- **Online Booking:** Data regarding room availability can be utilized by the hotel in an online booking system on the hotel’s website. This allows a potential guest to see the availability of different types of rooms as well as the pricing schemes of the hotel. The user can then book a room using this

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system which will automatically update the hotel management system once the booking is confirmed. The hotel staff will be made aware of the bookings and can make preparations for the guest's arrival.

These innovations as well as others using IT can help a hotel focus its manpower on providing the best service it can offer because its clerical and management overheads have been reduced through implementation of an effective computerized system for booking, billing and room management.

11.7 KNOWLEDGE MANAGEMENT

Knowledge can be of two types – implicit and explicit. Explicit knowledge is that knowledge that can be learned easily using tools and techniques but implicit knowledge is more difficult to learn. A knowledge management system focuses mostly on acquiring explicit knowledge. These systems capture explicit knowledge so that there is some learning from it and in future, the organization becomes stronger from this knowledge. Knowledge management systems can hold the following types of knowledge:

1. Descriptive knowledge
2. Procedural knowledge
3. Reasoning knowledge
4. Presentation knowledge
5. Linguistic knowledge
6. Assimilative knowledge

Knowledge management is one of the newer concepts in the information systems literature. It aims to enhance the capacity of organizations in a structured manner to learn from the past so that the future is better. Two concepts associated with knowledge management requires mentioning here: The first one is organizational learning and the second one is organizational memory.

Organizational learning

It is the ultimate aim of knowledge management systems. KM enables organization memory and creates an environment where information is disseminated in a manner that the entire organization learns from the process. For example, if an organization has executed a contracted job in a foreign country about which it knew little before the assignment then all information about the working culture, practices, management, nature of job, etc., of the assignment if kept in a proper manner will foster organizational memory and will ultimately lead to organizational learning. Then even if the same team is not associated with some new job in the future in that country, then the new team will be able to satisfactorily perform the job after having assimilated the learning from the earlier team.

Organization memory

Knowledge management systems aim to enable the organization to have collectively a memory. This is done by formally collecting and putting information from different areas within an organization into one basket so that the organization as a whole benefits from such memory.

11.7.1 Knowledge Discovery in Database (KDD) and Data Mining

Knowledge discovery in database and data mining are related concepts in the sense that the later is a much more refined version of the former. KDD is an exploratory analysis and modelling of large data stores. It is the systematic and scientific process of identifying useful insights and understandable patterns in large data sets. Data mining is at the core of KDD and involves the use of statistical, mathematical, image processing, and other related techniques to explore the data and develop the model to discover unknown insights. The model is the main component of DM.

The KDD process is iterative and interactive and conforms to the following steps:

- Creating/developing an understanding of the application area/domain.
- Selecting/creating the data store/set on which to apply the model for finding a possible solution to an issue.
- Cleaning of dataset/store by removing null entities, inconsistencies, data errors, etc.
- Transforming data to keep in tune with proposed analysis.
- Selecting the appropriate DM tool and model.
- Solving the model with the dataset.
- Evaluating the model solutions.
- Using the discovered knowledge to take actionable decisions.

Check Your Progress

4. Mention any three points that must be considered for production scheduling for research.
5. Mention any three types of knowledge held by knowledge management systems.

11.8 PROCEDURAL MODELS

The procedure of Information Systems (ISs) design targets to help in the discovery of that solution which shall both cover in the best possible way the users' demands and also be feasible within the framework of the data processing environment of

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the organization. In general, a good IS design should possess the following characteristics:

- To be acceptable by all users
- To be auditable
- To be functional
- To face problems “head on”
- To be satisfactory
- To be inexpensive
- To be easy to maintain,
- To be easy to evaluate

It is believed that the above presuppositions are covered, to a great extent, by the proposed procedure.

11.8.1 Project Planning and Control Models

The production planning and control can be divided into three phases namely: planning phase, action phase and control phase. Let’s learn a little bit about these three phases.

Planning phase

Planning as an activity aims to devise a plan to achieve predetermined objectives of the company within the constraints of restrictive circumstances. In the context of production planning, the process includes selecting the optimal schedule for operations, deciding the sequence of economic batch quantity, assigning the machines in manufacturing as per the activities selected and dispatching priorities for sequencing. Planning phase itself includes two different categories of work: prior planning and active planning.

Action phase

This phase includes one of the most important step in production planning and control namely, dispatching. Dispatching can be understood as the transitional step between the planning and action phase. It refers to the order which initiates the manufacturing in an industry. Tools like store issue order, job order, time ticket, move order, and inspection order are the dispatching activities which forms the beginning of the manufacturing of a product. We will discuss the dispatch items in the following section of the unit.

Control phase

The last phase that is the control phase of the production planning and control comprises of two major activities, namely:

- Progress reporting
- Corrective action

As the name suggests, progress reporting keeps a cumulative track of all the data related to the all the activities. This information includes data related to details like equipment failures, operator efficiency, process variations, failures, material rejections, etc. These data help in the comparison of performance and helps in identifying the crucial areas that requires prompt attention. Corrective action comes into force when there are any unforeseen events that stall the production and manufacturing processes. In emergency situations, it might become difficult to follow the pre-set schedules, it then becomes imperative that the managers rehaul the entire product mix. It also includes analysis the problematic processes and improving the troubled areas in the production process.

Functions

The main activities encompassing Production, Planning and Control (PPC) are as follows:

- **Order preparation:** The work of PPC begins once an order is received from the sales department. This order is then converted into a 'work order' or 'shop order' and sent to various departments concerned, for planning action at their end.
- **Materials planning:** Once the order is received, the PPC decides on the raw materials required for manufacture, taking into account the capacity of various production shops, the bill of materials, inventory on hand, and lead time for procurement.
- **Routing (or process planning):** Routing means determination of the sequence of operations for manufacturing a product or service. This path is determined in advance and forms the basis for most of the scheduling and dispatching functions. According to Kimball and Kimball, 'Routing is the selection of path or route over which each piece is to travel in being transformed from raw material into finished product'. Routing includes the following activities:
 - o Deciding the volume of production
 - o Selecting the men, machines and materials to be used in its production
 - o Deciding the type, number, and sequence of production operations
 - o Deciding the place where production is to be carried out

When routing or process planning is being done, a route sheet is prepared. This is done in the following manner:

- o The product is analysed with regard to its constituent parts. A decision is then taken as to what parts are to be manufactured and which are to be purchased.

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- o The specifications, grade, quality and quantity of materials to be used in production are determined.
- o The number of manufacturing operations and their sequence is determined and listed on the route sheet.
- o The process time for each operation and the type and number of machines necessary to produce are determined.
- o The lot size for production is determined keeping in mind the customers' orders and rejections and spoilage anticipated during the course of manufacturing.
- **Estimating:** This involves establishing the operation times for every process; this also leads to fixation of performance standards for both men and machines.
- **Scheduling:** According to Spriegal and Lanburgh, 'Scheduling involves establishing the amount of work to be done and the time when each element of work will start or order of the work'. Thus, scheduling includes the following activities:
 - o Determination of quality and rate of output of the plant or department
 - o Allocation of time for each operation

Scheduling indicates when the work will be released to the plant in a prescribed order and in proper sequence. It fixes the time of start and completion of the operation. The scheduling function begins when the following information is furnished:

- o Date of delivery specified by the customer's order
- o Time required for assembly and subassembly process
- o Time to be taken in the production of component parts
- o Time required to make purchases
- o Time required for moving the materials from one station to the other, inspection, etc.
- o Priority of orders

Necessary provisions for unforeseen contingencies such as power breakdown, strike and lockout, absence of workers or rush of orders of extreme importance, etc. are usually made when the schedule is prepared.

- **Loading:** This involves allocating jobs to machines as per the capacity of machines and priority of jobs to be done, so that the machinery is utilized to the maximum possible extent. It includes the following activities :
 - o Preparation of machine loads
 - o Fixing of actual dates of various operations/sequence of operations to be performed on the jobs

- o Coordination with the sales department to confirm delivery dates and keeping them informed about the status of the schedules

- **Dispatching:** Dispatching means preparation and distribution of work orders and manufacturing instructions to the concerned departments in accordance with the details worked out under routing and scheduling functions. The work order received by the various departments is an authority for them to start the work according to that schedule. According to Spriegal and Lansburgh:

Dispatching involves the meeting of schedules by proper utilization of machines, workplaces, materials and workers, as designed by the routing. The dispatching unit of the planning department thus includes persons whose duty it is to see that orders are issued to the shop, that materials are at the work place, that tools are provided, that job cards are issued, and, in general all necessary steps are taken to ensure that the schedules will be properly carried out.

- **Progressing:** This involves controlling the process of production, collection of data from various manufacturing shops, recording the progress of work and comparing progress against the plan.
- **Expediting and follow-up:** Follow-up means to see whether the work is being carried out according to the plan and orders and instructions issued. It ascertains that the materials, tools and equipment are supplied at the job at the right time and to the right person or job. Follow-up is the means by which the progress and execution of the plan is evaluated from time to time and divergence from the plan is noted. The reasons for such divergence are then found out and efforts are made to eliminate them from the plan.
- **Inspection:** Inspection means comparing the actual with the written or expected specifications and assessing whether they have been met. Inspection can be process inspection or product inspection, in which the process or the product is inspected respectively.
- **Cost control:** Production planning and control is responsible for cost control and cost reduction by reducing or eliminating wastes, value analysis, etc.
- **Miscellaneous functions:** In addition to the above stated functions of production planning and control, there are certain miscellaneous functions such as building cost estimates for products, fixing standards with the help of industrial engineering department, capacity planning, making or buying decisions, making specifications of raw materials, process improvement, etc., that have to be performed. Another function is taking corrective measures. If the production manager feels that routing is defective or scheduling is rigid and unrealistic, he can rectify the route and lay down realistic and flexible schedules. Workload, machines and men should be determined scientifically, and an effective and optimum utilization of the plant's

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capacity should be the objective. Sometimes abnormal situations like strikes and power or machinery breakdown can upset the work schedules. In such situations, the production manager should adjust the schedules and make up for delays. The production manager is also responsible for appraising the performance of personnel working in the production department.

11.8.2 Cost Accounting Systems

Cost Accounting Information System (CAIS) is an accounting information system which determines the costs of products manufactured or services provided and record these costs in the accounting records. It is the key to management's assessment of the company's efforts to achieve profit. Since it is so important, the CAIS must be carefully designed and properly maintained. Generally, the purposes or functions of cost accounting information system fall into four categories. These include providing information for:

- External financial statements,
- Planning and controlling activities or processes,
- Short term strategic decisions and
- Long term strategic decisions.

These four functions relate to different audiences, emphasize different types of information, require different reporting intervals and involve different types of decisions.

11.8.3 Mathematical Programming Techniques

Mathematical programming is one of the most important techniques available for quantitative decision-making. The general purpose of mathematical programming is finding an optimal solution for allocation of limited resources to perform competing activities. The optimality is defined with respect to important performance evaluation criteria, such as cost, time, and profit. Mathematical programming uses a compact mathematical model for describing the problem of concern. The solution is searched among all feasible alternatives. The search is executed in an intelligent manner, allowing the evaluation of problems with a large number of feasible solutions.

Check Your Progress

6. Define dispatching.
7. How is optimality defined in mathematical programming?

11.9 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

*MIS: Support Models
and Knowledge
Management*

1. The following are the advantages of MIS models:
 - (a) Can be a learning experience.
 - (b) Provides predictive power.
 - (c) Less expensive than trial and error method.
2. A well-designed DSS is an interactive software-based framework that assists decision-makers in compiling valuable information from a variety of raw data, records, personal knowledge, and business models in order to identify and solve problems and make decisions.
3. The primary role of the marketing information system is to provide managers within the marketing department, handling different marketing activities with relevant information, so that the department can function efficiently and effectively.
4. Following are some significant points that must be considered for production scheduling for research:
 - (a) Simultaneous scheduling of resources and critical path warnings.
 - (b) Powerful event tracking functionality.
 - (c) Ability to plan human resource requirements.
5. The knowledge management systems can hold the following types of knowledge:
 - (a) Descriptive knowledge
 - (b) Procedural knowledge
 - (c) Assimilative knowledge
6. Dispatching can be understood as the transitional step between the planning and action phase. It refers to the order which initiates the manufacturing in an industry.
7. In mathematical programming, the optimality is defined with respect to important performance evaluation criteria, such as cost, time, and profit.

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11.10 SUMMARY

- A model is an abstraction of something it represents (some phenomenon), called an entity. There are basically four types of models. These are, physical models, narrative models, graphs and mathematical models.

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- DSSs help people make decisions about problems that are rapidly changing and not easily perceived in advance that is, unstructured and semi-structured decision problems at the management, operations, and planning levels of an organization.
- A system is deterministic if its outputs are certain. This means that the relationships between its components are fully known and certain. Hence, when an input is given the output is fully predictable.
- Marketing information systems are used by the marketing department to help them to take decisions in the marketing domain. The information in this kind of system is mostly transaction level information.
- The marketing information system may itself consist of several subsystems. Each of these subsystems performs a specific task and supplies specific information to the users.
- No organization can survive without the management of its finances. Finance is the function that manages the financial resource of the organization.
- Financial MIS helps the finance department to take financial decisions in a better manner. The financial MIS is linked with several other departments and in some instances; the basic data may not be created at the finance department at all.
- All organizations pursue a goal or an objective and offer a service or a product. Operations management ensures the smooth running of all the activities related to the creation of a product or a service.
- The operations (production) management MIS helps in taking operations related decisions. The operations management MIS is connected to the financial MIS and the marketing MIS so that some basic data can be interchanged between the departments.
- Knowledge can be of two types – implicit and explicit. Explicit knowledge is that knowledge that can be learned easily using tools and techniques but implicit knowledge is more difficult to learn.
- A knowledge management system focuses mostly on acquiring explicit knowledge. These systems capture explicit knowledge so that there is some learning from it and in future, the organization becomes stronger from this knowledge.
- KM enables organization memory and creates an environment where information is disseminated in a manner that the entire organization learns from the process.
- Knowledge management systems aim to enable the organization to have collectively a memory. This is done by formally collecting and putting information from different areas within an organization into one basket so that the organization as a whole benefits from such memory.

- The procedure of Information Systems (ISs) design targets to help in the discovery of that solution which shall both cover in the best possible way the users' demands and also be feasible within the framework of the data processing environment of the organization.
- The production planning and control can be divided into three phases namely: planning phase, action phase and control phase.
- Cost Accounting Information System (CAIS) is an accounting information system which determines the costs of products manufactured or services provided and record these costs in the accounting records.
- The general purpose of mathematical programming is finding an optimal solution for allocation of limited resources to perform competing activities.

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11.11 KEY WORDS

- **Semi-Structured Decision:** It is one in which most of the factors needed for making the decision are known but human experience and other outside factors may still play a role.
- **SKU:** In the field of inventory management, a Stock Keeping Unit (SKU) is a distinct type of item for sale, such as a product or service, and all attributes associated with the item type that distinguish it from other item types.
- **Ratio Analysis:** It is a quantitative procedure of obtaining a look into a firm's functional efficiency, liquidity, revenues, and profitability by analysing its financial records and statements.

11.12 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the steps to be followed to construct an MIS model?
2. What are the subsystems that make up an operations management MIS?
3. What is the significance of cost accounting systems?

Long-Answer Questions

1. Discuss the subsystems that make up a marketing MIS.
2. Explain the significance of different subsystems of financial MIS.
3. Describe the main activities encompassing Production, Planning and Control (PPC).

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11.13 FURTHER READINGS

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BLOCK IV
ORGANIZATION AND STRATEGY OF MIS
SECURITY AND ETHICAL ISSUES

*Organization and
Computer Networks*

NOTES

**UNIT 12 ORGANIZATION AND
COMPUTER NETWORKS**

Structure

- 12.0 Introduction
- 12.1 Objectives
- 12.2 Basics of Computer Systems
 - 12.2.1 The Input Unit
 - 12.2.2 The Central Processing Unit (CPU)
 - 12.2.3 The Output Unit
 - 12.2.4 The Memory Unit
- 12.3 Basic Network Terminologies: Definition and Applications
 - 12.3.1 Network Topologies
 - 12.3.2 Private Branch Exchanges (PBX)
 - 12.3.3 LANs and WANs
 - 12.3.4 Broadband Network Services and Technologies
 - 12.3.5 Network Convergence
 - 12.3.6 The Intranet and the Extranet
- 12.4 Database Management Systems: Types of DBMS Users and Designing of DBMS
 - 12.4.1 Advantages of the Database System
 - 12.4.2 Components of DBMS
 - 12.4.3 People Who Work with Databases
 - 12.4.4 The DBMS Architecture
- 12.5 Answers to Check Your Progress Questions
- 12.6 Summary
- 12.7 Key Words
- 12.8 Self Assessment Questions and Exercises
- 12.9 Further Readings

12.0 INTRODUCTION

Computers have pervaded virtually all aspects of life today. In businesses also, the use of computer-based information systems is being increased continuously. To use these systems efficiently, it is imperative for the managers to understand the basics of computer technology. A major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, more powerful and efficient, and reliable devices, characterize each generation of computer. Today, computers are available in many sizes and types, ranging from a small one that fits into the palm to a large one that occupies an entire room. In this unit, we will discuss the basics of computer systems, along

*Self-Instructional
Material*

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with the basic network terminologies. We will also focus on database management systems.

12.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the basics of computer systems
- Discuss the basic network terminologies
- Describe the database management systems

12.2 BASICS OF COMPUTER SYSTEMS

The term computer is derived from the word compute, which means to calculate. A computer is an electronic machine which can perform calculations and control operations that can be expressed either in numerical or logical terms. For this, a computer receives input (using input devices) in the form of instructions (known as programs), processes it (using processors) and then produces the desired output (using output devices).

A computer can be viewed as a system which consists of a number of interrelated components that work together with the aim of converting data into information. The physical parts that make up a computer include an input unit, a central processing unit, an output unit, and a memory unit (see Figure 12.1). All these parts are referred to as hardware.

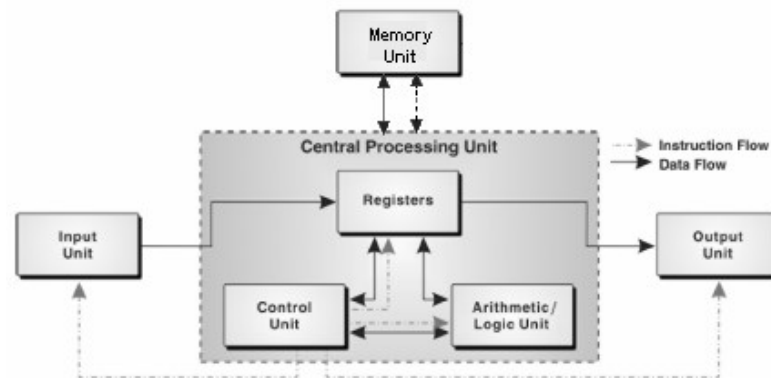


Fig. 12.1 Hardware Components of a Computer

12.2.1 The Input Unit

The basic task of an input unit is to gather data and convert it into a computer-understandable form, that is, in the binary form (form of 0s and 1s). It accepts instructions and data with the help of input devices. An input device is an electromechanical device used to feed data into the computer. Some of the commonly used input devices include the keyboard, pointing devices, scanner,

optical character recognition, magnetic ink character reader, bar code reader, digital camera, and microphone.

Keyboard

A keyboard is the most commonly used input device. It comprises different keys (see Figure 12.2) using which the user can enter data into the computer, and execute commands. It resembles a regular typewriter with a few additional keys. Data is entered into the computer by simply pressing the keys. The layout of the keyboard has changed very little ever since it was introduced. In fact, the change in its technology has been the addition of more keys that provide additional functionality. The number of keys on a typical keyboard varies from eighty-two to 108 keys.

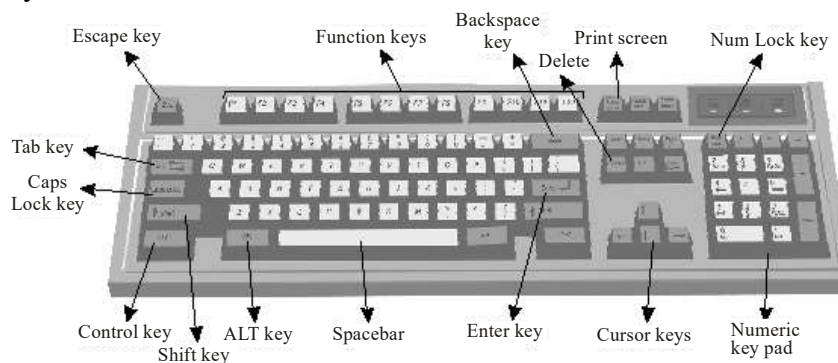


Fig. 12.2 Keyboard

Pointing devices

A pointing device is used to communicate with the computer by pointing to locations on the monitor screen. Such devices do not require keying of characters; instead the users can move a cursor on the screen and perform move, click, or drag operations. Some of the commonly used pointing devices are mouse, joystick, trackball, light pen, and touch screen.

Mouse

Mouse is a small hand-held pointing device used to move the cursor on the screen, issue commands, and select an option from a group of choices. It allows us to create graphic elements on the screen, such as lines, curves, and freehand shapes.

A mouse has generally two or three buttons on its top; the one on the left is known as the left button and the other on the right is known as the right button. It may be classified as a mechanical mouse or an optical mouse (see Figure 12.3), based on the technology it uses.

- **Mechanical mouse:** It comprises a rubber ball at the bottom surface. As the mouse is moved on a flat surface, the rubber ball rotates to move the mouse pointer on the screen. A mechanical mouse is the most common and least expensive pointing device.

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- **Optical mouse:** It uses a light beam instead of a rotating ball to detect the movement. As the user rolls the mouse on a flat surface, the cursor on the screen also moves in the direction of the mouse's movement.



Fig. 12.3 Types of Mouse

Joystick

A joystick (see Figure 12.4) is a device that moves in all directions and controls the movement of the cursor. The joystick offers three types of control, namely digital, glide, and direct. The digital control allows limited movement like up, down, left, and right. The glide and direct controls allow movements in all directions (360 degrees). The direct control joysticks can also respond to the distance and speed with which the stick is moved by the user. The basic design of a joystick consists of a stick attached to a plastic base with a flexible rubber sheath. This plastic base has a circuit board beneath the stick. The electronic circuitry in the joystick measures the movement of the stick from its central position and sends the information for processing.

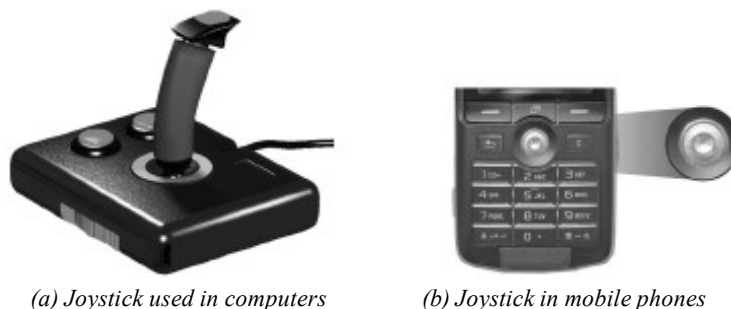


Fig. 12.4 Joysticks

Earlier, joysticks were mainly used in computer games and applications, such as flight simulators, training simulators, CAD/CAM systems, and for controlling industrial robots. They were extensively used to enhance the gaming experience as they provide movement in all directions. Nowadays, joysticks are also used in mobile phones (see Figure 12.4(b)) as a built-in tool to help in navigating, and accessing various built-in features or applications of the mobile phones.

Trackball

Trackball (see Figure 12.5) is another pointing device that is similar to a ball nestled in a square cradle. It functions as an alternative to a mouse. In general, a trackball is a mouse turned upside down. It has a ball, which can be rotated by fingers in any direction, and the cursor moves accordingly. The size of the ball in the trackball varies from as large as a cue balls to as small as a marble. Since it is a static device, instead of rolling the mouse on the top of the table the ball on the top is moved by using fingers, thumbs, and palms. This pointing device comes in various shapes and forms but with the same functions. The three shapes, which are commonly used are a ball, button, and a square. The main advantage of a trackball is that it requires less desk space than a mouse.



Fig. 12.5 A Trackball

Light pen

A light pen (see Figure 12.6) is a hand-held electro-optical pointing device that helps in drawing images and selecting objects on the display screen by directly pointing to the objects. When it touches (or is aimed at) the monitor, light is detected from the screen, enabling the computer to identify the location of the pen on the screen. Although named light pen, it actually does not emit light; instead it contains photocell to detect the presence of light.



Fig. 12.6 Light Pen

Touch screen

A touch screen (see Figure 12.7) is a special kind of display screen device which allows the direct selection or activation of the computer function when somebody

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touches the screen. Essentially, it registers the input when a finger or other object is placed on the screen. The advantage of touch screen is that the information can be accessed with minimum effort. Moreover, it does not require any additional peripheral device to input data. The disadvantage of touch screen is that it is expensive and not suitable for inputs of large amount of data.



Fig. 12.7 A Touch Screen

Typically, touch screens are used in information providing systems like hospitals, airlines and railway reservation counters, ATMs, and so on.

Scanner

A scanner is used to convert text or an image in printed form to an electronic representation which can be viewed on the screen. It scans the input data using a light beam and transforms it to an ASCII code (code used by a computer to represent the characters you find on your keyboard—alphabets, numbers, punctuation marks, and so on) and graphics. Note that most of the scanners come with a utility program that allows them to communicate with the computer and save the scanned image as graphic file on the computer. Moreover, they can store images in both greyscale and colour mode. Some of the commonly used scanners are as follows:

- **Hand-held scanners:** These scanners (see Figure 12.8(a)) are small in size and are available in different resolutions (measure the quality of an image). They are available in either greyscale or in colour. While scanning a document, this scanner is moved a number of times over the document to obtain the best results.
- **Flat-bed scanners:** These scanners (see Figure 12.8(b)) are more expensive than hand-held scanners. It scans the document, image or texts in one go. While scanning, the document is placed on the flat glass surface and the light sensors move over the document to scan it.
- **Sheet-fed scanners:** These scanners (see Figure 12.8(c)) are similar to flat-bed scanners. However, while scanning a document, the document is moved across a stationary scan head. It allows only a paper to be scanned rather than books or other thick objects.

- **Drum scanners:** These scanners (see Figure 12.8(d)) are very expensive and produce high-resolution images. They have a scanning photomultiplier tube. While scanning a document, a drum rolls over the entire document around the tube. Since drum scanners provide high resolution, and are mostly used when a scanned image has to be enlarged.

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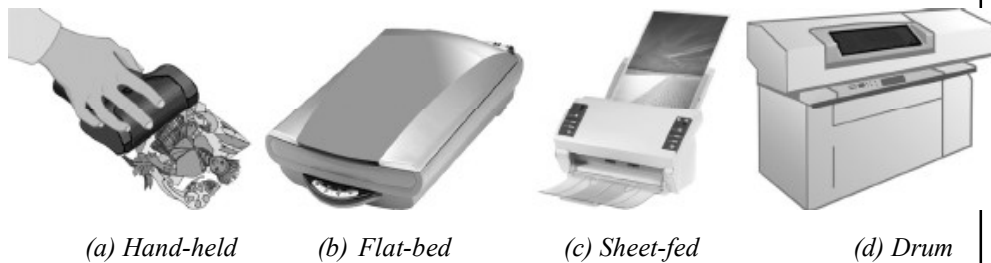


Fig. 12.8 Types of Scanners

Optical Character Recognition (OCR)

OCR is a process to scan printed pages as images on a flat-bed scanner and then use the OCR software in order to recognize the letters as ASCII text. The OCR software has tools to acquire the image from a scanner and recognize the text. In the OCR system (see Figure 12.9), a book or a magazine article is directly inputted into an electronic computer file, and then this file is edited by a word processor. The first major use of OCR was in processing petroleum credit card sales drafts. Over time, other applications evolved, including cash register tape readers, scanners, and so on.

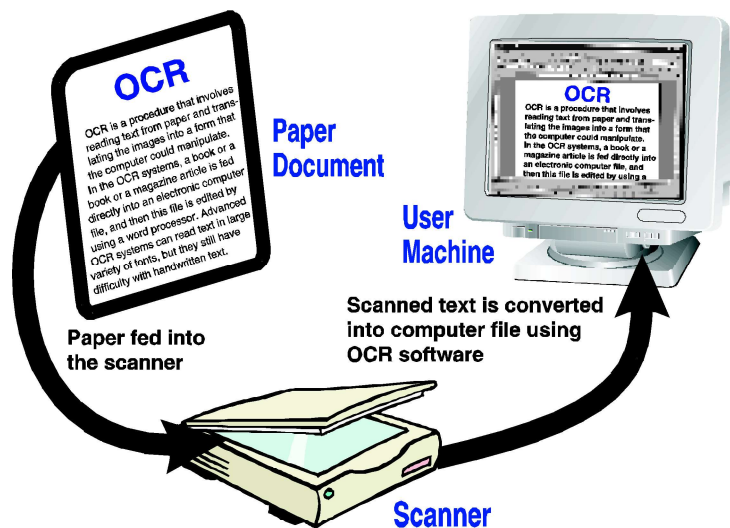


Fig. 12.9 An OCR System

Using an OCR system, one can consolidate data entry and reduce data entry errors. The result of OCR is very human readable and can be used with many printing techniques. However, it is a very expensive input device, and if the document

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is not typed properly, it becomes difficult for the OCR to recognize the characters.

Magnetic Ink Character Reader (MICR)

MICR (see Figure 12.10) is an input device that is used to read the characters printed in magnetic ink. It reads the characters by examining their shapes in a matrix form and the information is then passed on to the computer. It provides a secure, high-speed method of reading and processing information. MICRs are generally used in banks to read the cheque number and branch code which are located at the bottom of the cheques.



Fig. 12.10 Magnetic Ink Character Reader

Bar code reader

A bar code reader is used to read the bar code. A bar code is a machine-readable code in the form of parallel vertical lines of varying widths (see Figure 12.11(a)). Bar codes are commonly used for labelling goods that are available in supermarkets and for numbering books in libraries. The bar code reader (see Figure 12.11(b)) senses and reads the bar codes using reflective light. The information recorded in the bar code reader is then fed into the computer, which recognizes the information from the thickness and spacing of bars.



(a) Bar code

(b) Bar code reader

Fig. 12.11 Bar Code Reader

Digital camera

A digital camera (see Figure 12.12) is a device which stores images digitally rather than recording them on a film. It comprises an electrical sensor and a memory card. The images are stored in the memory card and can be seen after they are captured. The images can also be transferred to the computer and can be printed, edited or sent over the Internet.



Fig. 12.12 A Digital Camera

The major advantage of a digital camera is that making photos is both inexpensive and fast because there is no requirement of film processing.

Microphone

A microphone (see Figure 12.13) or simply mic, is an input device used to convert sound waves into an electric representation of sound waves. Microphones are commonly used in telephones, for recording or for amplifying. A microphone is used as one of the means to communicate over the Internet using a computer. Note that a microphone is connected to the sound card, which is an expansion card used to generate sounds through external speakers.



Fig. 12.13 A Microphone

12.2.2 The Central Processing Unit (CPU)

CPU, also known as processor, is referred to as the brain of a computer system. It takes the data, processes it, and converts the data into meaningful information. It is an extensive and highly complex set of electronic circuits which executes instructions from stored programs. It controls all internal and external devices,

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performs arithmetic and logical operations, and operates only on the binary data. CPU consists of three main subsystems, namely arithmetic logic unit, registers, and control unit. These subsystems work together to provide operational capabilities to the computer.

Arithmetic logic unit (ALU)

ALU contains the electronic circuitry for executing all arithmetic (+, −, *, /) and logical (<, >, =, <=, >=, <>) operations on the data provided to it. Whenever an arithmetic or a logical operation is to be performed, the data required for performing the operation is sent from the main memory to the ALU. The operation takes place and the result is returned to the main memory. If, for example, addition of two numbers, say, 2 and 3, is to be performed, the data 2 and 3 are sent to the ALU from the main memory. ALU performs the addition (2 + 3) and finally sends the output (5) to the main memory. ALU comprises the following two units.

- **Arithmetic unit:** It is responsible for performing and carrying out arithmetic calculations, such as addition, subtraction, multiplication and division.
- **Logic unit:** It performs logical operations based on the instructions provided to it. It can compare letters or special characters or numbers and then can take action on the basis of the result of comparison. Logical operations of the logic unit test for three conditions, namely equal to condition, less than condition and greater than condition. The result of a logical operation can be either true or false.

Registers

Registers are special purpose, high-speed temporary memory units which contain different types of information like data, addresses, instructions and the intermediate results of calculations. Basically, they contain the information that the CPU is currently working on.

Registers can be considered as the working memory of the CPU. They work under the direction of the control unit for accepting, holding, and transferring data or instructions.

Control unit (CU)

The control unit (CU) contains circuitry that uses electrical signals for directing the computer system, for carrying out or executing the stored program instructions. It directs other parts of the system to execute program instructions by communicating with both the arithmetic logic unit and the memory. It does not execute program instructions by itself. It resembles an orchestra leader who himself does not play a musical instrument but directs other people to play instruments in a harmonized manner. The control unit controls the I/O (input/output) devices and transfer of

data to and from the primary memory. The control unit itself is controlled by the individual instructions in programs located in the primary memory.

12.2.3 The Output Unit

The output unit is formed by attaching the output devices to a computer. The basic functioning of the output device is just the opposite of the input device, that is, the data is fed into the computer system through the input device while the output is taken out from the computer through the output device.

Output devices take the machine-coded output results from the CPU and convert them into a form that is easily readable (such as characters or graphics) to human beings. The outputs, which can be easily understood and used by human beings, are in the form of hard copy and soft copy. The physical (printed) form of output is known as the hard copy. The electronic version of an output which usually stays in the computer memory and/or on the disk is known as the soft copy. Some commonly used output devices are printer, plotter, visual display unit, and speaker.

Printer

A printer prints information and data from the computer onto a paper. Some printers print only textual information, whereas others can print graphics as well. Printers are classified into two basic categories, namely impact printers and non-impact printers.

Impact printers

Impact printers work by physically striking a head or a needle against an ink ribbon to make a mark on the paper. Though multiple copies can be printed, they are slow in terms of number of characters per second. Impact printers are classified into line printers and character printers. Line printers print a single line at a time and the printing speed varies between 300 to 3000 lines per minute approximately. Character printers print a single character of the text at a time and the printing speed varies from 30 to 600 characters per second approximately. Some of the impact printers are as follows:

- **Dot matrix printer or wire matrix printer:** It uses the oldest printing technology and prints one character at a time. It consists of a print head which strikes the printer ribbon situated between the paper and the print head pin. As the head stamps onto the paper through the inked ribbon, a character is produced that is made up of dots. The speed of dot matrix printers is measured in characters per second (cps). These printers are inexpensive and have low operating costs. However, these printers are very noisy, print only in black, and produce low-quality printouts. The Figure 12.14 shows a dot matrix printer.

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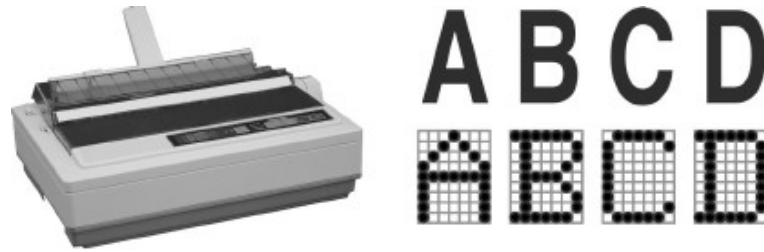


Fig. 12.14 A Dot Matrix Printer

- **Daisy wheel printer or letter quality printer:** It prints professional quality documents. It is named so because the print head of this printer resembles a daisy flower and the printing arms look like the petals of the flower. The print heads of these printers are made of plastic or metallic wheels. A raised character is placed on the tip of each of the daisy wheel's petals. Each petal has an appearance of a letter (upper case and lower case), number or punctuation mark on it. To print, the print wheel is rotated around until the desired character is under the print hammer. The petal is then struck onto the paper, creating the character. Unless the print wheel is physically replaced, daisy wheel printers cannot print graphics and cannot change fonts. These printers are slower and more expensive than dot matrix printers. However, if the appearance of the correspondence is important and you do not need graphics, a daisy wheel printer is a better choice. The Figure 12.15 shows a daisy wheel printer.



Fig. 12.15 A Daisy Wheel Printer

- **Drum printer:** It prints a line in a single operation. It contains a large rotating drum mounted horizontally and positioned in front of a very wide, inked ribbon. This inked ribbon is positioned in front of the paper. The drum contains characters moulded on the surface in columns around its circumference. The drum spins continuously to allow a continuous high-speed printing. Drum printers are much faster than character printers but they tend to be quite loud and often produce a lower print quality. These printers are very expensive and their character fonts cannot be changed. The Figure 12.16 shows a drum printer.

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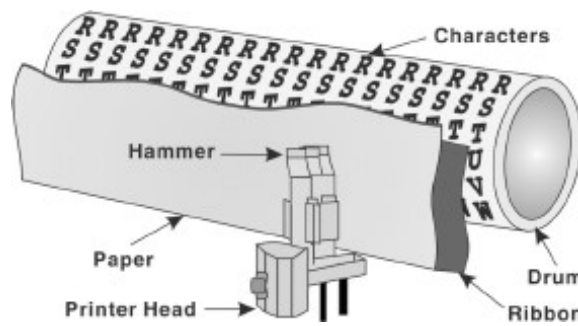


Fig. 12.16 A Drum Printer

Non-impact printers

Non-impact printers do not involve any contact between the print head and the surface that it prints on. These printers provide higher speed in terms of characters per second. Some of the non-impact printers are as follows:

- **Inkjet printer:** It places extremely small droplets of ink onto the paper to create a character or an image. It has a print cartridge with a small series of electrically heated chambers. These chambers are attached to the print head with a series of small nozzles that spray ink onto the surface of the paper. As the print head moves back and forth across the page, it prints a character by shooting small droplets of ink onto the paper. Inkjet printers print documents at a medium pace, but slow down while printing a multicoloured document. These printers are commonly used at homes. The Figure 12.17 shows an inkjet printer.

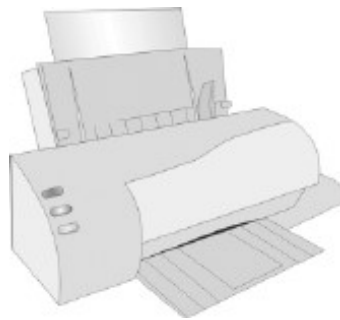


Fig. 12.17 An Inkjet Printer

- **Laser printer:** It provides the highest quality text and images for personal computers today. It is a very fast printer, which operates on the same principle as that of a photocopy machine. Most laser printers can print text and graphics with a high-quality resolution. They are also known as page printers because they process and store the entire page before actually printing it. In laser printers, the document to be printed is converted into a series of ON and OFF commands to the laser, which creates corresponding pulses of light. A spinning mirror deflects the laser beam and creates a horizontal line across the surface

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of a light-sensitive drum. After a horizontal line is created, the drum rotates (normally about 1/300 of an inch) and the laser draws the next horizontal line. These printers are more expensive but useful for volume printing as they are very fast. The Figure 12.18 shows a laser printer.



Fig. 12.18 A Laser Printer

Plotter

A plotter is a pen-based output device that is attached to a computer for making vector graphics (images created by a series of many straight lines). It is used to draw high-resolution charts, graphs, blueprints, maps, circuit diagrams, and other line-based diagrams. Plotters are similar to printers, but they draw lines with the use of a pen. Thus, they are able to produce continuous lines, whereas printers can only simulate lines by printing a closely spaced series of dots. Different coloured pens are used by multicolour plotters for drawing different coloured lines. Colour plots can be made by using four pens (cyan, magenta, yellow, and black) and need no human intervention to change them. There are two different types of plotters, which are as follows:

- **Drum plotter:** It consists of a long cylinder known as the drum. The paper that is to be printed is placed over the drum. The drum can rotate in either clockwise or anti-clockwise direction under the control of plotting instructions sent by the computer. The Figure 12.19(a) shows a drum plotter.
- **Flat-bed plotter:** It consists of a stationary horizontal plotting surface on which a paper is fixed. This plotter is capable of working on any standard, that is, from A4 size paper to big beds. The Figure 12.19(b) shows a flat-bed plotter.



(a) Drum plotter



(b) Flat-bed plotter

Fig. 12.19 Plotters

Visual display unit (VDU)

A VDU, also known as a monitor, is the most basic and commonly used output device for viewing and displaying images. A VDU is similar to a television where images are represented in the form of pixels—the smallest unit of resolution. VDUs are available in a monochrome or a colour display. A monochrome uses only one colour (usually white, green, or black) to display the text on contrasting background. A colour display commonly presents 256 colours at one time from a selection of over 256,000 choices. VDUs can be developed using one of the two technologies, namely cathode ray tube or liquid crystal display.

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Cathode Ray Tube (CRT) monitor

A CRT is a vacuum tube which is used as a display screen for a computer output device. In CRTs, the screen pixels are made from phosphor. An electron beam (cathode ray) is emitted by the electron gun towards the specified position to strike the phosphor. This causes the phosphor to emit light and results in the display of an image. The electron beam scans the screen multiple times per second. A CRT uses three electron guns to scan dots or stripes of green, red and blue phosphorus coated on the screen. Figure 12.20 shows a CRT monitor.



Fig. 12.20 A CRT Monitor

Liquid Crystal Display (LCD) monitor

An LCD screen (see Figure 12.21(a)) is lighter, portable, and compact as compared to a CRT monitor. It is used in smaller computers like personal digital assistants (PDAs) and laptops. In addition, LCD is commonly used in digital watches and cellular phone displays.

An LCD screen comprises different layers (see Figure 12.21(b)). The rearmost layer is known as the backlight which is a fluorescent light source. There are two polarizing filters and light passes through the first filter. The polarized light then passes through a layer containing thousands of liquid crystals aligned in small containers known as cells. These cells are aligned in rows across the screen; one or more cells make up one pixel. Three liquid crystal cells make up one pixel.

Each of these three cells has a red, green or a blue filter. Light that passes through the filtered cells creates the colours on the LCD.

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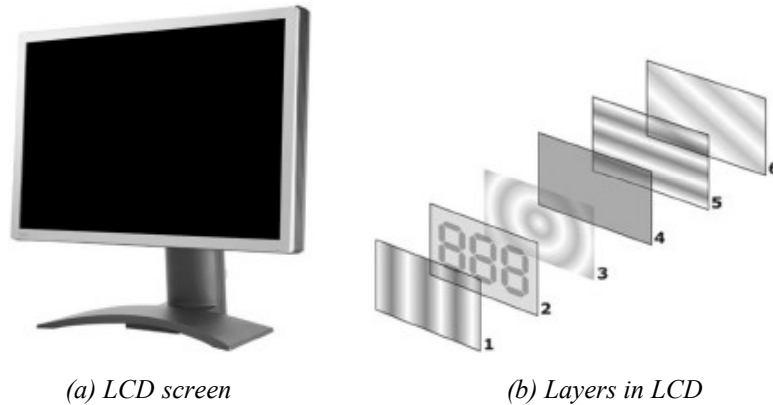


Fig. 12.21 A Liquid Crystal Display Monitor

Speaker

A speaker (see Figure 12.22) is used to generate sound as an output. It generates sound by converting the electric signals into sound waves which enable us to hear. It can be attached to the computer using a sound card or may be provided inside the computer by the manufacturer.



Fig. 12.22 Speakers

12.2.4 The Memory Unit

The memory unit is used to store the input data, intermediate results during the course of calculations, and the final results. The memory of a computer can be considered as 'cells' which are broken down into smaller parts known as bits. A bit is the basic unit of memory. It is the smallest unit of information on a computer. A single bit can hold either one of the two values, 0 or 1, and is represented by 'b' (in lower case). Memory can be divided into two categories, namely primary memory and secondary memory.

Primary memory

The primary memory, also known as the main memory, stores data and instructions for processing. Logically, it is an integral component of the CPU, but physically, it

is a separate part placed on the computer's motherboard (also known as the main board). It can be further classified into two types, namely random access memory and read-only memory.

Random Access Memory (RAM)

RAM is the memory where the operating system, application programs and current data are temporarily stored so that the processor of the computer can access them quickly when required. It is volatile in nature which means that the information stored in it remains as long as the power is switched on. As soon as the power is switched off, the information contained is lost.

Read-only Memory (ROM)

The ROM is the memory which contains contents that once written can only be read and used but cannot be modified. These contents are prewritten by the manufacturer. Every computer comes with a small amount of ROM which contains the boot firmware (called BIOS). This holds information that enables the computer system to perform start operations and transfers the control to the operating system. Unlike RAM, it is non-volatile in nature, that is, the contents of ROM are not lost even in case of a sudden power failure.

Secondary memory

The secondary memory, also known as the auxiliary memory, is used for storing instructions and data, since the main memory is temporary and limited in size. This memory is less expensive and has a much larger storage capacity than the primary memory. Instructions and data stored on such storage devices are usually permanent in nature and can be removed only when the user wants, or if the device is destroyed. Note that unlike CPU registers and the main memory, the secondary memory is not directly accessible to the processor. The processor can access the secondary memory via the main memory, that is, firstly, the information from the secondary memory is shifted to the main memory, and then to the processor. Some commonly used secondary storage devices are floppy disk, magnetic tape, hard disk, and optical disk.

Floppy disk

A floppy disk (see Figure 12.23(a)) simply known as a floppy is a data storage device which is a mylar (a thin polyester film) disk coated with a magnetic material. It is enclosed in a square plastic body which provides protection to the disk surface.

Floppy disks are read and written by a Floppy Disk Drive (FDD) which is a device that performs operations on a disk, including rotating the disk, reading, and writing data onto the disk. These are portable and can be used to carry data easily from one machine or device to another. These are available in two sizes — 5¼ and 3½ inch. The 5¼-inch floppy can store up to 1.2 MB of data and the 3½-inch floppy can store up to 1.44 MB of data.

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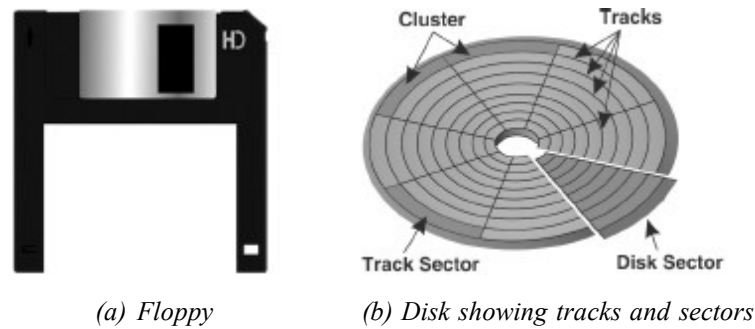


Fig. 12.23 Floppy Disk

The surface of floppy disk is divided into tracks and sectors (see Figure 12.23(b)). Tracks are series of concentric circles where data is recorded. Each track contains the same number of bytes and, hence, the amount of data is limited to the size of the innermost track. The track is divided into sectors. A sector is an imaginary pie of slices formed with the intersection of tracks.

Magnetic tape

A magnetic tape (see Figure 12.24) appears similar to the tape used in music cassettes. It is a plastic tape with magnetic coating. The data is stored in the form of tiny segments of magnetized and de-magnetized portion on the surface of the material. The magnetized portion of the surface refers to the bit value '1', whereas the demagnetized portion refers to the bit value '0'. Magnetic tapes are available in different sizes, but the major differences are the speed at which the tape is moved past the read/write head and the density of the recorded information. The amount of data or the number of binary digits that can be stored on a linear inch of tape is known as its recording density.



Fig. 12.24 A Magnetic Tape

Magnetic tapes are very durable and can be erased as well as reused. These tapes are cheap and reliable storage media for organizing archives and taking backup. However, these are not suitable for data files that need to be revised or updated often, because it stores data in a sequential manner.

Hard disk

A hard disk (see Figure 12.25), also known as a hard drive or a fixed disk, is a storage device that can store a large amount of data (up to 160 GB approximately). In other words, these storage devices have the capacity to store data equivalent

to 1000s floppies. A hard disk consists of a stack of disk platters that spin on the spindle. Platters are made up of aluminium alloy or glass substrate with a magnetic material coating and protective layers. Each platter is divided into tracks which are further divided into smaller sectors. Each platter has two heads (read/write), one on the top of the platter and the other on the bottom; so, a hard disk with three platters would have six surfaces and six heads.

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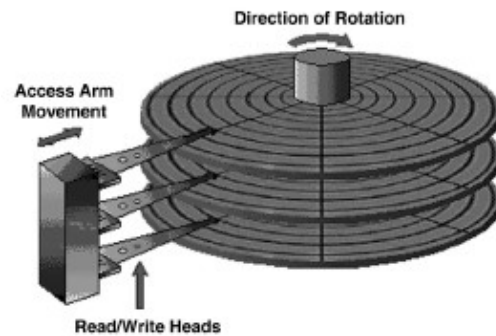


Fig. 12.25 Hard Disk

Hard disks are read and written by a hard disk drive. The reading and writing of the data is done with a read/write head. The platters rotate at a high speed and the read/write head records data onto the disk or reads data from it.

Optical disk

Apart from magnetic tape and magnetic disk, a new storage medium, which is gaining popularity, is the optical disk. An optical disk is a circular, flat, plastic disk coated with material. Bits in an optical disk may be stored in the form of highly reflective areas and significantly less reflective areas, and from this the stored data may be read upon illumination with a narrow-beam source like a laser diode. These disks are capable of storing enormously high amount of data in a limited amount of space. The optical disk storage system consists of a rotating disk coated with a thin layer of metal (aluminium, gold, or silver) that acts as a reflective surface and a laser beam, which is used as a read/write head for recording data onto the disk. The two most commonly used optical disks are as follows:

- **Compact disk (CD):** It has a shiny and a silver-coloured surface and is of 12 cm in diameter. It can store approximately 650MB to 800MB of data. Originally, it was developed only for storing music (in the form of digital audio), but now it can also store textual data and graphics files. CDs are broadly divided into two categories, which are as follows:
 - o **CD-recordable (CD-R):** The data can be written only once and once the data is written, it cannot be deleted or modified.
 - o **CD-rewritable (CD-RW):** The data can be written, erased and rewritten many times.

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Fig. 12.26 A Compact Disk

- **Digital video disk (DVD):** It is an optical disk that resembles a CD. However, it holds much more data as compared to a CD. It can store up to 8.5 GB of data which makes it a very useful storage medium. DVDs are broadly divided into two categories, which are as follows:
 - o **DVD-recordable (DVD-R):** The data can be written only once.
 - o **DVD-random access memory (DVD-RAM):** The data can be written, erased and rewritten many times.



Fig. 12.27 A Digital Video Disk

Check Your Progress

1. What is the number of keys on a typical keyboard?
2. What types of controls are provided by a joystick?
3. What is the advantage of a trackball over a mouse?
4. Define registers.
5. What is the difference between impact printers and non-impact printers?
6. How are sectors of a floppy disk formed?

12.3 BASIC NETWORK TERMINOLOGIES: DEFINITION AND APPLICATIONS

Communication networks refer to an arrangement of telecommunications components that facilitate transmission of information. There are a number of ways to organize the telecommunications components to design a communication

network, thereby providing a number of ways to classify the communication networks. One possible way is to classify networks on the basis of their layout or topology; another is on the basis of geographical area they span.

12.3.1 Network Topologies

The term 'topology' refers to the way a network is laid out either physically or logically. The selection of a particular topology is important and depends upon a number of factors, such as cost, reliability and flexibility. The various network topologies include bus, ring, star, tree, mesh, and graph.

Bus/linear topology

The bus topology uses a common single cable to connect all the workstations. Each computer performs its task of sending messages without the help of the central server. Whenever a message is to be transmitted on the network, it is passed back and forth along the cable from one end of the network to the other. However, only one workstation can transmit a message at a particular time in the bus topology.

As the message passes through each workstation, the workstations check the message's destination address. If the destination address in the message does not match with the workstation's address, the bus carries the message to the next station until the message reaches its desired workstation. Note that the bus comprises terminators at both ends. The terminator absorbs the message that reaches the end of the medium. This type of topology is popular because many computers can be connected to a single central cable.

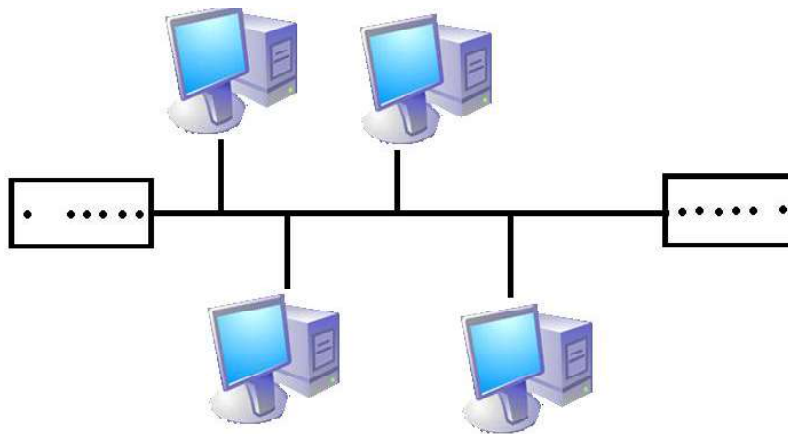


Fig. 12.28 Bus Topology

Its advantages are:

- It is easy to connect and install.
- It involves a low cost of installation.
- It can be easily extended.

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Its disadvantages are:

- The entire network shuts down if there is a failure in the central cable.
- Only a single message can travel at a particular time.
- It is difficult to troubleshoot an error.

Ring/circular topology

In the ring topology, the computers are connected in the form of a ring without any terminated end. Every workstation in the ring topology has exactly two neighbours. The data is accepted from one workstation and is transmitted to the destination through a ring in the same direction (clockwise or counter clockwise) until it reaches its destination.

Each node in a ring topology incorporates a repeater. That is, each workstation retransmits data or message received from a neighbouring workstation, no signal is lost and, hence, repeaters are not required. In addition, since the ring topology does not have a terminator that terminates the message received, the source computer needs to remove the message from the network.

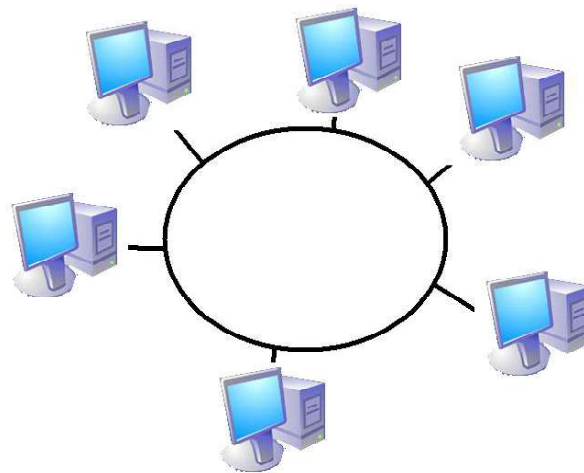


Fig. 12.29 Ring Topology

Its advantages are:

- It is easy to install.
- It uses lesser cable length for installation.
- Every computer is given equal access to the ring.

Its disadvantages are:

- The maximum ring length and the number of nodes are limited.
- A failure in any cable or node breaks the loop and can bring down the entire network.

Star topology

In the star topology, the devices are not directly linked to each other but are connected through a centralized network component known as the hub or the concentrator. Computers connected to the hub by cable segments send their traffic to the hub that resends the message either to all the computers or only to the destination computer. The hub acts as a central controller and if a node wants to send the data to another node, it boosts up the message and sends the message to the intended node. This topology commonly uses a twisted pair cable; however, coaxial cable or optical fibre can also be used. It is easy to modify and add new computers to a star network without disturbing the rest of the network. Quite simply, a new line can be added from the computer to the central location and plugged into the hub. However, the number of systems that can be added depends upon the capacity of the hub.

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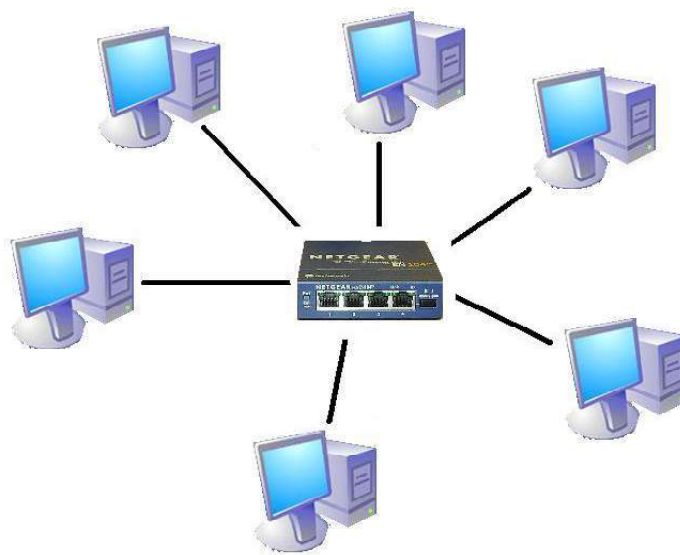


Fig. 12.30 Star Topology

Its advantages are:

- It is easy to troubleshoot.
- A single node failure does not affect the entire network.
- Fault detection and removal of faulty parts are easier.
- In case a workstation fails, the network is not affected.

Its disadvantages are:

- It is difficult to expand.
- The cost of the hub and the longer cables makes it more expensive than others.
- In case the hub fails, the entire network fails.

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Tree topology

The tree topology combines the characteristics of the bus and star topologies. It consists of groups of star-configured workstations connected to a bus backbone cable. Every node is not directly plugged to the central hub. The majority of nodes connect to a secondary hub which in turn is connected to the central hub. Each secondary hub in this topology functions as the originating point of a branch to which other nodes connect. This topology is commonly used where a hierarchical flow of data takes place.

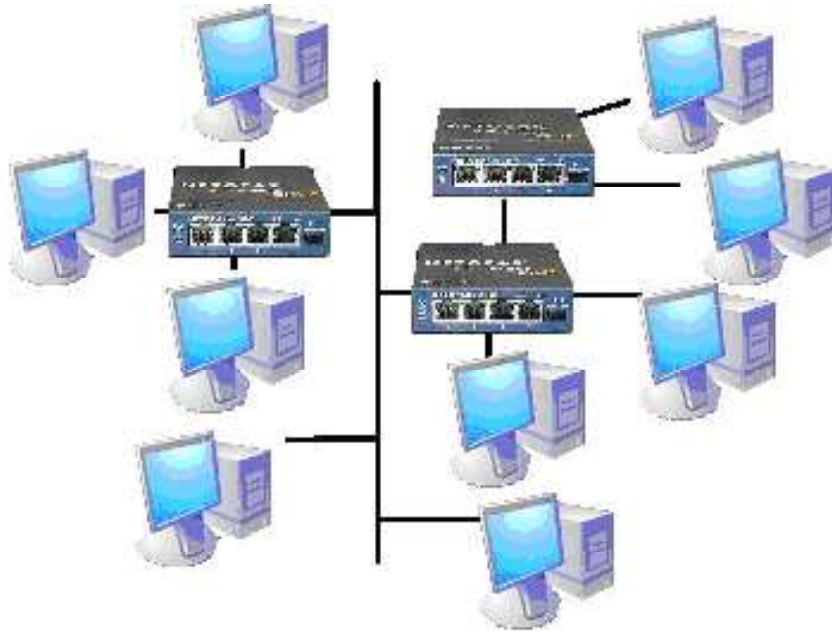


Fig. 12.31 Tree Topology

Its advantages are:

- It eliminates network congestion.
- The network can be easily extended.
- The faulty nodes can easily be isolated from the rest of the network.

Its disadvantages are:

- It uses large cable length.
- It requires a large amount of hardware components and, hence, is expensive.
- The installation and reconfiguration of the network is very difficult.

Mesh topology

In the mesh topology, each workstation is linked to every workstation in the network. In other words, every node has a dedicated point-to-point link to every other node. The messages sent on a mesh network can take any of the several

possible paths from the source to the destination. A fully connected mesh network with n devices has $n(n-1)/2$ physical links. If, for example, an organization implementing the topology has 8 nodes, $8(8-1)/2$, that is, 28 links are required. In addition, routers are used to dynamically select the best path to be used for transmitting data. The mesh topology is commonly used in large Internet-working environment because it provides extensive backup and outting capabilities. This topology is ideal for distributed computers.

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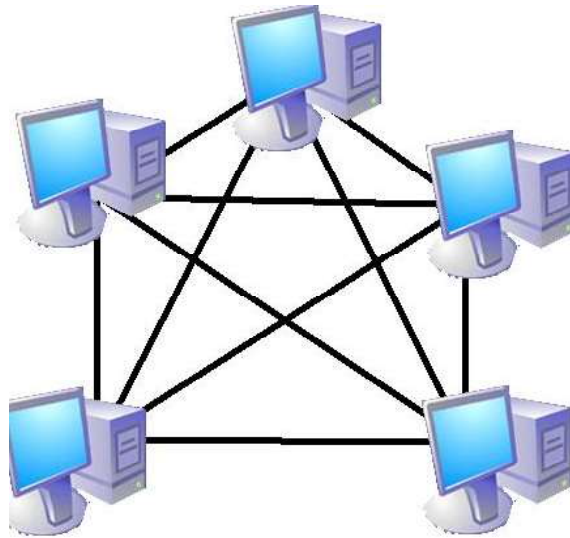


Fig. 12.32 Mesh Topology

Its advantages are:

- The availability of large number of routes eliminates congestions.
- It is fault tolerant, that is, failure of any route or node does not result in network failure.

Its disadvantages are:

- It is expensive as more cabling is required.
- It difficult to install.

Graph topology

In a graph topology, the nodes are connected randomly in an arbitrary fashion. There can be multiple links and all the links may or may not be connected to all the nodes in the network. However, if all the nodes are linked through one or more links, the layout is known as a connected graph.

12.3.2 Private Branch Exchanges (PBX)

As the name implies, PBX is a private telephone exchange designed to serve a particular organization or office. Unlike usual telephone exchanges that handle telephone calls of many organizations as well as general people, PBX handles the

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telephone calls of a particular organization only. It not only connects the internal phones of the organization to each other, but also connects them to the public switched telephone network (PSTN)—the main public network. Since PBX integrates telephones, modems, fax machines, and other office devices, each end point on the branch is generally referred to as an extension.

PBX has a dial plan and provides a small number (three or four digits) to connect to any extension within the organization. It also provides an escape code (usually a single digit code) dialing which enables the users to make calls outside the organization. Although initially the PBX was used to reduce the cost on internal calls, today it also offers other services, including call forwarding, storing, holding, and redialing. One latest development in PBX is the development of the Voice over Internet Protocol (VoIP) PBX, which uses the Internet protocols to carry both voice and data.

Other latest trends include focus on core competence. Many (small) organizations realized that handling PBX is not related to their core competence and it is costly for them to purchase and maintain the hardware components required for PBX. Therefore, the concept of hosted PBX arose. In this setup, PBX is maintained by specialized companies and they provide services to other organizations via the Internet. Organizations seeking PBX services just have to sign up for the services from the specialized companies.

12.3.3 LANs and WANs

Computer network is an interconnection of computers that exchange information as well as share resources among them. It can be as small as several personal computers on a small network, or as large as the Internet. Computer networks can be classified into two main categories, namely Local Area Network and Wide Area Network on the basis of the size of the network.

Local area network (LAN)

A local area network (LAN) is the network restricted to a small area, such as an office or a factory or a building. It is a privately owned network that is confined to an area of a few kilometres. In a LAN, the computers connected have a network operating system installed in them. One computer is designated as the file server which stores all the software that controls the network and the software that can be shared by the computers attached to the network. The other computers connected to the file server are called workstations. The workstations can be less powerful than the file server and may have additional software on their hard drives. On most LANs, cables are used to connect the computers. Generally, a LAN offers a bandwidth of 10 to 100 Mbps. LANs are distinguished from other networks by three main characteristics, including their size, topology, and transmission technology.

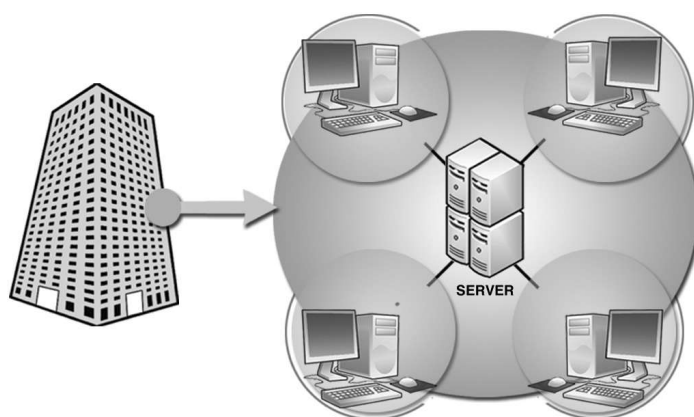


Fig. 12.33 Local Area Network

Wide area network (WAN)

A wide area network (WAN) spreads over a large geographical area like a country or a continent. It is much bigger than a LAN and interconnects various LANs. This interconnection helps in a faster and more efficient exchange of information at a higher speed and low cost. These networks use telephone lines, satellite transmission and other long-range communication technologies to connect the various networks. A company, for example, with offices in New Delhi, Chennai and Mumbai may connect their individual LANs together through a WAN. The largest WAN in existence is the Internet.



Fig. 12.34 Wide Area Network

12.3.4 Broadband Network Services and Technologies

The telecommunications revolution increased the demand for high-speed transmission as well as access to the Internet. Many services and technologies are available that can fulfill this demand. Some of these are as follows:

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- **Frame relay:** It is a fast and less expensive network service, and using this service, a speed of 56 Kbps to 40 Mbps can be achieved. It divides data into frames before transmission and takes advantage of high-speed and reliable digital circuit for transmission. The use of digital circuits lessens the need for error checking. Frame relay services are used by many organizations in their communication networks.
- **Asynchronous transfer mode (ATM):** In this technology, data is transmitted in fixed-size cells of 53 bytes—48 bytes are used for data and 5 bytes are used for header information. It is capable of transmitting data, voice, and video with a speed of 1.5 Mbps to 9 Gbps.
- **Integrated services digital network (ISDN):** It is a dedicated connection that involves digitization of the telephone network so that digital data, such as voice, graphics, and text, can be transmitted over the existing telephone lines. ISDN services are provided in two levels—basic rate ISDN and primary rate ISDN. The basic rate ISDN can transmit data with a speed of 128 Kbps, whereas the primary rate ISDN is faster and can achieve a speed of 1.5 Mbps.
- **Digital subscriber line (DSL):** It is also a dedicated connection that uses the standard telephone lines to transmit and receive information digitally. The speed provided by this connection ranges from 128 Kbps, to 8 Mbps and thus, it is suitable for both homes and small business organizations. It is more expensive than ISDN but provides high speed. Moreover, it does not interfere with normal telephone use.
- **Cable:** It is a new and fast emerging technology that establishes a temporary and on-demand connection between a computer and analog cable TV network to allow data transmission over the existing cable line. It requires a special device called **cable modem** to modulate and demodulate the data and provides access speed ranging from 512 Kbps to 20 Mbps. It is suitable for both homes and businesses. It is economical as well as provides higher speed than dial-up and ISDN.
- **T-lines:** When big firms need to transmit huge amount of data over long distances with high security, they often lease high-speed data lines called **T-lines**. T-lines range from T-1 to T-4, where each line supports different data transmission rate. T-1 and T-3 lines are widely used by customers and they support data transmission rate of 1.544 Mbps and 45 Mbps respectively.

12.3.5 Network Convergence

The term network convergence is used to refer to the technologies that help communicating a variety of data (voice, text, and video) into a single network. Many organizations have switched their several independent networks to a single

converged network in order to save their cost of IT operations. A major demand of network convergence is a high bandwidth of network, since voice, text, and video data is to be transmitted through a single network. To meet this demand, adequate hardware should be installed properly at different points in the network. Another demand is to establish the standards for smooth operation of network regardless of the end-user platforms and the communication mediums.

12.3.6 The Intranet and the Extranet

The Intranet is a system of computers inside an organization that makes it possible for people who work there to look at the same information and to send information to each other. On the other hand, an extranet is a controlled private network that allows access to partners, vendors and suppliers or an authorized set of customers – normally to a subset of the information accessible from a company's Intranet.

Check Your Progress

7. Define network topology.
8. In which of the topologies neither hub nor router is used?
9. What is the function of PBX?
10. Define file server.
11. Mention the various broadband network services and technologies that provide high-speed transmission as well as access to the Internet.
12. What is the difference between the Intranet and Extranet?

12.4 DATABASE MANAGEMENT SYSTEMS: TYPES OF DBMS USERS AND DESIGNING OF DBMS

The bottlenecks of the file system approach lead to the introduction of the database approach, which consolidates data from distinct files into databases that can be shared by a number of applications. A database can be defined as a collection of interrelated data from which users can efficiently retrieve the desired data. In addition to the storage and retrieval of data, certain other operations can also be performed on a database. These operations include adding, updating, and deleting data. All these operations on a database are performed using a **database management system (DBMS)**, which is an integrated set of programs used to create and maintain a database. The main objective of DBMS is to provide a convenient and an effective method to define, manipulate, store, and retrieve the data stored in the database. In addition, DBMS ensures the security of the database from unauthorized access, and the recovery of data during system failures. It also provides techniques for data sharing among several users. The database and the DBMS software are collectively known as the database system.

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12.4.1 Advantages of the Database System

In the database approach, the data is stored at a central location and shared among multiple users. Thus, the main advantage of the database system is the centralized data management. The centralized nature of the database system provides several advantages, which overcome the limitations of the conventional file processing approach. These advantages are as follows:

- **Controlled data redundancy:** During the database design, various files are integrated, and each logical data item is stored at a central location. This eliminates replication of the data item in different files, and ensures consistency and saves the storage space. Note that the redundancy in the database systems cannot be eliminated completely, as there could be some performance and technical reasons for having some amount of redundancy. However, DBMS should be capable of controlling this redundancy in order to avoid data inconsistencies.
- **Enforcing data integrity:** In the database approach, enforcing data integrity is much easier. Various integrity constraints are identified by the database designer during designing the database, some of which are enforced automatically by DBMS while others are to be implemented in the application programs.
- **Data sharing:** The data can be shared among the various application programs. Moreover, new applications can be developed to use the same stored data. Data sharing enables to satisfy the data requirements of new applications without having to create any additional data or with minimal modification.
- **Ease of application development:** The application programmer needs to develop the application programs according to the needs of the users. The other issues like concurrent access, security, data integrity, etc., are handled by DBMS. This makes the application development an easier task.
- **Data security:** Since the data is stored centrally, enforcing security constraints is much easier. DBMS ensures that the only means of access to the database is through an authorized channel. Hence, data security checks can be carried out whenever access is attempted to sensitive data. To ensure security, DBMS provides security tools, such as user codes and passwords.
- **Multiple user interfaces:** To satisfy the demands of various users having different technical knowledge, DBMS provides different types of interfaces, such as query languages, application program interfaces, and graphical user interfaces (GUI) that include forms-style and menu-driven interfaces. A form-style interface displays a form to each user and the user interacts using these forms. In a menu-driven interface, the user interaction is through the lists of options known as menus.

- **Backup and recovery:** DBMS provides backup and a recovery subsystem which is responsible for recovery from hardware and software failures. If, for example, the failure occurs in between the transaction, the DBMS recovery subsystem either reverts the database back to the state which existed prior to the start of the transaction or resumes the transaction from the point it was interrupted, so that its complete effect can be recorded in the database.

In addition to the advantages due to the centralized data management, database system also has some other advantages, which are as follows:

- **Program-data independence:** It is an important characteristic of DBMS that allows changing the structure of the database without making any changes in the application programs which are using the database.
- **Data abstraction:** The property of DBMS that allows program-data independence is known as data abstraction. Data abstraction allows the database system to provide its users with an abstract view of data without providing the physical storage and implementation details.

12.4.2 Components of DBMS

A database management system has the following three components:

- **Data Definition Language (DDL):** The data definition language is a special language that allows specifying the structure of the database. The DDL statements are also used to specify the integrity rules, thereby maintaining the database integrity. Like any other programming language, DDL also accepts a set of instructions (statements) as input and generates the description of structure of the database as output.
- **Data Manipulation Language (DML):** Once the database structure is defined, data needs to be manipulated. The manipulation of data includes insertion, deletion, and modification of records. DBMS provides a data manipulation language (DML) that enables users to retrieve and manipulate the data. The statement which is used to retrieve the data is called a query.
- **Data dictionary:** Apart from the data, the database also stores metadata, which describes the tables, columns, indexes, constraints, and other items that make up the database. In simple words, metadata is data about data. This metadata is stored in an area called the data dictionary. DBMS refers the data dictionary before reading or modifying the data. Note that the database users cannot update the data dictionary; instead it is only modified by the database system.

12.4.3 People Who Work with Databases

Database is an important asset of business. To design, use and maintain such important asset, many people are involved. The people who work with databases

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include the database users, systems analysts, application programmers, and the database administrator (DBA). Database users are those who interact with the database in order to query and update the database, and generate reports. Database users are further classified into the following categories:

- **Naive users:** The users who query and update the database by invoking some already written application programs. The naive users interact with the database using form interface.
- **Sophisticated users:** Users, such as business analysts, scientists, etc., who are familiar with the facilities provided by DBMS interact with the system without writing any application programs. Such users use the database query language to retrieve data from the database to meet their complicated requirements.
- **Specialized users:** The users who write specialized database programs which are different from traditional data processing applications, such as banking and payroll management which use simple data types. Specialized users write applications, such as expert systems, knowledge-based systems, and CAD systems that store data having complex data types.

Systems analysts determine the requirements of the database users (especially naive users) to create a solution for their business needs, and focus on non-technical and technical aspects. The non-technical aspects involve defining the system requirements, facilitating interaction between the business users and technical staff, etc. The technical aspects involve developing the specification for user interface. Application programmers are the computer professionals who implement the specifications given by the systems analysts, and develop application programs. They can choose tools, such as rapid application development (RAD), to develop the application programs with minimal effort. The database application programmer develops application programs to facilitate easier data access for the database users.

The database administrator (DBA) is a person who has central control over both the data and the application programs. The responsibilities of a DBA vary depending on the job description, and the corporate and organizational policies. Some of the responsibilities of a DBA are as follows:

- **Schema definition and modification:** The overall structure of the database is known as the database schema. It is the responsibility of the DBA to create the database schema by executing a set of data definition statements in DDL. The DBA also carries out the changes to the schema according to the changing needs of the organization.
- **New software installation:** It is the responsibility of the DBA to install new DBMS software, application software, and other related software. After installation, the DBA must test the new software.

- **Security enforcement and administration:** The DBA is responsible for establishing and monitoring the security of the database system. It involves adding and removing the users, auditing, and checking for the security problems.
- **Data analysis:** The DBA is responsible for analysing the data stored in the database, and studying its performance and efficiency in order to effectively use the indexes, parallel query execution, etc.
- **Preliminary database design:** The DBA works along with the development team during the database design stage due to which many potential problems that can arise later (after installation) can be avoided.
- **Physical organization modification:** The DBA is responsible for carrying out the modifications in the physical organization of the database for better performance.
- **Routine maintenance checks:** The DBA is responsible for taking the database backup periodically in order to recover from any hardware or software failure (if they occurs). Other routine maintenance checks that are carried out by the DBA are checking the data storage and ensuring the availability of free disk space for normal operations, upgrading disk space as and when required, etc.

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12.4.4 The DBMS Architecture

A major purpose of DBMS is to provide users with an abstract view of the database. It implies that the system does not provide all the details of data; rather it hides the details of how the data is stored and maintained. DBMS provides three levels of abstraction, namely internal, conceptual and the external level.

- **The internal level:** This is the lowest level of data abstraction that deals with the physical representation of the database on the storage medium. The internal level is also known as the physical level. At this level, complex low-level data structures are described in detail, which deal with the actual storage. The data structure simply includes what data is stored and how it is represented in the memory. The low-level data structure also includes the internal details of the database, such as the storage space occupied by a record, the offset for each data of a record, etc.
- **The conceptual level:** This level describes what type of data is actually contained in the database and what relationships exist among them. The conceptual level is also known as the logical level. At this level, the database is described in the form of simple structures, such as tables and constraints. The users of the conceptual level are not concerned with the details of the internal level. They are just concerned with ‘what’ data is contained rather than ‘how’ it is contained.

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- **The external level:** This is the highest level of abstraction. The external level (or the view level) depicts the view of the database from an individual user. Most users of the database do not require all the information contained in the database. Hence, the database can provide different information to different classes of users. Concisely, this level is concerned with the way in which individual users view the data.

The Figure 12.35 shows the DBMS architecture (also known as the three-level architecture) for the employee database containing details like employee number, employee name, salary, etc. The external level shows the database view from two different users. The first user's external view incorporates two fields, Employee Number and Employee Name. The second user's external view also incorporates two fields, namely Employee Name and Salary. The conceptual level represents different fields of database like Employee Number (6 characters), Employee Name (25 characters) and Salary (5 digits). The internal level represents the total record length (36 bytes) of the database. Note that an offset is the displacement of the data from the base address in the memory.

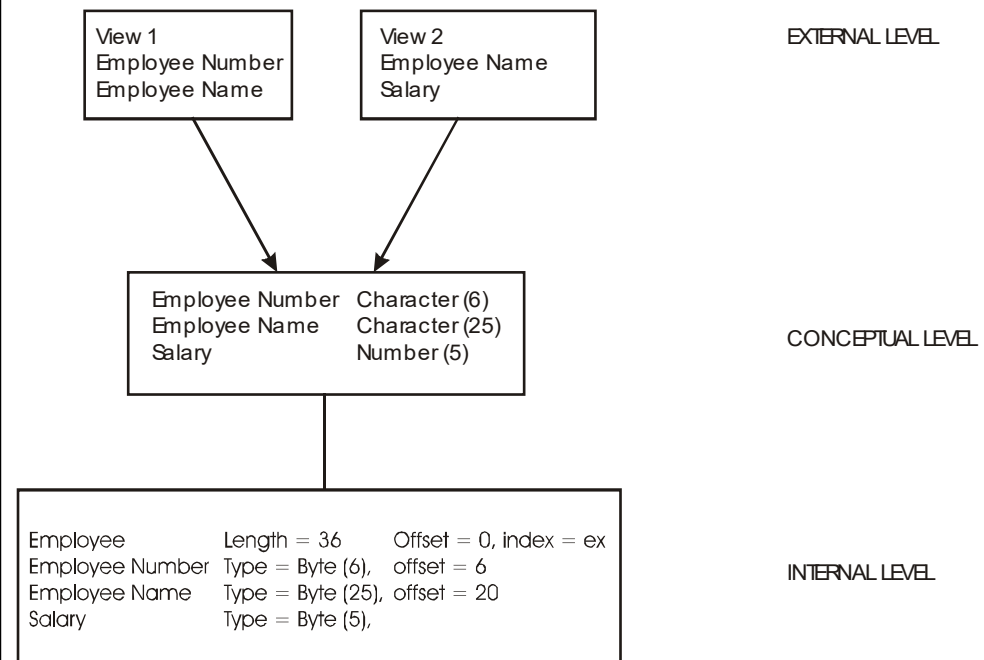


Fig 12.35 The DBMS Architecture

Data Independence

The main advantage of the three-schema architecture is that it provides data independence. Data independence refers to the ability to modify the database structure at one level without affecting the database structure in the next higher level. There exist two levels of data independence, namely logical data independence and physical data independence.

- **Logical data independence:** It is the ability to make changes of the external views or application programs at the conceptual level independently. Simply, it pertains to the immunity of the external model to the modifications in the conceptual model. The examples of the changes at the logical level include addition and removal of entities in the database.
- **Physical data independence:** It is the ability to change the physical organization of data without making any changes at the conceptual or the external level. Modification at the physical level is occasionally necessary in order to improve the performance. Simply, it pertains to immunity of an application to the modifications in the internal level and the access strategy (the way of accessing data). The examples of changes at the physical level include reorganization of files, adding a new access path, etc.

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Check Your Progress

13. What do you mean by a database system?
14. Which type of users query and update the database by invoking some already written application programs?
15. Which level of data abstraction deals with the physical representation of the database on the storage medium?
16. What is logical data independence?

12.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The number of keys on a typical keyboard varies from 82 to 108 keys.
2. The joystick offers three types of control, namely digital, glide, and direct. The digital control allows limited movement like up, down, left, and right. The glide and direct controls allow movements in all directions (360 degrees). Direct control joysticks can also respond to the distance and speed with which the stick is moved by the user.
3. The advantage of a trackball over a mouse is that a trackball requires less desk space than a mouse.
4. Registers are special purpose, high-speed temporary memory units which hold various types of information, such as data, instructions, addresses, and the intermediate results of calculations.
5. Impact printers work by physically striking a head or needle against an ink ribbon to make a mark on the paper while non-impact printers do not involve any contact between the print head and the surface that it prints on.
6. A sector is an imaginary pie of slices formed with the intersection of tracks.

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7. The network topology refers to the way a network is laid out either physically or logically.
8. In ring topology, neither hub nor router is used.
9. PBX handles the telephone calls of a particular organization. It not only connects the internal phones of the organization to each other but also connects them to the public switched telephone network (PSTN)—the main public network.
10. The computer that stores all the software to control the network and the software that can be shared by the computers attached to the network is called the file server.
11. The various broadband services and technologies that provide high-speed transmission as well as access to the Internet include frame relay, ATMs, ISDN, DSL, cable, and T-lines.
12. The Intranet is a system of computers inside an organization that makes it possible for people who work there to look at the same information and to send information to each other. On the other hand, an extranet is a controlled private network that allows access to partners, vendors and suppliers or an authorized set of customers—normally to a subset of the information accessible from a company's Intranet.
13. The database and the DBMS software are collectively known as the database system.
14. Naive users query and update the database by invoking some already written application programs.
15. Internal level of data abstraction deals with the physical representation of the database on the storage medium.
16. The ability to make changes at the conceptual level independently of the external views or application programs is known as Logical data independence.

12.6 SUMMARY

- A computer is an electronic machine which can perform calculations and control operations that can be expressed either in numerical or logical terms.
- A computer receives input (using input devices) in the form of instructions (known as programs), processes it (using processor) and then produces the desired output (using output devices).
- The physical parts that make up a computer include an input unit, a central processing unit, an output unit, and a memory unit. All these parts are referred to as hardware.

- An input device is an electromechanical device used to feed data into the computer. Some of the commonly used input devices include keyboard, pointing devices, scanner, optical character recognition, magnetic ink character reader, etc.
- The central processing unit (CPU), also known as processor, is referred to as the brain of a computer system. It takes the data, processes it, and converts the data into meaningful information.
- ALU contains the electronic circuitry that executes all arithmetic (+, −, *, /) and logical (<, >, =, <=, >=, <>) operations on the data made available to it.
- The control unit (CU) contains circuitry that uses electrical signals for directing the computer system, for carrying out or executing the stored program instructions.
- Output devices take the machine-coded output results from the CPU and convert them into a form that is easily readable to human beings. Some commonly used output devices include printer, plotter, visual display unit, and speaker.
- The memory unit is used to store the input data, intermediate results during the course of calculations, and the final results. Memory can be divided into two categories, namely primary memory and secondary memory.
- The primary memory, also known as the main memory, stores data and instructions for processing. It can be further classified into two types, namely random access memory and read only memory.
- The secondary memory, also known as the auxiliary memory is used for storing instructions and data, since the main memory is temporary and limited in size. Some commonly used secondary storage devices are floppy disk, magnetic tape, hard disk, and optical disk.
- Communication networks refer to such an arrangement of telecommunications components that facilitate transmission of information. They can be classified on the basis of their layout or topology, or on the basis of the geographical area they span.
- The term topology refers to the way a network is laid out either physically or logically. The various network topologies include bus, ring, star, tree, mesh, and graph.
- Private branch exchange (PBX) is a private telephone exchange designed to serve a particular organization or office.
- PBX not only connects the internal phones of the organization to each other but also connects them to the public switched telephone network (PSTN)—the main public network.

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- A computer network is an interconnection of computers that exchange information as well as share resources between them.
- A local area network (LAN) is the network restricted to a small area, such as an office or a factory or a building. It is a privately owned network that is confined to an area of a few kilometres.
- A wide area network (WAN) spreads over a large geographical area like a country or a continent. It is much bigger than a LAN and interconnects various LANs. This interconnection helps in a faster and more efficient exchange of information at a higher speed and low cost.
- The term network convergence is used to refer to the technologies that help communicating variety of data (voice, text, and video) into a single network.
- The bottlenecks of the file system approach lead to the introduction of the database approach, which consolidates the data from distinct files into databases that can be shared by a number of applications.
- A database can be defined as a collection of interrelated data from which users can efficiently retrieve the desired data.
- The main objective of DBMS is to provide a convenient and an effective method to define, manipulate, store, and retrieve the data stored in the database. The database and the DBMS software are collectively known as the database system.
- In the database approach, the data is stored at a central location and shared among multiple users. Thus, the main advantage of the database system is the centralized data management.
- A database management system has three components, namely data definition language (DDL), data manipulation language (DML), and data dictionary.
- A database administrator (DBA) is a person who has the central control over both data and application programs. The responsibilities of a DBA vary depending on the job description, and the corporate and organization policies.
- A major purpose of a DBMS is to provide users with an abstract view of the database. It implies that the system does not provide all the details of data; rather it hides the details of how the data is stored and maintained.
- DBMS provides three levels of abstraction, namely internal, conceptual and the external level.
- The data independence refers to the ability to modify the database structure at one level without affecting the database structure in the next higher level.

12.7 KEY WORDS

- **Phosphorus:** It is a synthetic fluorescent or phosphorescent substance, especially one used to coat the screen of a cathode ray tube.
- **Motherboard:** It is the main printed circuit board (PCB) in general-purpose computers and other expandable systems.
- **Optical Disk:** In computing and optical disc recording technologies, an optical disk is a flat, usually circular disc that encodes binary data in the form of pits and lands on a special material on one of its flat surfaces.
- **Coaxial Cable:** It is a type of electrical cable consisting of an inner conductor surrounded by a concentric conducting shield, with the two separated by a dielectric; many coaxial cables also have a protective outer sheath or jacket.

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12.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What functions does each unit of CPU perform?
2. Write a short note on printers.
3. What are the types of scanners that are being commonly used these days?
4. What are the responsibilities of a DBA?

Long-Answer Questions

1. Discuss the different types of pointing devices available for use.
2. Describe the memory unit of a computer system in detail.
3. Describe the various types of network topologies along with their advantages and disadvantages.
4. Explain the advantages of the centralized nature of database system.

12.9 FURTHER READINGS

Senn, James A. 1984. *Analysis and Design of Information System*. New York: McGraw-Hill.

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UNIT 13 STRATEGIC MANAGEMENT INFORMATION SYSTEM

*Strategic Management
Information System*

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Structure

- 13.0 Introduction
- 13.1 Objectives
- 13.2 Strategic Management Information System
 - 13.2.1 Background
 - 13.2.2 Performance
 - 13.2.3 Value Chain
- 13.3 Product Differentiation
- 13.4 How IT Influences Organizations' Goals
 - 13.4.1 The Five Levels
 - 13.4.2 Governance Modes in the Use of IT
- 13.5 Answers to Check Your Progress Questions
- 13.6 Summary
- 13.7 Key Words
- 13.8 Self Assessment Questions and Exercises
- 13.9 Further Readings

13.0 INTRODUCTION

Information systems are aimed at solving the problems of the organization or offering new opportunities. Strategic information systems attempt to give competitive advantage to the organization. There are several factors that can make a product or service superior to that of its competitors. These factors should be considered while devising the differentiation strategy. There are five major types of competitive threats, namely, industry (existing) competitors, threat of substitutes, bargaining power of buyers, bargaining power of suppliers, and threat of new entrants. Information Technology also helps managers establish direct control over business functions, personnel and other resources. This unit will discuss in detail strategic information system, differentiation strategy and five levels of competitive threat. The role of information technology and IT governance will also be explained.

13.1 OBJECTIVES

After going through this unit, you will be able to:

- Discuss in detail Strategic Management Information System
- Understand how companies devise their differentiation strategy
- Explain the impact of Information Technology on organizational goals
- Examine the five levels of competitive threats
- Explain the concept of IT governance

*Self-Instructional
Material*

13.2 STRATEGIC MANAGEMENT INFORMATION SYSTEM

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Information systems are designed with the goal of solving some problems or seeking new opportunities. The information system that helps an organization to accomplish a long-term competitive advantage is known as **strategic information system (SIS)**. It can be developed from scratch or by modifying an existing system.

These systems change the goals, operations, products, services, and processes of the organization to help it gain an edge over the competitors. Sometimes, even the organization's business needs to be changed, which in turn forces it to adopt the new behaviour patterns. All these results in changing internal operations, recruiting new managers and workforce, and establishing close relationships with customers and suppliers.

13.2.1 Background

The concept of SIS was first introduced into the field of information systems in 1982-83 by Dr. Charles Wiseman, President of a newly formed consultancy called Competitive Applications, who gave a series of public lectures on SIS in NYC sponsored by the Datamation Institute, a subsidiary of *Datamation Magazine*.

13.2.2 Performance

The overall performance of a firm depends on the performance of each business unit. The performance can be improved if all the business units work together instead of on their own and share their knowledge. The information systems promote synergy by integrating separate business units so that they can act as a whole. The business units are combined in such a way that the outputs of one unit become inputs to other units, thereby lowering the cost and increasing the profits.

Information systems encourage sharing of knowledge, and thus, help in creating a core of competency. A **core competency** is an activity for which a firm is the foremost leader. It may include the world's best toymaker or the best package delivery service. It depends on the knowledge that is obtained over several years of experience and a good research organization. Such a system also improves existing competencies and enables the employees to become aware of the new external knowledge.

13.2.3 Value Chain

The most commonly used model to support business-level strategies is the Value Chain Model. According to this Model, every firm is a sequence of basic activities, with each activity adding some value to its products or services. The Model aims to identify those activities where information technology can be applied effectively to help a firm in gaining an advantage over its competitors.

The basic activities that constitute a firm are classified into primary and support activities. **Primary activities** are directly associated with production and distribution of products or services of a firm that create value for the customer, whereas **support activities** provide support to primary activities. Various primary and support activities along with the type of strategic information system that can be used to make them cost-effective are listed in Table 13.1.

Table 13.1 Primary and Support Activities along with the Type of Information System used

Activities		Description	Type of SIS used
Primary	Inbound logistics	Includes receiving and storing materials for distribution	Automated warehousing systems
	Operations	Converts inputs into finished products	Computer-controlled machining systems
	Outbound logistics	Involves storing and distributing finished products	Automated shipments scheduling systems
	Sales and marketing	Includes promoting and selling products	Computerized ordering systems
	Service	Includes maintaining and repairing goods or services	Equipment maintenance systems
Support	Organization infrastructure	Administration, management	Electronic scheduling systems
	Human resource	Hiring and training of employees	Workforce planning systems
	Technology	Improving products and production process	Computer-aided design systems
	Procurement	Purchasing inputs	Computerized ordering systems

Internet technologies enable firms to expand their value chain to include customers, suppliers, and other business partners, thereby creating a value web. A **value web** is a group of independent firms that coordinate their value chain with the use of information technology to generate a product or service for a market collectively. Using the value web, the firms can maintain long-term relationships with their customers, as well as adjust to the changing demand and supply needs.

Check Your Progress

1. Who introduced the concept of SIS?
2. What is Value Chain Model?

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13.3 PRODUCT DIFFERENTIATION

In considering a differentiation strategy, there are various factors or dimensions which can be exploited to establish a product or service and make it superior to that of competitors. For industrial products, seven different dimensions of superior product quality may be considered, namely, features, conformance to quality standards specified by customers, actual performance, durability, reliability, style and design. In addition to the differentiating factors of a physical product, differentiation strategy can be pursued further through delivery, installation, service, customer training, maintenance, repair and post-purchase product upgrades. For consumer goods and services, core attributes of many products/services are often very similar, (e.g., liquid detergents, life insurance or general insurance), and, the customer may find it difficult to distinguish between performance of various products/services in the market. In such situations, one way to differentiate the company from the competitor is to use promotion as a means of creating a perceived difference in the minds of the customers. For example, Fairy Liquid is promoted in UK as an effective washing detergent which, because of very mild formulation, promises that ‘hands that do dishes can be as soft as your face.’

Here are some more examples of how companies can differentiate their products/brands ; a unique taste (Dr. Pepper, Listerine); multiple features (Microsoft Windows and Microsoft Office); wide selection and one-stop shopping (Walmart, Amazon.com, Shopper’s Stop); superior service (FedEx); spare parts availability (Caterpillar guarantees 48 hour spare parts delivery to any customer anywhere in the world or else the part is supplied free); engineering design and performance (Mercedes, BMW); status/prestige and distinctiveness (Rolex); product reliability (Johnson & Johnson in baby products); quality manufacture (Michelin in tyres, Honda in automobiles); technological leadership (3M Corporation in bonding and coating products).

Effective bases of, or approaches to, differentiation are those which are difficult for competitors to imitate or involve large investments. History of strategic management and marketing shows that resourceful competitors can ‘clone’ almost any product, if considered profitable by them. If, for example, Coca-Cola introduces a vanilla-flavored soft drink, so can Pepsi; if Ford offers a 50,000 km bumper-to-bumper warranty on its new vehicles, so can General Motors, Volkswagen and Toyota. This implies that, for differentiation to be sustainable, it should be based on core competence or distinctive competence or ‘unique competitive capabilities’ of a company. Such differentiation should typically be based on product or process innovation, technical superiority, product quality or reliability or customer service (like the Caterpillar example above). In such cases, buyers perceive distinct/differentiating value and this is difficult for competitors to offset easily.

Differentiation strategy may work best under certain specific product and market situations. Six such situations are mentioned below:

- (a) There are many ways to differentiate the product and buyers perceive these differences;
- (b) Incorporating features in the product which increase buyer satisfaction in non-economic or intangible ways (Goodyear's Aqua tread tyres specially appeal to safety-conscious motorists);
- (c) Buyer needs and uses are diverse and many;
- (d) Price is based on maximum perceived value and not actual value (cost);
- (e) Different competitors follow different approaches to differentiation avoiding one-to-one rivalry or confrontation;
- (f) Fast technological change in the industry and competitors make frequent product changes.

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13.4 HOW IT INFLUENCES ORGANIZATIONS' GOALS

The development of Information Technology has been an important revelation in the field of technology since the Industrial Revolution. Due to this, the world has become closer. Not only this, it has also altered the way people think and interact with each other. Organizations are slowly and gradually using information technology to solve business problems, improve efficiency and effectiveness of the decision making process and increase productivity in order to achieve dynamic stability and compete for new markets. According to Cerere, organizations have always tried to adapt technologies that can improve the efforts of the manpower in production and management. He also observed that information technology despite evolving has become an important tool in the management of organizational operations.

Information Technology can be defined as the hardware, software, telecommunications, database management, and other information-processing technologies used to store, process, and deliver information. It can be used to help managers establish direct control over business functions, personnel and other resources. There has been an increasing reliance on information technology as companies use it achieve their missions and goals in an effective way. In the current business environment that is aggressive and global in nature, information technology plays a key role in offering solutions to problems and improving management decision making. Moreover, Information Technology also offers exciting opportunities for organizations to achieve their goals effectively. Therefore, leaders

in organizations must fully appreciate the possibilities offered by Information Technology.

Performance

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Information technology is at the centre of varied business functions, operations, products and services. Organizations, today, spend at least 50 per cent of their investment funds on IT and related communications. The manner in which organizations manage their investments is important in terms of organizational efficiency and effectiveness. Furthermore, IT is often the link between the business model and the critical drivers of success. Many organisations have been unsuccessful with their IT-based investments because of poor alignment of IT with the business.

13.4.1 The Five Levels

A vital task of a strategist is to anticipate and/or recognize the nature of competition and potential threat from competitors and to develop appropriate response strategies. The most difficult task in this is to properly assess the magnitude of existing competition and correctly foresee the threat from new and emerging competitors. Porter (1980) in his pioneering work on competitive strategy had identified five major types of competitive threats, which are valid even today. These are:

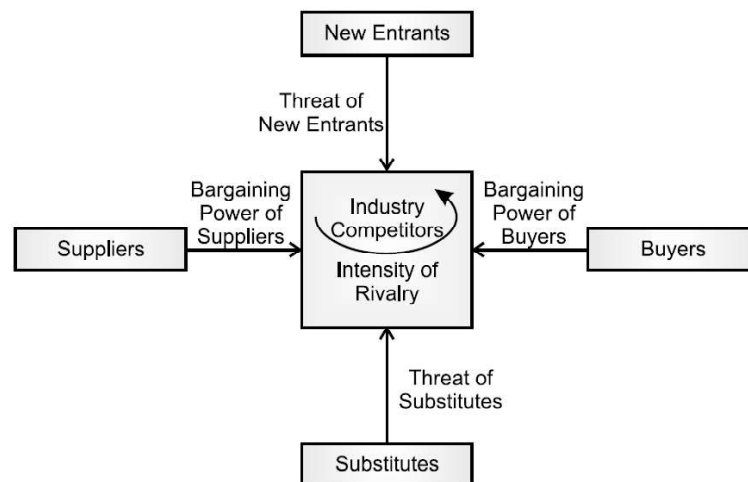


Fig 13.1 Porter's Five Forces Model

Source: M E Porter, *Competitive Strategy: Techniques for Analysing Industries and Competitors* (New York: The Free Press, 1980).

1. Industry (existing) competitors
2. Threat of substitutes
3. Bargaining power of buyers

4. Bargaining power of suppliers

5. Threat of new entrants

Industry competitors: Various degrees or intensities of competitive rivalry exist in the market for a product. This is the battle for market share and is the most immediate concern of a company, particularly if it is a market leader or challenger. Ongoing battles between Coca-Cola and Pepsi, Surf and Ariel, Colgate and Pepsodent are good examples. Competitive intensity or rivalry depends, to a large extent, on the stage of the product life cycle. Competition is practically non-existent at the introduction stage, then starts growing steadily and becomes significant till the product enters the decline stage (Fig.13.2).

Besides product life cycle, there are a number of other factors which affect competitive rivalry. First is market growth rate. Life cycle analysis also suggests this. During the growth phase, when the industry growth rate is high, companies expect their own growth rates to be high because of market growth; but, during maturity, organizational growth has to be achieved by extracting market share from competitors. Second is the relative size or strength of competitors. If competitors are of similar size, competition will also be more intense than when the market is dominated by one or few big players and the smaller players accommodate themselves. Third is the existence of exit barriers. If there is strong exit barrier (may be in the form of high fixed investment with long pay-back period), competition will be high. This can be quite true in capital goods industries.

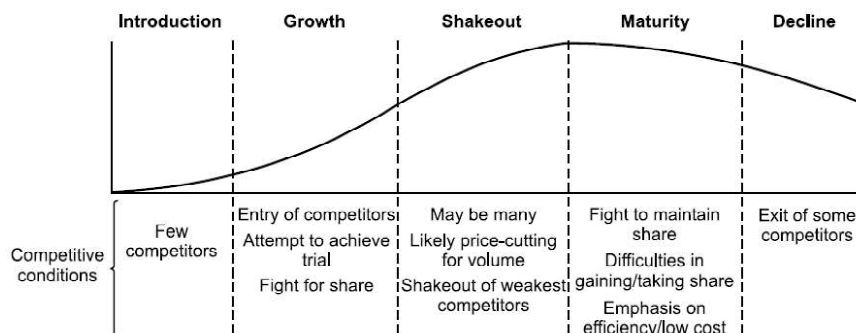


Fig 13.2 Competitive Rivalry During Different Stages of PLC

Threat of substitutes: Substitute products reduce demand for a particular product or a category of products because some customers switch over to the alternatives. Substitution depends on whether an alternative product offers higher perceived value to the customers. Substitution may take three different forms: product-for-product substitution, substitution of need and generic substitution. *Product-for-product* substitution or substitution for the *same use* are same; for example, e-mail substituting for postal service or mobile phones substituting for landlines. *Substitution of need* means that a new product or service makes an

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existing product or service redundant. For example, IT has provided e-Commerce as a tool which has generally made secretarial services or printing redundant to a large extent. *Generic substitution* takes place when different products or services compete for a share in the same family income or household income: for example, air conditioner manufacturers competing with colour televisions or music systems or home theatres for snatching a share in 'fixed' household income.

Bargaining power of buyers: Buyers are generally in a better bargaining position. But, they can become stronger bargainers or create competition among suppliers under certain specific conditions. Some of these conditions are:

- (i) the buyer purchases a very significant proportion of total output of the supplier—can happen typically in industrial products;
- (ii) the industry consists of a large number of small operators so that buyers can easily create competition among them;
- (iii) cost of switching a supplier is low, i.e., substitutes are available or there is no product differentiation, or, for industrial or service products, there is no long-term contract; *iv.* backward integration into supplier's product—a truck or car manufacturer beginning to make components or accessories like Tata Motors or an air conditioner manufacturer also making compressors like Carrier Aircon or a colour TV manufacturer also making picture tubes like Sony.

Bargaining power of suppliers: Suppliers, or sellers, generally in a weak bargaining position, can be strong bargainers under certain conditions. Such market conditions are:

- (i) no close substitutes available for the product offered by the supplier ;
- (ii) the product(s) sold by the supplier(s) is an important or critical input in the buyer's product; for example, ICs and chips in electronic products which can be bought only from few or selected suppliers;
- (iii) high switching cost of changing a supplier—may be because the supplier manufactures a special product or the product is clearly differentiated;
- (iv) forward integration into buyer's product; for example, a carbon black producer entering into tyre manufacturing and competing with tyre manufacturers or TVS (earlier Lucas-TVS), traditionally a component or accessories maker, enters into production of motor cycles (TVS-Suzuki).

Threat of new entrants: Many times, new entrants pose a major threat to the existing market players. Examples of entry of Toyota and Honda in the US car market (and also in the global market), Maruti Suzuki's entry into the Indian car market, Vimal fabrics in the Indian textile market and Titan in the Indian watch market are well known. In fact, most of the established products and brands in consumer and industrial markets today were new entrants at some point of time. Forecasting the emergence of new entrants is very important for existing competitors

and it is also one of the most difficult jobs. But, companies which fail to foresee the new entrants or ignore them may even face disastrous results.

Porter has mentioned some potential threats from new entrants. Awareness of these and timely action can act as anticipatory safeguards. Some possible potential threats are mentioned below:

- (a) Companies presently not in the industry, but, likely to overcome entry barriers, particularly because of low cost. Typical examples are duplicators or imitators:
- (b) Companies which derive synergy from being in the industry, (e.g., a soda water manufacturer getting into flavoured soft drink manufacturing or a soft drink company diversifying into fresh fruit juice-making and marketing).
- (c) Companies for whom competing in the industry is a deliberate extension of their corporate strategy.

13.4.2 Governance Modes in the Use of IT

Information technology (IT) governance is a subset discipline of corporate governance. It focusses on IT performance and risk management. According to the IT Governance Institute, IT governance refers to 'leadership, organizational structures and processes to ensure that the organisation's IT sustains and extends the organisation's strategies and objectives.' While the Australian Standard for Corporate Governance of Information and Communication Technology (ICT), defines Corporate Governance of ICT as 'The system by which the current and future use of ICT is directed and controlled. It involves evaluating and directing the plans for the use of ICT to support the organisation and monitoring this use to achieve plans. It includes the strategy and policies for using ICT within an organisation.'

The interest in IT governance is because of the ongoing necessity within companies to focus value creation efforts on the company's strategic goals and to better manage the performance of those responsible for creating this value in the best interest of all stakeholders. IT governance has evolved from concepts such as The Principles of Scientific Management, Total Quality Management, ISO 9001 Quality management system, and so on.

Check Your Progress

- 3. What is the vital task of a strategist?
- 4. State the factors which affect competitive rivalry.
- 5. What do you mean by substitution of need?
- 6. Why has there been an increasing interest in IT governance?

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13.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

NOTES

1. The concept of SIS was first introduced into the field of information systems in 1982-83 by Dr. Charles Wiseman
2. The most commonly used model to support business-level strategies is the Value Chain Model. According to this Model, every firm is a sequence of basic activities, with each activity adding some value to its products or services. The Model aims to identify those activities where information technology can be applied effectively to help a firm in gaining an advantage over its competitors.
3. A vital task of a strategist is to anticipate and/or recognize the nature of competition and potential threat from competitors and to develop appropriate response strategies.
4. Besides product life cycle, there are a number of other factors which affect competitive rivalry. First is market growth rate. Second is the relative size or strength of competitors. Third is the existence of exit barriers.
5. Substitution of need means that a new product or service makes an existing product or service redundant.
6. The interest in IT governance is because of the ongoing necessity within companies to focus value creation efforts on the company's strategic goals and to better manage the performance of those responsible for creating this value in the best interest of all stakeholders.

13.7 SUMMARY

- Information systems are designed with the goal of solving some problems or seeking new opportunities. The information system that helps an organization to accomplish a long-term competitive advantage is known as strategic information system (SIS). It can be developed from scratch or by modifying an existing system.
- The concept of SIS was first introduced into the field of information systems in 1982-83 by Dr. Charles Wiseman, President of a newly formed consultancy called Competitive Applications, who gave a series of public lectures on SIS in NYC sponsored by the Datamation Institute, a subsidiary of Datamation Magazine.
- The overall performance of a firm depends on the performance of each business unit. The performance can be improved if all the business units

work together instead of on their own and share their knowledge. The information systems promote synergy by integrating separate business units so that they can act as a whole.

- The most commonly used model to support business-level strategies is the Value Chain Model. According to this Model, every firm is a sequence of basic activities, with each activity adding some value to its products or services. The Model aims to identify those activities where information technology can be applied effectively to help a firm in gaining an advantage over its competitors.
- A value web is a group of independent firms that coordinate their value chain with the use of information technology to generate a product or service for a market collectively. Using the value web, the firms can maintain long-term relationships with their customers, as well as adjust to the changing demand and supply needs.
- In considering a differentiation strategy, there are various factors or dimensions which can be exploited to establish a product or service and make it superior to that of competitors. For industrial products, seven different dimensions of superior product quality may be considered, namely, features, conformance to quality standards specified by customers, actual performance, durability, reliability, style and design. Differentiation strategy may work best under certain specific product and market situations.
- The development of Information Technology has been an important revelation in the field of technology since the Industrial Revolution. It has altered the way people think and interact with each other.
- According to Cerere, organizations have always tried to adapt technologies that can improve the efforts of the manpower in production and management. He also observed that information technology despite evolving has become an important tool in the management of organizational operations.
- Information Technology can be used to help managers establish direct control over business functions, personnel and other resources. There has been an increasing reliance on information technology as companies use it to achieve their missions and goals in an effective way.
- A vital task of a strategist is to anticipate and/or recognize the nature of competition and potential threat from competitors and to develop appropriate response strategies. The most difficult task in this is to properly assess the magnitude of existing competition and correctly foresee the threat from new and emerging competitors.
- Porter (1980) in his pioneering work on competitive strategy had identified five major types of competitive threats, which are valid even today. These are:

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- o Industry (existing) competitors
 - o Threat of substitutes
 - o Bargaining power of buyers
 - o Bargaining power of suppliers
 - o Threat of new entrants
- Various degrees or intensities of competitive rivalry exist in the market for a product. This is the battle for market share and is the most immediate concern of a company, particularly if it is a market leader or challenger. Ongoing battles between Coca-Cola and Pepsi, Surf and Ariel, Colgate and Pepsodent are good examples.
 - Substitute products reduce demand for a particular product or a category of products because some customers switch over to the alternatives. Substitution depends on whether an alternative product offers higher perceived value to the customers. Substitution may take three different forms: product-for-product substitution, substitution of need and generic substitution.
 - Buyers are generally in a better bargaining position. But, they can become stronger bargainers or create competition among suppliers under certain specific conditions.
 - Suppliers, or sellers, generally in a weak bargaining position, can be strong bargainers under certain conditions.
 - Many times, new entrants pose a major threat to the existing market players. Examples of entry of Toyota and Honda in the US car market (and also in the global market), Maruti Suzuki's entry into the Indian car market, Vimal fabrics in the Indian textile market and Titan in the Indian watch market are well known.
 - Information technology (IT) governance is a subset discipline of corporate governance. It focusses on IT performance and risk management. According to the IT Governance Institute, IT governance refers to 'leadership, organizational structures and processes to ensure that the organisation's IT sustains and extends the organisation's strategies and objectives.'
 - The interest in IT governance is because of the ongoing necessity within companies to focus value creation efforts on the company's strategic goals and to better manage the performance of those responsible for creating this value in the best interest of all stakeholders. IT governance has evolved from concepts such as The Principles of Scientific Management, Total Quality Management, ISO 9001 Quality management system, and so on.

13.8 KEY WORDS

- **Strategic information system:** The information system that helps an organization to accomplish a long-term competitive advantage is known as strategic information system (SIS).
- **Value Chain Model:** According to this Model, every firm is a sequence of basic activities, with each activity adding some value to its products or services. The Model aims to identify those activities where information technology can be applied effectively to help a firm in gaining an advantage over its competitors.
- **Value web:** It refers to a group of independent firms that coordinate their value chain with the use of information technology to generate a product or service for a market collectively.

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13.9 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What is strategic information system?
2. Write a short note on Value Chain Model.
3. Briefly mention the potential threats from new entrants in the market.
4. Write a short note on IT governance.

Long-Answer Questions

1. Discuss with examples the ways in which companies can devise their differentiation strategy.
2. Analyze the ways in which Information Technology has helped organizations achieve their goals.
3. Examine the five major types of competitive threats.

13.10 FURTHER READINGS

- Senn, James A. 1984. *Analysis and Design of Information System*. New York: McGraw-Hill.
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UNIT 14 SECURITY AND ETHICAL ISSUES

NOTES

Structure

- 14.0 Introduction
- 14.1 Objectives
- 14.2 Control Issues in Management Information Systems
 - 14.2.1 SCIM Components
 - 14.2.2 User Management
- 14.3 Security Hazards
 - 14.3.1 Information Security Attacks from Insiders
 - 14.3.2 Types of Information Security Attacks from Outsiders
 - 14.3.3 Incident Response
 - 14.3.4 Some Attack Techniques and Technologies
- 14.4 Ethical Issues and Technical Solutions for Privacy Protection
 - 14.4.1 Ethics in an Information Society
 - 14.4.2 Ethics for IS Professionals
- 14.5 Answers to Check Your Progress Questions
- 14.6 Summary
- 14.7 Key Words
- 14.8 Self Assessment Questions and Exercises
- 14.9 Further Readings

14.0 INTRODUCTION

Managing complex information and communication technologies in an organization is not an easy task. It requires the implementation of robust IT security policies and procedures. Organizations face many challenges in managing and protecting information from unauthorized access. Such challenges refer to the difficulties that organizations face in the management of complex information and communication technologies from malicious external threats. In this unit, we will discuss the control issues in management information systems, along with the security hazards. We will also focus on ethical issues and technical solutions for privacy protection.

14.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the control issues in management information systems
- Discuss the security hazards in MIS
- Describe the ethical issues and technical solutions for privacy protection

14.2 CONTROL ISSUES IN MANAGEMENT INFORMATION SYSTEMS

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Information security has been based on the principle of exclusion. Since the early days of computer applications from 1970s onwards, where the primary goal of security has always been to prevent unauthorized users from accessing IT assets. Thus, the systems were made sufficiently secure if:

- Access was restricted with username and password authentication.
- Gateways were monitored and controlled strictly so that communication with the outside world was limited and controlled.
- Electronic communication was limited with stakeholders through only approved applications.

However, IT systems have today become more networked and integrated with its stakeholders than the systems of the 1970's. Spread of Internet and new business processes has enabled easier access and greater reach but at the same time have increased vulnerability of information systems to attacks and other threats from the outside world. Hence, the principle of exclusion has been refined in the modern context to mean the following:

- Ensuring that the right resource is available to the right person.
- Ensuring that appropriate access controls and authentication is required to access the information resources.
- Ensuring perimeter (virtual) based protection system to allow authorized users but to disallow outsiders.
- Ensuring reliable and on demand integrated information flow.

Today the challenge is to enable inclusion (that too most of the time by having a web enabled system) for insiders including customers, suppliers, employees, partners and other stakeholders and at the same time enforce exclusion of hackers, intruders, competitors and other outsiders in information systems. The Figure 14.1 describes the challenge aptly. The virtual perimeter has to protect the information assets from outsiders and at the same time has to grant restricted access to external users, like customers and at the same time base that access on the basis of well defined rules. Therefore, a balance needs to be maintained between security exclusion and inclusion for optimum efficiency. The balance between security exclusion and inclusion is maintained by a proper Security Controls and Identity Management or SCIM solution.

14.2.1 SCIM Components

SCIM solutions are a mix of technological and managerial/process driven interventions that help the organization to maintain the security balance. SCIM has following components:

(a) Business process control

It is a set of administrative and managerial interventions mostly in the nature of policies, guidelines and procedures that helps in improving the security of the organization's information assets. The interventions are designed to manage the risks associated with the security balance that the organization would like to maintain.

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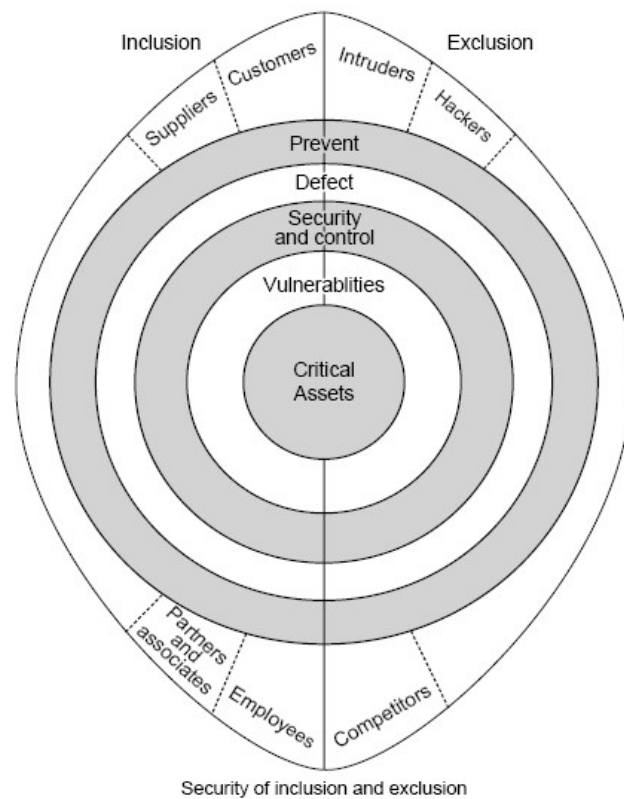


Fig. 14.1 SCIM Issues

(b) Identity management

They are a set of management processes and technological interventions that enables perimeter based protection of systems so that authorized users get the necessary and sufficient access as per their authorization and others are denied access. It may be conceived as the process of managing user information about the interaction with an information system. It involves insertion, updating, deletion of users (user information), assigning rights and privileges, permissions and trailing of users (user information) so that the user is able to access the necessary and sufficient information from the organizations information asset base. There are benefits of identity management. Identity management may itself be subdivided into five different components:

- **Authentication:** It is the process by which the identity of a user is verified by a security system/security apparatus before granting access to the system/

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area that contains information assets. If the user is unable to provide the correct information then access is denied.

- **Username and password:** These are the most widely used form of authentication mechanism in which the user is identified by an ordered pair of (username, password), through which he access the system resources. This username and password acts as an alias for the user and all his rights, privileges, permissions and role is granted based on the username and password through which he access the system.
- **Digital certificates:** These are electronic equivalents of handwritten signatures. They serve that same purpose as handwritten signatures namely, to verify and act as a seal for the authenticity of a document to have originated from a particular person. A trusted authority to present the users identity and establish his trustworthiness issues them. However, they are not like handwritten signatures which are a set of ordered letters. Instead, they are more complex to avoid any forgery. They are normally based on PKI.
- **Biometric control:** It acts as by means of username-password. There is always a risk of someone stealing the username and password and using it inappropriately. In order to avoid this risk, biometric controls are used. These unique identification characteristics of each human being that works as an authentication mechanism for the person. For example, fingerprints are unique to each individual and therefore a biometric control mechanism that scans for fingerprints and on finding the exact match allows access to the system which is much better and secure way of authentication. In such a case, there is the neither problem of losing/forgetting password nor of passwords being stolen.
- **Smart cards:** These are hardware devices that have some kind of unique identifying technology within it or holds (stores) some unique code that can be scanned and verified. Such cards are embedded with RFID chips so that RFID scanners may detect them from a distance and therefore authenticate them. In such cases, the user does not have to explicitly type in the authentication code, like in the case of username and password scheme of authentication but the system interacts directly with the hardware device (smart card) which holds a unique code that verifies the identity of the user.

The term defines the process of controlling the access of users, limiting it to only those applications for which the user have permission and limits the extent to which he can interact with applications and systems. Some users may have read access, some may have read and write access, still other may have read, write and delete/modify access. Similarly, a user with read access in one application may have read and write access in another application and so on. This is done to ensure that after authentication users are given access to only those resources for which they have the need. If a user works in the sales department entering invoice data, then he may have full access to the invoice system but may not even have

read access for the taxation system. This is done to ensure that information is available on a need to know basis. Access control approaches are mainly of three types as given below:

- **User based:** In this approach, the access policy of the user is determined for every user. Thus, a user level and group level access policy is required for such systems. This policy is implemented by using access control lists. This approach requires more administrative time to manage and control access as lot of duplication of effort takes place.
- **Role based:** It is a more organized approach towards access control in which access is granted to users based on their role in the organization. Since the role of a user in an organization is fairly well defined and the access policy will easily flow from his role.
- **Policy based:** It is the approach in which policies are based and users are made to fall in some part of the policy. Thus, the access is dynamically determined based on rules set in the policy.

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14.2.2 User Management

This is the process of managing users so that the users may remain within the perimeters of their access and may get seamless access to data for which they have permission.

- Automated workflow
- Delegated administration
- Automated removal
- Self-service capability
- Provisioning

The physical security of the information systems and the information that it holds is also very important. Some of the measures that are required for ensuring physical security of the IS are:

- Ensuring that only authorized personnel get entry into the area from where access to information system is available. This can be ensured by having entry restrictions on visitors which can be enforced using RFID embedded employee access cards or by having biometric sensors in key access areas. Since the visitors will not have authorization to enter the restricted zone, access to information system will be denied to unauthorized personnel automatically.
- Installation of CCTV on corridors, etc. to monitor the people who access the IS.
- Structurally keeping the servers and other key infrastructure deep inside the office space to ensure that they are suitably hidden.

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- Ensuring the servers and other key infrastructure are locked behind closed doors accessible to only a few authorized personnel, like system administrators.
- Ensuring that the Server Park or data centre has proper fire safety equipment.

Check Your Progress

1. Mention any two principles of exclusion in modern context.
2. What are SCIM solutions?

14.3 SECURITY HAZARDS

In this section, we are going to discuss about the threats and vulnerabilities of information systems from both insiders and outsiders and the ways of managing such threats and vulnerabilities.

14.3.1 Information Security Attacks from Insiders

It is now an acknowledged fact within the information security community that insiders (people with access to information systems of organizations) within the organization represents one of the biggest (estimates vary from half- to three-fourths of all security incidents) information security threats (Dhillon 1999, Whitman 2003). Considering that a large number of such incidents go undetected (Hoffer and Straub 1989) it is most likely that these numbers are actually much higher. Specialists therefore prescribe a cocktail of measures to prevent security incidents. These measures fall under two broad categories:

- **Procedural or business control measures:** Those that define access and other security policies, usage guidelines, security education, training and awareness (SETA) programs.
- **Technical measures:** It includes authentication measures, monitoring techniques, tools and filtering mechanisms.

14.3.2 Types of Information Security Attacks from Outsiders

Information security attacks can be of various types. Modern attacks and techniques are difficult to detect and stop as it requires continuous monitoring of the system. Perimeter security is therefore of vital importance as the objective of a security system is to halt an attacker from gaining access into the system. The following section discusses the major forms of attack.

Hacking

It is the activity of getting into a computer system without authorization to have an access for a look around and see what is possible to do in the system. Hackers are mainly of three different types.

- **Ethical hackers:** Ethical hacking and hacking etiquette demands that the hacker after having penetrated the system notifies the system administrator of his entry to let him know about the vulnerability of the system. This kind of hacking actually helps the organization to improve its security apparatus.
- **Crackers:** These are malicious hackers. Once they get inside a system, they destroy valuable assets. Their objective is to cause as much damage to the system as possible. These attacks are to be feared as they have the potential to cause large-scale damage to the organization's information assets.
- **Phreaks:** These are people who hack into the phone systems of organizations so that they can then make calls at the expense of the organization.

Each hacking incident however, may be different from the other as each hacker in each incident tries a different trick to exploit the vulnerability of a system. Since nowadays most systems are connected to the Internet, most hacking incidents occur from net-based hackers who gain access into the organizations computer systems and then cause damage to the system. Most hacking incidents follow a typical pattern or method, which are:

- **Reconnaissance:** The hacker before embarking on a full-scale attack tries to find out the counter measures that are protecting a system. He tests the waters before jumping into the action. In this stage, he typically tries to gather information about the system (and/or network), its vulnerabilities, critical information stored in the system, key employee information, public information about the system and the organization, information about customers of the organization. This is passive reconnaissance. After this stage, the hacker moves on to active reconnaissance in which he acquires DNS information, IP addresses, performs ping sweeps, SNMP network scans and other attacks like banner grabbing, etc.
- **Vulnerability scanning:** After the reconnaissance stage, the hacker moves to the scanning stage in which he looks for vulnerabilities in the perimeter security of the system. He also scans the routers and firewalls of the organization to check for vulnerabilities.
- **Securing/getting access:** After the scanning stage, he moves to the stage of gaining access, here he accesses the organization's system after capitalizing on any vulnerability in the organization's security system. This can happen through the operating system of the organization's server or networked computer, an application (either planted within the system or suitable file corrupted/modified by the hacker to work on his commands), or through any network devices in the organization's network.
- **Maintaining access:** After getting access to the organization's system, the hacker would normally like to continue to maintain access. This he manages by planting a custom-built application on the already compromised server of the organization. This strategy helps the hacker to enter and exit the system at will. Thus, the hacker can have complete control over the

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organization's system. He can upload applications, modify applications, modify data without anyone's knowledge, steal data and cause widespread damage to the system. At this stage, the hacker evaluates the information assets of the organization and based on his intentions goes ahead with a plan to profit from his efforts. He can wish to just maintain access without causing any damage, steal information and sell it outside, profit from altering the data of the organization or simply blackmail the organization.

- **Covering tracks:** Once the hacker has enabled his access into the organization's system, he would like to remove any trace of his entry and exit from the system. This he manages by suitably deleting the evidence of his access from the audit files and log files. Thus, the system administrators remain oblivious to the access of the hacker.

Denial of Service (DoS)

This is another form of security attack in which the attacker overwhelms the organization's server (or other hardware resources) or the telecommunication lines from the ISP. Normally, DoS attacks are one-to-one meaning that the attackers launches an attack from his machine and attacks one organization with the objective of overwhelming its resources (hardware or telecom) thereby denying the system's services to legitimate users. Since February 2000, the trend for such attacks has changed. Now attackers use a many-to-one mode of attack for DoS. This is known as distributed denial of service (DDoS). The attacker creates zombies (these are compromised machines on the Internet that run application codes which are controlled by the attacker). At his instructions DoS attacks are launched simultaneously on a single target from all the zombies (sometimes as many as tens of thousands). The only way to control DDoS attacks is to control the number of zombies on the network. It is one of the most difficult forms of attack against which an organization is to be secured.

Malicious code

This is another form of security threat, being pieces of code that reach vital areas of a system and renders great damage to it. The easiest form of distributing malicious codes is through e-mails. It is therefore a good idea to check the attachment files in e-mails before opening them. There are many different types of malicious code:

- **Virus:** This is the most common type of malicious code. Viruses are also of various types. File viruses are viruses that infect files of a system and then keep on multiplying themselves whenever a user opens a file or access a file and therefore spread to all parts of a system and damage all files in a system. Such file viruses are the most common form of virus applications. Most file viruses are executable files. Other types of viruses attack the master boot record of the operating system thereby rendering the OS useless. Some viruses are application specific like macro viruses that affect office applications.

- **Worm:** It is a form of malicious code that affects networks. They have the capability to replicate themselves over a network and spreads very quickly from one machine to another in a network. Several highly publicized attacks have been reported.
- **Trojan:** It is a stealth version of a malicious code. It seems like a good and trustworthy code on the surface but is actually a malicious code in reality. The easiest way to stop Trojans is to stop opening untrustworthy attachments and stop downloading and running freeware.
- **Logic bomb:** This type of malicious code waits in a system for a trigger, like a particular date and time, to unleash damage. The code waits patiently and does not act malevolently until a particular date and time and after that due date and time, it would work in a malevolent manner by damaging the system and data.

Social engineering

This is another way of attacking a system. Social engineering is a set of techniques used to trick gullible users into parting with their critical information like username and password. The social engineering attacker uses the following human attributes to get access to critical data:

- Most people trust others unless they are found untrustworthy. The attacker exploits this trait of human nature. For example, simple calls made ostensibly on behalf of a trustworthy organization like a bank would make us divulge a lot of critical information about our bank accounts.
- The fear of getting into trouble is also another human trait that the attacker exploits. For example, a simple mail requesting you to give your password for better maintenance of your bank account may actually cause fear in your mind that if you do not divulge your password, maintenance will not be proper and hence some individuals indeed do give away their password.
- Preference for shortcuts is another human trait that attackers exploit. Most people give passwords as nicknames or birth dates or name of their pets which can be easily cracked.

Thus, we can see that a skilled social engineer may be able to get critical data that will enable him to access the system without much trouble. Thus, this type of attack is a very serious threat that all must be careful about.

Sometimes a cruder version of social engineering called phishing is used to trick the user by sending him emails about opportunities or threats to near and dear ones. This kind of emails normally trick users to part with money instead of system critical data and is the handiwork of petty criminals and not sophisticated cyber attackers, whose sole aim is to get critical information about systems so that they may gain access into it and not to fool or fleece people for small sums of money.

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Some top hacking incidents of all time

Some of the hacking incidents which left a mark are:

- **1990s:** Kevin Mitnick, a well known hacker, hacked into computer networks and systems of top telecom companies like Nokia, Fujitsu, Motorola, and Sun Microsystems. The incident caused a huge stir in the security establishment and Mitnick was arrested by the FBI in 1995, but later released on parole in 2000.
- **1995:** A Russian hacker Vladimir Levin was the first hacker to hack into a bank to rob money. In early 1995, he hacked into a top US bank which had a very secure VAX VMS based system and robbed an estimated \$10 million USD. He was later arrested.
- **1990:** In 1990 a radio station in Los Angeles started a contest that awarded a Porsche for the 102nd caller. Kevin Paulson, a hacker took control of the entire city's telephone network, and ensured that he is the 102nd caller, so that he get the prize. He was later arrested.
- **1996:** Timothy Lloyd wrote a small piece of malicious software code that allowed a "logic bomb" to explode which deleted software worth \$10 million USD.
- **1988:** Robert Morris a Cornell University graduate launched a worm on the Internet that infected machines world wide and crashed thousands of machines.
- **1999:** David Smith wrote and launched one of the most dreaded virus, Melissa that damaged machines worldwide.
- **2000:** MafiaBoy hacked into the most popular sites on the Internet world, like eBay, Amazon and Yahoo and managed to engineer a Denial of Service attack.

14.3.3 Incident Response

Let us discuss incident response in detail for better understanding of the concept.

What is an Incident?

An incident, in the parlance of information security, is a security breach or even an attempt to breach security. An unsuccessful attempt to crack the security system is also an incident and needs to be investigated thoroughly.

Incident Response Process

Whenever an incident takes place, a series of steps need to be taken to find out the causes of the incident to ensure that such incidents do not occur in future. The incident response process involves the following steps:

- **Incident identification**—It is the first step of incident response in which the incident is identified. Some common incidents may be DoS, port scanning,

IP sniffing, social engineering, banner capture, unauthorized access or virus infection.

- **Incident classification**—It is the next step in which the incident is classified based on its severity. Every organization must maintain an incident classification chart to rate an incident when it occurs based on its criticality.
- **Incident notification**—It is the notification given to specific functionaries about the incident.
- **Incident response and containment**—It is the action taken to thwart the incident.
- **Incident recovery**—It is the recovery activity to restore system to the previous status.
- **Post mortem**—This is the post incident investigation to find out the vulnerabilities in the system that allowed the incident to happen.

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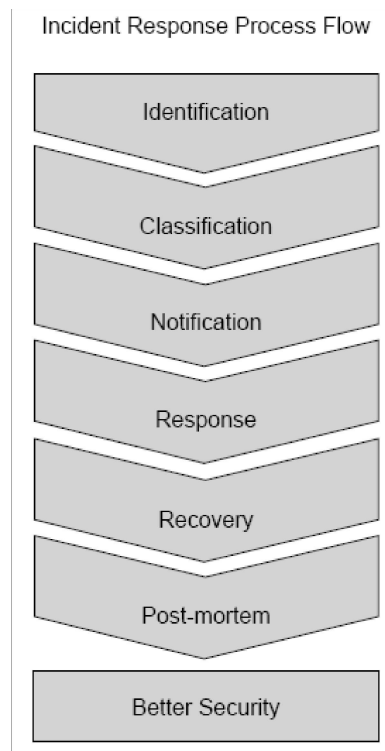


Fig. 14.2 Incidence Response Flow Chart

14.3.4 Some Attack Techniques and Technologies

Some of the attack tools and techniques are:

1. IP spoofing is a the techniques of using forged 12 digit IP address (source) in the IP packets that are used in TCP/IP protocol for data communication (primarily on the Internet or on any other TCP/IP network) for concealing the identity of the sender or impersonating another computing system.

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2. Packet sniffing is a technique or a program to troubleshoot network traffic. However, often it is used by hackers to get information about the source and destination of IP packets on a TCP/IP network. When on a TCP/IP network like Internet, data is broken down into small packets that are transmitted over the network and gather together at the destination, reassembled and displayed/stored etc. These packets have stamps of destination and source on them so that they are not lost. Packet sniffing is the technique that can capture these floating packets on the TCP/IP network like a wiretap and find out what is being sent to or from a source or destination.

Check Your Progress

3. What are the two categories of data security measures?
4. Why is perimeter security of a network important?
5. Which is the most difficult form of attack against which an organization is to be secured?
6. What do you mean by IP spoofing?

14.4 ETHICAL ISSUES AND TECHNICAL SOLUTIONS FOR PRIVACY PROTECTION

Information systems have today transcended the boundaries of organizations and have entered our personal space. Systems have become more networked, bringing in more people together. The rise in Internet penetration has increased this phenomenon of social integration on cyberspace. Social networking and social media sites available today help aid in this social interaction. However, this social communitization is fraught with challenges. People are more comfortable interacting with one another in cyberspace than in real world. Ethical issues have also cropped up due to this surge in information system usage. Some of the social issues related to systems are given in the Box 14.1.

Box 14.1 Social Issues Related to IS

Issue

Increased interaction in cyberspace but not so in real world – the increased interaction on digital space has reduced face to face social interaction leading to reduced emotional attachments and bonding.

Increased use of assumed identity-less face-to-face social contact has resulted in more and more people resorting to assumed identities on cyberspace sometimes resulting in crimes.

The invasive use of technology has resulted in lesser privacy for individuals resulting in social problems.

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Information systems help to transfer information very fast and this has resulted in some cases of rumour mongering.

The emergence of social networking has resulted in less trust on official media and more trust on social networks for information.

The easy access to cyber world for a section of society is leading to digital divide in the general society where some have easy access to the cyber space while others are left out. The ones left out are also left out of the several opportunities that information systems can provide.

Disclosing another individual's personal details to others – this is a serious ethical issue. Sometimes when the disclosure is of a very private nature this can even become a legal issue.

Cyberstalking – is when an individual is always stalked in cyberspace resulting in violation of an individual's privacy and creating fear in the mind of the stalked. This on a small scale is an ethical issue but may become a legal issue if the stalking becomes serious.

Disclosure of trusted content is also another ethical issue. If an individual is in the possession of some trusted content and he shares it with others, then that becomes an ethical issue.

Distribution of pornographic material with open access is another ethical issue and needs to be controlled.

Plagiarism is becoming very rampant as content in soft form can just be copied and pasted from other files and claimed as one's own. This on a small scale is an ethical issue but when the plagiarism is intentional and large scale then this becomes a violation of copyright, which is a legal issue.

Sending SPAM is also another ethical issue, which creates a lot of problems for ordinary users of information systems

Apart from these ethical issues, other legal issues that may arise from the world of information systems are:

- Child pornography
- Stealing of password
- Hacking
- Phishing

Thus, we can see that society is changing due to information systems and new value systems and ethical parameters are emerging for this digital space.

14.4.1 Ethics in an Information Society

Ethics is a branch of philosophy that deals with what is considered right and wrong in society. It deals with issues which are not in the realm of legal or statutory domains but which may be considered conventionally right or wrong as per perception of the society of that time. Slavery was at a certain point in time, legal in United States and then with the passing of legislation later during Abraham

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Lincoln's Presidency was deemed illegal. The issue is that even when slavery was legal, it was considered as unethical by some as society considered it as something wrong even when it was legal. Therefore, we can say that ethics is a far greater concept than legality. It has something to do with the basic idea of right and wrong that becomes ingrained in us from childhood. Therefore, if you do a good job and your boss steals all the credit for your work then it becomes unethical behaviour on his part but it may not be illegal. An issue becomes ethical in nature when it transgresses any basic norm of human existence.

The issue of ethics in the information age has acquired a different dimension altogether. With more access to information, greater connectivity and anonymity new ethical issues are coming to the fore every day. Some major ethical issues hover around the following questions:

1. How much information about an individual is private and how much that is private which cannot be captured or disclosed?
2. What information can be kept by organizations dealing with individuals?
3. How much right does an individual have over his/her own information.
4. Who can access and who cannot access information?

Most cases of ethical violation in the information society occur due to disclosure of private information. This brings us to the interesting topic of privacy. Let us delve into the issue a little deeper. Is information about a suspected terrorist private or the act that he commits private? Probably not on the other hand if we are asked if information about a dowry victim is private, we will all probably agree that it is. Thus, we see that privacy assumes different degree of severity. In the first case, one can argue that if information about a suspected terrorist is not made public, then the terrorist will not get caught, and will cause more destruction. Thus, the well-being of a majority is at stake if the privacy of information of the terrorist is to be considered. Hence, it may be argued by some that disclosure of such private information as how he looks and what his height is may be considered fine but the same cannot be said for the latter case about the dowry victim. Thus, we see that ethics, privacy and other such related issues have to be considered carefully.

However, the following may be considered ethical issues in information society:

- Disclosing another individual's personal details to others. This is a serious ethical issue. Sometimes when the disclosure is of a very private nature this can even become a legal issue.
- Cyber stalking is when an individual is always stalked in cyberspace resulting in violation of an individual's privacy and creating a fear in the mind of the stalked. This on a small scale is an ethical issue but may become a legal issue if the stalking becomes serious.
- Disclosure of trusted content is also another ethical issue. If an individual is in the possession of some trusted content and he shares it with others then that becomes an ethical issue.

- Distribution of pornographic material with open access is another ethical issue and needs to be controlled.
- Plagiarism is becoming very rampant as content in soft form can just be copied and pasted from other files and claimed as one's own. On a small scale this is an ethical issue but when the plagiarism is intentional and on a large scale then this becomes a violation of copyright which is a legal issue.
- Sending SPAM is also another ethical issue which creates a lot of problems for ordinary users of information systems

Ethics in information society is a very delicate issue and changes with time. At one point of time, stealing of password was an ethical issue. Today it is a crime and has become a legal issue. Such changes in legal and ethical points of view occur with change in legislation and with changes in the norms of society.

14.4.2 Ethics for IS Professionals

Information systems are developed and managed by the IS professionals with technical knowledge and the users, generally, do not have this technical knowledge. As a result IS professionals, many a times use the power of technical knowledge over the other users in the organization. A person would be known to have power over other person if he/she is able to influence the behaviour or thinking of the other person. It has been observed that IT professionals many a times influence the thinking or behaviour of the other users and make them to listen to and agree to what they say. Since the user, many a times is dependent on the IT technology, the IT professionals, even go to the extent of dictating terms to the users and thus control their behaviour of using information systems. This is known as exercising the Power of IS Professionals over users. For example, the consultants who are appointed to implement ERP system in an organization, may not listen to the users for their genuine requirements for the customization of the system on the pretext of technical grounds. Even though the users may not be convinced but they have to agree to the IT professionals because of the technical exercise of power. This exercise of power of IS professionals over other users may be unintentional where both the parties are unaware of this exercise of power. In the case when both the user and the IT professionals are aware of the power exercise situation, both the parties would negotiate to arrive at a solution. In still another situation, where the user is not aware of the power exercise, this would result into manipulation by the IT professional. However, if the user is aware and the IS professional is not aware of such a situation, then it may lead to the resistance of the user. The ethical issues arise in situations where either party is unaware of the power exercise.

Organizations should sensitize all the users as well as the IT professionals in the organization so that no one feels that they are being dominated by the other party. Similarly, IT organizations and training programmes organized for such people need to sensitize the IT professional on this issue. Instead of giving technical reasons, they need to provide the logic that why a particular process cannot be changed or has to be accepted by the users.

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Check Your Progress

7. What is cyber stalking?
8. How do the most cases of ethical violation occur in an information society?

14.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The principle of exclusion has been refined in the modern context to mean the following:
 - (a) Ensuring that the right resource is available to the right person.
 - (b) Ensuring that appropriate access controls and authentication is required to access the information resources.
2. Security Controls and Identity Management (SCIM) solutions are a mix of technological and managerial/process driven interventions that help the organization to maintain the security balance.
3. The two categories of data security measures include procedural or business control measures (like security policies, usage guidelines, and training and awareness programs) and technical measures (such as monitoring techniques, tools and filtering mechanisms, authentication measures).
4. Perimeter security of a network is of vital importance as it aims to halt an attacker from gaining access into the system.
5. Distributed Denial of Service or DDoS is one of the most difficult forms of attack against which an organization is to be secured.
6. IP spoofing is a technique of using forged 12 digit IP address (source) in the IP packets that are used in TCP/IP protocol for data communication (primarily on the Internet or on any other TCP/IP network) for concealing the identity of the sender or impersonating another computing system.
7. Cyber stalking is a crime in which an individual is always stalked by the attacker in cyberspace resulting in violation of an individual's privacy and creating fear in the mind of the stalked individual. This on a small scale is an ethical issue but may become a legal issue if the stalking becomes serious.
8. Most cases of ethical violation occur in an information society due to disclosure of private information.

14.6 SUMMARY

- Information security has been based on the principle of exclusion. Since the early days of computer applications from 1970's onwards, where the primary

goal of security has always been to prevent unauthorized users from accessing IT assets.

- Today the challenge is to enable inclusion for insiders including customers, suppliers, employees, partners and other stakeholders and at the same time enforce exclusion of hackers, intruders, competitors and other outsiders in information systems.
- Business Process Control is a set of administrative and managerial interventions mostly in the nature of policies, guidelines and procedures that helps in improving the security of the organization's information assets.
- Identity management a set of management processes and technological interventions that enables perimeter based protection of systems so that authorized users get the necessary and sufficient access as per their authorization and others are denied access.
- Five components of identity management are authentication, username and password, digital certificates, biometric control, and smart cards.
- User management is the process of managing users so that the users may remain within the perimeters of their access and may get seamless access to data for which they have permission.
- Information security attacks can be of various types. Modern attacks and techniques are difficult to detect and stop as it requires continuous monitoring of the system.
- Hacking is the activity of getting into a computer system without authorization to have an access for a look around and see what is possible to do in the system. Hackers are mainly of three different types: ethical hackers, crackers and phreaks.
- Denial of service (DoS) is a security attack in which the attacker overwhelms the organization's server (or other hardware resources) or the telecommunication lines from the ISP.
- Malicious code is another form of security threat, being pieces of code that reach vital areas of a system and renders great damage to it. The easiest form of distributing malicious codes is through e-mails.
- Social engineering is another way of attacking a system. Social engineering is a set of techniques used to trick gullible users into parting with their critical information like username and password.
- Whenever an incident takes place, a series of steps needs to be taken to find out the causes of the incident to ensure that such incidents do not occur in future.
- Packet sniffing is a technique or a program to troubleshoot network traffic. Packet sniffing is the technique of that can capture these floating packets on the TCP/IP network like a wiretap and find out what is being sent to or from a source or destination.

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- Ethics is a branch of philosophy that deals with issues which are not in the realm of legal or statutory domains but which may be considered conventionally right or wrong as per perception of the society of that time.
- The issue of ethics in the information age has acquired a different dimension altogether. With more access to information, greater connectivity and anonymity new ethical issues are coming to the fore every day.
- Organizations should sensitize all the users as well as the IT professionals in the organization so that no one feels that they are being dominated by the other party.

14.7 KEY WORDS

- **Ping Sweeps:** It refers to a basic network scanning technique which is used to determine a range of IP addresses which map to live hosts (computers).
- **Banner Grabbing:** It refers to a technique used to gain information about a computer system on a network and the services running on its open ports.

14.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. State the measures that are required for ensuring physical security of the IS.
2. What are the steps involved in the incident response process?
3. What ethical and legal issues may arise from the world of IS?

Long-Answer Questions

1. Discuss the components of identity management.
2. Explain the typical pattern of hacking incident.
3. Describe the ethical issues in case of IS professionals.

14.9 FURTHER READINGS

- O'Brien, James A. 2001. *Management Information Systems*, 7th edition. New York: McGraw-Hill Education.
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- Parker, C. S. 1989. *Management Information Systems: Strategy and Action*. New York: McGraw-Hill.
- Laudon, Jane P. and Kenneth C. Laudon. 2007. *Management Information System: Managing the Digital Firm*. New Jersey: Prentice Hall.