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Master of Business Administration

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MANAGEMENT INFORMATION SYSTEM

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INTRODUCTION

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. The client-server model is a computing model that acts as distributed application which partitions tasks or workloads between the providers of a resource or service called servers and service requesters called clients. Often clients and servers communicate over a computer network on separate hardware, but both client and server may reside in the same system.

Electronic commerce or e-commerce is a familiar term for most of us nowadays. E-commerce presents a new form of business transaction which is fast gaining popularity. It refers to the conduct of business electronically or over the Internet. E-commerce has shaped the business of the future and its influence is expected to grow even further. Electronic commerce depicts the specific technologies, such as electronic funds transfer, supply chain management, the Internet marketing, online transaction processing, electronic data interchange, inventory management systems and automated data collection systems. Modern electronic

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commerce typically uses the World Wide Web during the transaction process and includes a wider range of technologies, such as email, mobile devices and telephones.

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The book, *Management Information System* follows the self-instruction format wherein each unit begins with an ‘Introduction’ to the topic of the unit followed by an outline of the ‘Unit Objectives’. The detailed content is then presented in a simple and structured form interspersed with ‘Check Your Progress’ questions to facilitate a better understanding of the topics discussed. The ‘Key Words’ are given on respective pages to help the student revise what he/she has learnt. A ‘Summary’ along with a set of ‘Self Assessment Questions and Exercises’ is also provided at the end of each unit for effective recapitulation.

BLOCK I
BASICS OF MANAGEMENT INFORMATION SYSTEM

*Foundations of
Information System*

**UNIT 1 FOUNDATIONS OF
INFORMATION SYSTEM**

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- 1.0 Introduction
- 1.1 Objectives
- 1.2 Information system: Meaning and Role
- 1.3 System Concepts and Organization as a System
 - 1.3.1 Components of Information System
 - 1.3.2 Various Activities of IS and Types of IS
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1.0 INTRODUCTION

Information systems (IS) are formal, organizational and sociotechnical systems which are devised to collect, process and distribute information. An information 'valuable' only when supplied 'timely' and 'accurately' to a management. This insatiable need for information in a business organization has given rise to the discipline of management information system, which deals with the methodical study of a seemingly disparate set of subjects that includes management systems, information systems, information theory and information technology.

In this unit, you will learn about Management Information System (MIS) which is defined as an organized assembly of resources and procedures that are required to collect, process and distribute data. The unit will also introduce you to the various subsystems of IS and role of information in decision making. You will also acquire knowledge of concept and purpose of system design in the unit. It introduces the role of MIS in an organization, system related concepts of MIS, components of IS, various types and applications of IS. It describes the conceptual and detailed system design processes.

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1.1 OBJECTIVES

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

- Understand the meaning and role of information system and MIS.
- Discuss the development process role of IS and in an organization
- Discuss the subsystems of Information System
- Analyse the concept and purpose of system design
- Describe the system related concepts of MIS
- Elaborate the components of information system
- Assess the types and various application areas of IS

1.2 INFORMATION SYSTEM: MEANING AND ROLE

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.

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Information Systems and ICT

Trends in modern business require that Information Systems (IS) should be able to run on Information and Communication Technology (ICT) platforms. Even though an information system in its pristine form does not require any technological intervention, practicality of use in modern business environment forces information systems to run on information and communication technology platforms. The basic reasons for IS to run on ICT are as follows:

Timeliness: ICT-enabled IS can deliver information faster to the decision-maker. In today's competitive environment, speed is the key to success. Information that is relevant now for decision-making will lose its value if delayed. It will be like listening to 'news' of the previous day. The value of information decreases drastically if it is delayed. The manual systems of IS cannot cope up with the speed required for delivering information and hence, it is essential to take recourse to an ICT-enabled platform.

Accuracy: Information should be accurate and precise in order to be of any use to the decision-maker. Any information is useless and of no value if found inaccurate.

Basics of Computers

To appreciate MIS and develop a solution-based information technology platform for MIS, one must understand the basics of computers. A brief description of a computer and its allied devices is provided below.

The computer is a device consisting of hardware and software. Hardware is the term used to refer to the physical components of a computer. All electrical, electronic and mechanical components of the computer fall in this category. It includes:

Input/Output Devices: These are the devices through which data is entered into the computer and come out as output from the system. The following is a set of I/O devices:

Input Devices:

The following are common input devices:

- Keyboard
- Mouse
- Light Pen
- Joystick
- Scanners

Output Devices:

The following are commonly used output devices:

- Display Unit—Cathode Ray Tube (CRT) based or Light Crystal Display (LCD) based
- Printers
- Plotters

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Central Processing Unit: This is the component in which all the data handling—data storage, data processing and data retrieval—is done. This is the main component of a computer. A Central Processing Unit or CPU in a strict sense also indicates a portion of the microprocessor, which plays a central role in the data processing activity; but here the CPU is used in a more broad sense to refer to the main component of the computer. In this context, the CPU consists of the following:

- Microprocessor
- RAM
- ROM
- Hard Disk
- Motherboard
- Bus

Ports: These are physical (and also virtual) junctions of the computer. They are the junctions through which the computer can be connected to other devices or other computers. Ports are of two types: serial and parallel.

Software: It is the non-physical component of a computer. It is classified into the following two categories:

1. **System Software:** It is the software, which is responsible for the basic functioning of the computer system.
2. **Application Software:** It is the software, which is responsible for the applications that run on a computer. MIS solutions are examples of application software.

Role of Information in Decision-Making

The decision-making process includes the following stages:

- **Identification and Structuring of Problem:** One needs information to identify a problem and put it in a structured manner.
- **Putting the Problem in a Context:** Without information about the context in which the problem has occurred, one cannot take any decision on it. In a way the context defines the problem.
- **Generation of Alternatives:** Information is a key ingredient in the generation of alternatives for decision-making.
- **Choice of the Best Alternative:** Based on the information about the suitability of the alternatives, a choice is made to select the best alternative.

Information is thus, very important for decision-making. Imagine a simple decision like the one a driver makes when he on seeing a child crossing the road applies the brakes to stop a speeding vehicle. The driver's decision to apply the brakes is based on a lot of information processing that happens in his brain. At every stage of the decision-making, he uses the information that he captures visually. All decisions are like this.

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First, you get information about a problem, which you then format into a structure; then the information about the context in which the problem has occurred is factored in. As in the above case, if the driver, instead of finding the child in the middle of the road, had found that the child was about to cross the road, would probably not have applied the brakes to stop but would have slowed down, as he would have calculated that by the time the vehicle reaches the crossing, the child would already have cleared the path. So if the problem was structured as ‘how to not hit the child crossing the road?’, the decision would be: if the child was at the middle of the road, the driver would have applied brakes; however, had the child been at (say) 90 per cent completion level of crossing the road, the driver would have only slowed down and not applied brakes to stop. Therefore, you can see that the context has a major role in decision-making and information is required both about the problem and the context in which the problem occurred. The next stage for the decision-maker would be to generate alternatives. In the driver’s case such possible alternatives would be a) to stop by braking, b) to slow down, c) to take a sharp turn towards left or right to avoid the child, d) to press the horn so that the child crosses the road fast, e) to drive the vehicle on to the footpath and off the road to avoid collision, etc. So the decision-maker generates these possible solutions to the problem at hand. Obviously, he needs knowledge and information to generate these alternatives. In the case of the above example, for generating alternative a), i.e., to stop by braking, the driver would need to know the braking distance. If he was unaware of this crucial information, he would not have been able to generate this alternative. So information is vital for generation of alternatives. The decision-maker also needs information about the suitability of each alternative to decide which is the ‘best’. In the example, the driver calculates the ‘pay off’ for each alternative based on his calculation of the outcome, which again is based on information. He selects the ‘best’ option, which solves the problem. Thus, you can see that information is the key to the decision-making process. Without information, and the right kind of information, decision-making is not possible.

Therefore, to enable managers to take good decisions, it is very important to provide them with the right kind of information. Management information system provides this service to the managers enabling them to take informed decisions.

Subsystems of an Information System

Information system is a special type of system, which allows storage, retrieval and processing of data in a secure environment. Logically, the major subsystems of information system are as follows:

Data Repository: This is a subsystem, which is at the core of any information system. Mostly this is a relational database management system, which has preformatted and structured tables for the storage of data. These structures are arranged in a way that helps in faster storage and retrieval of data with adequate security.

User Interface: This subsystem handles the interaction of the system with the user and hence, it has to manage issues related to the display of data on an output medium. This can be either graphical or based on character depending on the level of ease offered to the user.

Network: This subsystem ensures communication between the different entities of an information system. It is crucial for the functioning of an information system.

Computer Hardware: One needs an IT infrastructure to use information systems in an effective manner. Almost all the components of an information system are housed in some kind of computer hardware to enable it to perform the tasks better. For example, an algorithm to find the lowest of three numbers can also be calculated manually; but under a computerized system, it will be much faster and efficient.

System Software: Some basic software are required for the efficient functioning of information systems. These system software do not directly aid in the functionality of information systems but work as enablers. For example, operating systems, etc.

Input/Output: Sometimes, this is clubbed with the User Interface (UI) to suggest that I/O functions are handled by UI alone. However, in some systems, I/O may be user-independent; for instance, when an alert is activated, the input for the alert comes from some other system input rather than a user.

Business Rule (Process): This is a set of rules, which governs how a system should function to imitate the real business process.

Algorithm/Program/Application Software: This is the actual invisible component, which integrates all the components. The logic (business rule) is defined in the program (embedded in it), which enables the functioning of the information system for some specific purpose.

All the above components work in concert to establish a functional information system.

Check Your Progress

1. State the meaning and main objective of information systems?
2. Name the components of computer that fall under hardware category.
3. What are the subsystems of an information system?

1.3 SYSTEM CONCEPTS AND ORGANIZATION AS A SYSTEM

We are prone to using the term ‘organization’ rather loosely. In the context of information management, an organization means an entity (not necessarily only

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business entity) with a team of people working towards a common goal or objective. A business organization is a special type of organization where the goal or objective of the organization is the attainment of business objectives like increased profits, increased shareholder value, increased market share, etc. Moreover, business organizations have a way of attaining these objectives and are arranged in a distinct structure segregated into levels of hierarchy. Decision-makers at each level of hierarchy, are called managers and the common way of working and managing of a business organization is referred to as business management.

Organization Forms

Organizations have been conceptualized as having different forms like that of a machine, an organism, a coercive system and culture. Morgan (1986) has been the pioneer in identifying organizations using metaphors like machines, brains, organisms, political systems, cultures, psychic prisons, coercive instruments of subjugation, and as flux and transformation. Each metaphor gives a different form and view to the organization. This is a simplistic way of viewing a complex system of an organization.

Forces at Work

Several forces are always at play within an organization. The goal of the management is to align all the forces to work together for the fulfilment of the broad objectives of the organization. Mintzberg (1991) suggested that organizations are subjected to the following forces:

- **Direction:** It is a strategic pathway set by management.
- **Innovation:** It is the flexibility to adapt to changes in the environment and create new products and services.
- **Proficiency:** It is the visible skill base and knowledge of the people who make the organization.
- **Concentration:** It refers to a force used to focus the energies of the people of the organization on particular aspects, like development of core competencies, markets, etc.
- **Cooperation:** It refers to the team work with which the objectives are achieved in an organization.
- **Competition:** It implies the conflict within the organization that propels people to perform better.
- **Efficiency:** It refers to the continuous improvization of the processes to reduce costs and translate resources into better value for everyone.

Organization can be defined as when two or more people work in a structured or unstructured environment to achieve a common goal or mission using some resources.

Several formal definitions of organization have been popular over the years. A suitable way of formally defining an organization (J.J. Clancy, 1989) is that it regularly performs three important tasks. It produces products and services; it makes a profit in the process; and continues to grow and survive as an organization. An alternative definition (Galbraith, 1977), (Gerloff, 1985) suggests that an organization is a set of people with the purpose of achieving some common shared objectives through the division of labour, planning, bonded by systems and structures, and information-based logical decision-making throughout time.

Organizational Structure

Organizations are structured in several ways. In some cases, functional roles and specializations form the basis of the segregation of groups into homogenous entities like departments, etc., while in other cases, the logical business of the organization becomes the basis for segregation. For example, divisions based on product categories, geographies (particularly related to markets) and customer types. Organizational activities arranged in the form of a hierarchy can be based on the following types:

- **Functional Structure:** Work based on specialization within the organization, such as finance, marketing, etc. This is a traditional way of structuring organizations based on specializations. Each group works like a suborganization with policies and plans formulated at the top of the suborganization, after due inputs from the top management. Information normally flows vertically. Information management is comparatively easier in this type of structure as the roles are structured.
- **Product or Service Category Based Structure:** The product or service based category is specifically structured for example, X product division, Y product division, etc. In this type of organization, managers in charge of a product or product category work not only vertically, but also coordinate with each other and work horizontally.
- **Geography Based Structure:** This type of structure is suitable where markets are segmented in geographical areas. For instance, structure based on segregation/grouping on geographical areas like North Region or X province, Z zone, etc.
- **Customer Category Based Structure:** This involves grouping people according to high-paying customers and low-paying customers. This type of structure is especially suitable for service industries, banks, financial and brokerage companies, etc.
- **Matrix Structure:** It is a mix of different structures suitable for tackling important changes in the environment. Such structures are complex and information flows in all directions. It is challenging for managers to administer such a structure. Information management in these structures is difficult, as the decision-making process within the organization is sometimes non-linear.

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Different information management techniques are required for various organization structures. The role of the information manager is different in each case. Let us now understand the relation between management and information.

MIS in an Organization

Earlier we discussed about the constituents and functions of MIS. Here we define the role MIS plays in an organizational setting. MIS in an organizational setting, is much more than an information system. In organizations, MIS is a separate department, which primarily deals with the supply of information to management. The role of the department is to facilitate transfer of information from the source to the people who need it. It is essentially a support function. The role of the MIS department within an organization is as follows:

- **Creating MIS in Consultation with Users, Systems Analysts and External Consultants:** As the MIS department is aware of even the minute requirements of each department as well as the reason behind them, it is most suitable for creating a composite MIS, working in tandem with users, system analysts and external consultants.
- **Managing Data:** The MIS department also works as the custodian of data generated within the organization. Normally, all data is saved in databases, which are managed by the MIS department personnel. This is a specialized task.
- **Managing the ICT Infrastructure:** This is also one of the tasks of the MIS department, but in most organizations this job is outsourced to specialized ICT firms.
- **Managing the MIS:** The department is responsible for the smooth functioning of the system. It ensures that the system operates in accordance with expectations. The system administrators and database administrators are the key people who ensure that the system functions smoothly. The MIS department is also required to undertake maintenance of the software application and ensure that the security setup is not violated. The MIS department regularly maintains the system as well as checks transaction logs and sets audit trails to check any cases of security breach.

The key people who are responsible for the functioning of MIS are the CIO (responsible overall), the systems analyst, the database administrator and the systems administrator.

The database administrator popularly referred to as DBA (Database Administrator) is responsible for the management of data in an organization and assigns roles, rights and authority to different users or user classes. It is a highly specialized job and requires a good understanding of the Database Management System software. The DBA is responsible for the overall integrity and security of database controls involving a check over the access to the database by authorized persons. It is a very senior position and comes with a lot of responsibility. In fact,

most DBMS packages require that before a person assumes the responsibility of a database administrator, he should possess adequate experience of the DBMS package and then take a DBA examination. The function of a DBA is most critical when creating the MIS and includes ensuring security of data so that access violations are avoided.

The system administrator has a technical role, which is again a senior position and comes with a lot of responsibility. The system administrator is responsible for the following:

- **Security of the System:** Security of the system is his responsibility and he maintains it by creating usernames and passwords for each user and managing the audit trail of each user. He also manages security by monitoring the transaction log of the system to detect any unusual activity.
- **Maintenance:** The system administrator maintains the software system and ensures that the system works at its rated performance level. He regularly cleans the system and adopts measures (including rules and procedures) to ensure the efficiency of the system.
- **Virus Protection:** The system administrator ensures that there is no virus attack on the system by regularly adopting antivirus measures.
- **Firewall Management:** The system administrator manages the firewall, which stops unauthorized data from getting in or out of the system. This also protects the system from hackers and viruses.
- **Communication:** The system administrator manages the network and its congestion. He takes steps for the smooth functioning of communication channels in the organization.
- **Software Management:** The system administrator manages the software that is loaded in the system. He ensures that only authorized software is loaded.

These are the primary tasks of a systems administrator. Apart from these regular tasks, the systems administrator also performs a host of minor tasks.

Let us now look at the key skills required by the CIO and the system analyst.

System Related Concepts of MIS

Management Information System (MIS) is the designing and planning of data processing and information systems in an organized way, to help the management to achieve the desired business objectives. It collects the data from the sources external to the organization and also the exceptional information from a business perspective for the concerned management. It has a global system model based on the principle of control by exception. MIS structures a specific system for proper data processing and analysis. The various application packages as well as different operations research and business models are associated with MIS to

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produce authentic information. The information can be printed in a report format. The system also helps in storing the collected data and transitional results to be used by other systems. MIS is considered as an arrangement of the closed and deterministic systems, and open and probabilistic systems. MIS is basically an open system which constantly interfaces with the internal and the external environment of an organization, to meet the ever increasing and varying information requirements of the organization.

The systems are based on various information technologies and include the following types:

- Communications-Driven and Group Decision Support Systems (GDSS)
- Data-Driven Decision Support Systems
- Document-Driven Decision Support Systems
- Knowledge-Driven Decision Support Systems
- Model-Driven Decision Support Systems
- Inter-Organizational and Web-Based Decision Support Systems
- Executive Information Systems (EIS)

While developing and implementing a system, the following must be taken into account:

- Standards and basic elements of MIS.
- Relation between organization arrangement and MIS.
- Information needs for MIS.
- Various relevant types of MIS.
- Process to be followed to develop MIS.
- Criterion for MIS.
- Strategies for shaping MIS design.

In an organization, user-machine method is incorporated providing information to maintain procedures and support the management in decision-making. The entire system is based on programmed and manual actions; models for testing, scheduling, organizing and decision-making; and a database.

Nowadays, in an organization, the management depends on the systems approach to view an organization as a specified set of interconnected and organized subsystems, in which the values are commonly dependent. A system can have:

- The components, functions and the processes to be performed.
- The relationships between the components that conceptually binds them to form a system.
- The organized standard that makes it a function.

The organizing structure has the following five interdependent parts:

- Individual
- Formal and informal organization

- Design of activities resulting due to demands of the organization
- Role awareness
- Physical surroundings in which persons work

Within an organization, the interrelationship of the subsystems forms the basic structure of the systems approach. The dissimilar components of the organization, function in a harmonized way to achieve the organizational targets. The systems approach gives a full analysis of the organization. It aids organization analysis, so that the organization works in a scientific manner and incorporates different subsystems directed to a common goal.

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1.3.1 Components of Information System

A system consists of two types of components, abstract system components and physical system components. Abstract system components perform the operations such as collecting input data, processing the data and generating information from that data. Physical system components consist of various elements such as hardware, software and human resources. There are a few more components of an information system, such as:

- **Data:** Input that the system takes to produce information.
- **Hardware:** A computer and its peripheral equipment such as input, output and storage devices.
- **Software:** Application programs or a set of instructions that process the input data using computers, generate information and store information for future use.
- **Network:** A collection of computer systems connected to each other for communication to share the information.
- **Manpower:** Information system professionals and users who perform various organizational operations such as analysis of information, designing and construction of the information system, and maintenance of the information system. The workforce could comprise IT experts, managers and workers.
- **Graphical User Interface (GUI):** This is an interface for the users of an information system to work with information on the computer system. A user can operate, process and retrieve information from the computer storage using GUI.

The components of an information system describe the functioning of the system. An information system takes the input data from the users of the information system to perform the business operations.

1.3.2 Various activities of IS and Types of IS

There are many application areas that implement information systems in a business environment to solve the business problems and to pursue business opportunities. Figure 1.1 shows the various application areas of information systems in an organization.

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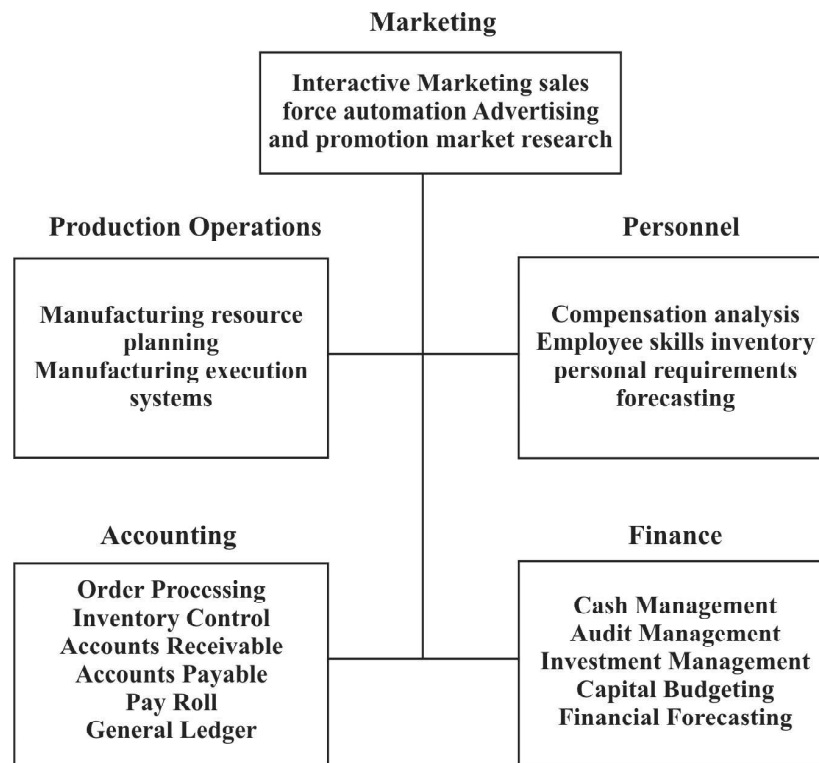


Fig. 1.1 The Application Areas of Information Systems

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. Figure 1.2 shows the classification of the information system.

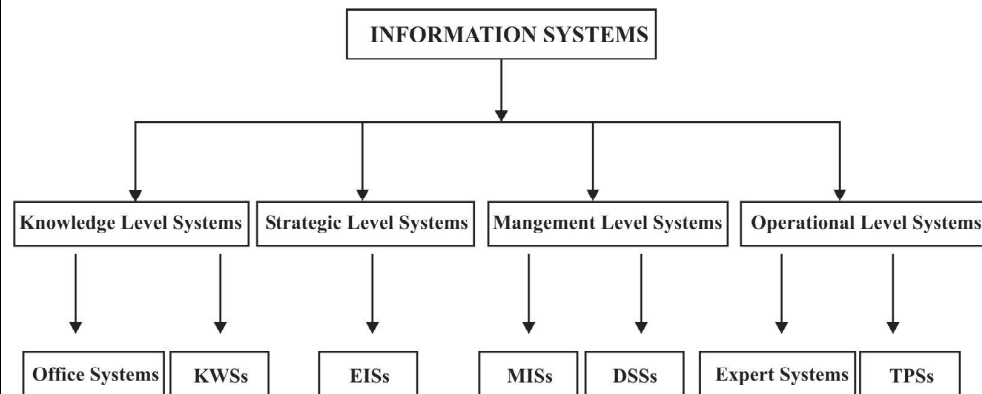


Fig. 1.2 The Classification of Information Systems

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.

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. Figure 1.13 shows various types of information systems, their functions and the level of the system in which they are used.

Check Your Progress

4. Define business management?
5. Mention the eight metaphors that Morgan used for organizations.
6. Define organization?
7. List the key people who are responsible for the proper functioning of MIS in an organization.
8. List the various type of Decision Support Systems.

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1.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

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1. 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.
2. All electrical, electronic and mechanical components of the computer fall in the hardware category such as input/output devices, CPU, ports etc.
3. The major subsystems of information system include:
 - (a) Data Repository
 - (b) User Interface
 - (c) Network
 - (d) Computer Hardware
 - (e) System Software
 - (f) Input/ Output
 - (g) Business Rule (Process)
 - (h) Algorithm/ Program/ Application Software
4. Business organizations have a way of attaining their business objectives like increased shareholder value, increased market share and increased profits etc. Organizations are arranged in a distinct structure segregated into levels of hierarchy. Decision-makers at each level of hierarchy, are called managers and the common way of working and managing of a business organization is referred to as business management.
5. Morgan has been considered as the pioneer in identifying organizations using eight metaphors such as machines, brains, organisms, political systems, cultures, psychic prisons, coercive instruments of subjugation and change and flux and transformation.
6. An organization can be defined as when two or more people work in a structured or unstructured environment to achieve a common goal or mission using some resources. However, many other formal definitions of organization have been popular over the years. According to J.J. Clancy (1989) an organization regularly performs three important tasks. It produces products and services; it makes a profit in the process; and continues to grow and survive as an organization.
7. The key people who are responsible for the functioning of MIS are the CIO (responsible overall), the systems analyst, the database administrator and the systems administrator.

8. The various types decision support systems that support decision-making activities are:

- Communications-Driven and Group Decision Support Systems (GDSS)
- Data-Driven Decision Support Systems
- Document-Driven Decision Support Systems
- Knowledge-Driven Decision Support Systems
- Model-Driven Decision Support Systems
- Inter-Organizational and Web-Based Decision Support Systems
- Executive Information Systems (EIS)

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1.5 SUMMARY

- 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.
- ICT-enabled IS can deliver information faster to the decision maker. The value of information decreases drastically if it is delayed.
- Information should be accurate and precise in order to be of any use to the decision-maker. Any information is useless and of no value if found inaccurate.
- To enable managers to take good decisions, it is very important to provide them with the right kind of information. Management information system provides this service to the managers enabling them to take informed decisions.
- Data Repository, User Interface, network, Computer Hardware, System Software, Business Rule, Input/ Output and Algorithm/ Program/ Application software are a few subsystems of Information System.
- Morgan (1986) has been the pioneer in identifying organizations using metaphors like machines, brains, organisms, political systems, cultures, psychic prisons, coercive instruments of subjugation, and as flux and transformation.
- In organizations, MIS is a separate department, which primarily deals with the supply of information to management. The role of the department is to facilitate transfer of information from the source to the people who need it.
- A system consists of two types of components, abstract system components and physical system components.
- There are various types of information systems on the basis of organizational functions that help in integrating business processes and information.

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1.6 KEY WORDS

- **Pristine form:** It refers to something that is unmodified or original.
- **Data Repository:** It refers to a general term used to refer to a destination designated for data storage.
- **System congestion:** It refers to the state of being congested.
- **Homogenous:** It refers to the items of a group that are all alike, interchangeable, or uniform.

1.7 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the basic reasons for Information Systems to run on ICT?
2. Write short notes on:
(a) Data Repository (b) User Interface
3. List the forces suggested by Mintzberg that organizations are subjected to?
4. What are the job responsibilities of Database Administrator in an organization?
5. What are the different components of information system?
6. Mention the various application areas of information systems in an organization.

Long-Answer Questions

1. Explain the role of information in decision making process.
2. Describe the different structures of an organization.
3. Discuss the role of the MIS department within an organization.
4. Elaborate the job responsibilities of a system administrator in an organization.
5. Discuss in detail about the various types of information systems.

1.8 FURTHER READINGS

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*Foundations of
Information System*

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UNIT 2 INFORMATION SYSTEM

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Structure

- 2.0 Introduction
- 2.1 Objectives
- 2.2 Concepts of Information System and Management Information Systems
- 2.3 Design of Information System
 - 2.3.1 Design Concepts
 - 2.3.2 Conceptual Design
 - 2.3.3 Detailed Design of System
- 2.4 Development of Information System, Implementation, Testing and Conversion
- 2.5 Evolution and Element of MIS
- 2.6 Answers to Check Your Progress Questions
- 2.7 Summary
- 2.8 Key Words
- 2.9 Self Assessment Questions and Exercises
- 2.10 Further Readings

2.0 INTRODUCTION

As discussed in the previous unit, an information system is a set of interconnected components that act as a pool resource to collect, process, store, and disseminate information to support decision making, coordination, control, analysis, and visualization in an organization. These information systems have revolutionized the way businesses operate and also their products and services have been upgraded and improved. Growing mobile digital platforms, growth of online software-as-a-service and development of cloud computing are the major information system trends that have greatly influenced the businesses in a positive way.

Information systems are important for running and managing a business today because of qualities like operational excellence, customer and supplier familiarity, improved decision making, new products and services, upgraded business models and competitive advantage these systems provide.

In this unit, you will study about the concepts of information system and management information system (MIS). Besides, you will also learn about the design and development of information system. Development of information system, implementation, testing, conversion and evolution and elements of MIS are the other key points which took under consideration in this unit.

2.1 OBJECTIVES

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

- Comprehend the basic concepts of information system and management information systems (MIS)

- Explain the different role plays of a manager within an organization
- Discuss the design of information system
- Describe the development of information system, implementation, testing, conversion and maintenance
- Explore the evolution and element of management information systems (MIS)

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2.2 CONCEPTS OF INFORMATION SYSTEM AND MANAGEMENT INFORMATION SYSTEMS

Information remains ‘valuable’ only when supplied ‘timely’ and ‘accurately’ to a management. This insatiable need for information in a business organization has given rise to the discipline of management information system, which deals with the methodical study of a seemingly disparate set of subjects that includes management systems, information systems, information theory and information technology. It deals with the purpose, planning, construction, implementation and operation of a set of systems (information gathering, assimilating and disseminating systems). Theoretically, it can be manual, but the compulsions of a modern competitive environment dictate that MIS can be in a computerized environment.

Several types of management information systems exist, ranging from the very basic in which the everyday tasks of an office are automated to the very complicated in which the system uses artificial intelligence and other advanced techniques to help the managers in decision-making. However, in all such systems the purpose of MIS is to assist the management of an organization in performing their tasks and aid in decision-making. MIS, in most cases, supplies information on a ‘need to know’ basis to the management; the type of information it supplies to the different levels of management differs in type and content.

The focus of an MIS is to supply the right information to the right person at the right time. This triad of the right person, the right information and the right time makes MIS a powerful tool essential for business organizations. If any of the three entities—person, information and time—is not right, then the MIS fails in its objective. Hence, the purpose of the MIS is to maintain the flow of information within an organization by focusing on the triad of right person, right information (i.e., the accuracy of the content of information) and right time. The entire study of MIS focusses on these three things and aims to improve upon them.

Trends in modern business show that the business environment has progressively become complex. Competition is now at a cut-throat level and there is hardly any scope for error. Managers have to be on their toes all the time, analysing the business environment and taking decisions to solve problems in order to take advantage of an opportunity. Thus, the focus is very much on decision-making. However, decision-making itself is of several styles. It can be intuition-based or data-based. The modern environment favours the data-driven informed approach of decision-making. Thus, in order to take a decision, the manager has

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to have some background information about the issue. This competitive environment and the associated role of the manager has given rise to a discipline called information management, which deals with the gathering, storing, analysing, retrieving and disseminating information within an organization. In today's environment, information management is essential for a modern manager to take any worthwhile decisions.

Management

Managers take decisions based on several triggers. Some managers are optimists and take an optimistic view of any situation, be it a problem or an opportunity, while others take a completely pessimistic view. They look at only the negative aspects of decisions. Some managers take decisions based on intuition, i.e., the reaction they feel coming from within themselves, their instinct. Some take decisions based on the analysis of data. These data-driven managers rely wholly on information systems to provide them with the necessary data and information in the form of reports. Nowadays, the prevailing view is that data and analysis-driven decisions deliver greater value to the organization than intuition-based decisions. In the instinct-based decision-making approach, the judgement and experience of the manager plays the most important role in choosing an alternative. However, even an experienced manager can be wrong when deciding on the basis of instinct. Hence, contemporary wisdom suggests that managerial decisions must be taken on the basis of solid rationale and information. If the manager has complete information about a problem or opportunity, then he can take an appropriate decision; else, his decision will be based on intuition or judgement, which is prone to personal bias and hence is likely to be inaccurate. Therefore, managers in today's world are increasingly data-driven rather than feeling-driven.

Before understanding the role played by the management in an organization, we must appreciate that the management is the invisible force that runs an organization. Managers get things done efficiently and effectively (mostly by others), thereby adding value to the organization. They plan, organize, direct and control the employees in order to ensure that everyone in the organization works towards a common goal. An organization without managers would have no cohesion, no purpose and no direction. It will simply collapse. Managers perform multiple roles within an organization. The role of the management can be divided into three categories—interpersonal, informational and decisional roles. The role of the management under different categories is as follows:

- **As a Titular Figurehead whose role is only symbolic:** The person who performs this role is widely respected within the organization and known for some special quality or contribution to the organization and society. Even though the person is a figurehead and does not enjoy a lot of actual authority and power, he/she helps to galvanize the employees to work towards a greater goal. This kind of role is often very important for the success of an organization.

- **As a Leader who takes responsibility of getting things done by inspiring and motivating his people:** In this role, a manager works like an inspirational guru to the people in his domain of influence. This role is sometimes performed by the management at junior level also, when managers lead by example, rather than on the basis of power and authority vested upon them. Several managers who have worked in shop floors have been known to inspire workmen and get things done by inspiring and motivating people.
- **As a Liaison Agent who interacts with social networks for business development and other related activities:** In this role, the manager works like a salesperson and a representative of the company, interacting and networking with people to get more business and achieve other related goals.
- **As a Control Monitor who controls the organizational activities:** In this role, the manager is a control master, who keeps a close tab on the activities within the organization and corrects any deviations from the planned result. A manager plays this role when he is in a middle-level position. He exercises his power to control the organizational system and regularly acts on feedbacks.
- **As an Information Disseminator who relays information from Top-down and bottom-Up:** A manager needs to be a good communicator to be able to achieve this. In this case, the role of the manager is not only to act as a post office but also to ensure that the disseminated information is understood by all concerned.
- **As a Communicator/Spokesperson who communicates with the environment:** In this role, the manager works like a public relations specialist for the organization and communicates the key issues facing the organization to the market, buyers, sellers, regulators, etc.
- **As an Entrepreneur who hunts for opportunities and initiates Changes:** In this role, the manager brings a particular opportunity to the fore and initiates steps to benefit from it.
- **As a Troubleshooter who solves organizational problems and does mid-course corrections:** In this role, the manager works as a control agent who ensures that corrective actions are taken at the appropriate time to thwart any problem.
- **As an Allocator of resource:** In this role, the manager decides on the quantum of resources required for completing activities under his domain.
- **As a Negotiator who manages deals for the organization:** In this role, the manager works as the sole representative of the organization keeping in mind the best interests of the organization.

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All managers perform all these roles in their regular course of work but some managers are more adept in performing certain roles, which they do with great élan.

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Why is MIS Required by a Manager?

A modern manager is responsible for the most important task within an organization, i.e., taking decisions. However, if we are to categorize his tasks on the basis of staffing, planning, controlling, organizing and leading, we would have to say that different managers at different levels spend different amounts of time and effort in each of these categories of activities, even though most managers would be required to perform all the activities in their own domain of influence. For performing his tasks in each of the activities that have been mentioned above the manager needs information. Without information he cannot perform his role in any of the activities of planning, organizing, directing or controlling. For example, a manager when performing the task of planning would need to know many things. Some of the issues that he needs to be aware of are as follows:

- What is the objective of the plan?
- What are the parameters that need special attention while planning?
- What are the independent variables and what are the dependencies?
- What are the things one must be kept under consideration to ensure that the plan is realistic?
- What is the context under which the planning is done?
- What are the key issues related to the plan?
- Who are the key people involved and affected by the plan?

Answers to all these questions will be required if the manager has to establish a suitable plan. However, each question has several questions/issues embedded in it. As we can see, a vast amount of information is required to set the process of planning into motion. A manager in today's modern competitive business environment, may not be fully aware of all the issues and the information against each issue. This is precisely the reason why he needs to rely on a system that provides him with this necessary information. Management information system bridges this gap by providing the manager all the necessary information from different angles, thereby making the task of the manager easier. The same is the case when the manager is organizing, directing or controlling. In each sphere of activity, the manager needs information just as he needs it in the case of planning. Normally, the means to get the information is through reports.

Check Your Progress

1. What are the three major new information system trends that revolutionized the business operations?
2. What does the management information system (MIS) deal with?
3. What makes MIS a powerful tool essential for business organizations?
4. How a manager acts as a control manager within an organization?

NOTES**2.3 DESIGN OF INFORMATION 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. 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:** It is the rate at which a system performs its jobs per unit time.

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- o **Response Time:** It is the time taken by a system to react to a given input.

- o **Run Time:** It is the ability to undertake a complete job within a specified time limit.

- **Security:** The security of a system includes the following:
 - 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 following two levels:

- Conceptual level or conceptual design.
- Physical level or physical design.

We will discuss these levels one by one in the following discussion.

2.3.1 Design Concepts

Some major design concepts that are to be adhered to in designing the system are explained below.

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

This 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.

2.3.2 Conceptual Design

The conceptual design stage allows a system analyst to choose an effective information system 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 as follows:

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

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

1. Problem Definition

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 supposed to solve problems related to information requirements for the organization. It is

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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. Constraint 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 as follows:

- **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 unfavorable organizational policy.
 - o Resource constraints, such as manpower, time, money, etc.

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 pre-determined 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 records, reports and documentation. On the other hand, external resource may include trade publications and government statistics.
- **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 2.1 shows the information requirements and information sources matrix.

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Table 2.1 The Information Requirements and Information Sources MatrixInformation
Requirements**NOTES**

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

Information Sources

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.

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.

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.

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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.

2.3.3 Detailed Design of System

Even after the conceptual design process is terminated the system design process is incomplete. The next step in the system design process involves the detailed design of a system. Conceptual design serves as a basis for the detailed design of an information system. The performance requirement specified in the conceptual design phase, acts as an input to the detailed design phase. The performance requirements are further refined, detailed and finalized in the detailed design of the system that is known as the system specifications. Following are the phases involved in the detailed system design:

1. Project planning and control.
2. Involvement of the user.
3. Definition of detailed subsystem.
4. Output/Input design.
5. Feedback from the user.

6. Design of the database.
7. Design of the procedure.
8. Design documentation.

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We will discuss each phase involved in the detailed system design one by one.

1. Project Planning and Control

An effective and efficient design of an information system can only be ensured when the detailed design process is complete. The introductory step in the detailed design process includes the planning and controlling of the project. The various important stages in the planning and controlling of a detailed design process are as follows:

- **Project Planning:** The project planning stage of a detailed design involves the following activities:
 - o Formulation of the project objectives.
 - o Definition of the project tasks.
 - o Creation of a network diagram of all events and activities in order to specify sequential and parallel events.
 - o Scheduling the job as per the requirements of a user.
 - o Preparation of a budget for the project.
- **Project Control:** The project control stage of a detailed design involves the following:
 - o A feedback of the actual performance, that is generated for the project in terms of time, cost and work of the project. It is then followed by comparisons with schedules, budgets and technical plans.
 - o A proper action is to be performed, if required, in order to maintain the proper functioning of the project control.

2. Involvement of the User

In the detailed design of a system the involvement of the user is also significant because it is important to obtain information from the user regarding the design of the system. The system designers must inform the users of an organization about the new information system that is being developed. The users are assured that the changes in the existing system will always benefit them. Also, in case new systems are developed, the users still benefit. The involvement of the user ensures a successful implementation of the information system.

3. Definition of Detailed Subsystem

Every system in the detailed system design needs to be decomposed in order to establish the required activities and their respective inputs and outputs. Generally,

the subsystems are defined in the conceptual design phase so that every detail of the subsystems can be implemented. The decomposition of the systems to the operational activities performed at this stage, can be carried out one by one. Figure 2.1 shows the decomposition of an information system into certain operational activities.

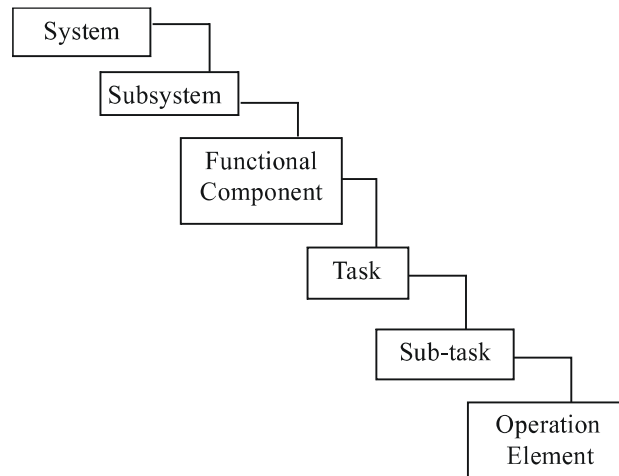


Fig. 2.1 *Decomposition of an Information System*

The integration of activities into a subsystem can also be performed. When the integration of activities is required, it can be based on the following features:

- Common functions.
- Common techniques or procedures.
- Logical flow relationship.
- Common outputs or inputs.

4. Input/Output Design

The **output/input design** is one of the most important characteristics of an information system because it solves the major purpose of the information system of providing support to a user for the decision-making process. After the subsystems are identified, the system designers define the specifications of the outputs and inputs for each sub-system. The programmers then use these specifications to develop programs in order to produce the output/input design. The important key points that need to be considered while preparing output and input are output design and input design.

Output Design

The term output necessarily implies to the information printed or displayed by an information system. Following are the activities that are executed in the output design stage:

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- Identification of the specific outputs required to meet the information requirements.
- Selection of methods required for presenting information.
- Designing of reports, formats or other documents that act as carrier of information.

Output Design Objectives: The output design of an information system must meet the following objectives.

1. The output design should provide information about the past, present or future events. The operational control level outputs provide information of the past and present events. On the other hand, outputs required at the strategic planning level provide information of the future events.
2. The output design should indicate important events, opportunities and problems.
3. The output design should be designed keeping in mind that an action must be triggered in response to some event. A set of rules is predefined for such a trigger.
4. The output design should produce some action to the transaction. For example, when the telephone bill is received, a receipt is printed.

Presentation of Output: The next consideration in the output design is the presentation of output in an information system. The presentation of an output is regarded as an important feature of output design. The presentation of an output can be represented either in tabular or graphical form or in both forms. A tabular format is preferred in the following conditions:

- When the details dominate the content of the output.
- When the contents of the output are classified in groups.
- When the output designs are to be compared.

A tabular format is also preferred for detailed reports. Table 2.2 shows the tabular format of output.

Table 2.2 *Tabular Format of Output*

Serial Number	Item Code	Quantity Ordered

Graphical representations are used to improve the effectiveness of the output because some users prefer to view information in graphic form rather than in rows and columns. Figures 2.2 and 2.3 shows the two different graphical formats of output.

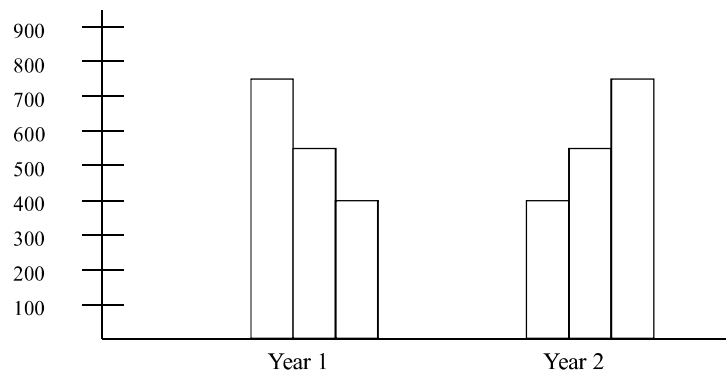


Fig. 2.2 Graphical Format of Output as Bar Chart

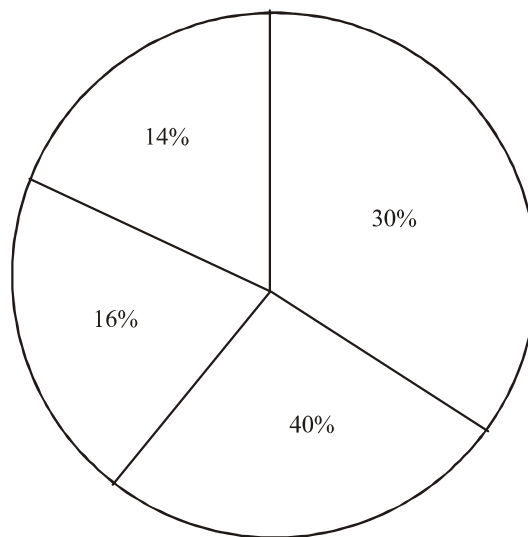


Fig. 2.3 Graphical Format of Output as Pie Chart

The tabular and graphical formats may be combined together to enhance the presentation of the output.

Output Design Specifications: The specifications for the output design should be considered first while designing any output. The main points in the output design specifications are as follows:

- **Paper Size:** It is important for a system designer to specify the size of the paper to be used for the output. The size of the paper can be A4 or A3 size. It can also be 9.5×11 or 11 × 14.7/8 inches.
- **Special Forms:** Outputs can be designed on pre-printed form. A pre-printed form requires standard print headings or titles for the output design. For example, some organizations may want to display their name and logo on the output document produced by the information system and other organizations may require to display the address as well along with the name and logo of the organization. The output display depends on the choice

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of the organization and it varies in different organization. Different ideas can be helpful in enhancing the presentation skills of the output document of the organization.

- **Multiple Copies of Output:** At times, more than one copy of an output is required and in such cases, multipart forms can be used to produce multiple copies of the output. Multiple papers are available in carbon and carbonless forms.
- **Turnaround Documents:** The output can be produced as a turnaround document. In this specification, the output can be used as an input document as well. The turnaround documents can be used in organizations where optical scanners are used for reading data from the forms.
- **Output Layout:** The output layout may be defined as the arrangement of items on the output medium. The layout design guides a programmer in the development of codes. The output layout should contain the following items:
 - o Headings and date.
 - o Data and details.
 - o Summaries and totals.
 - o Page title, number and date.
 - o Notes and comments.
 - o Column headings and data type.

The designers usually use N [n] for numeric data type and X [n] for alphanumeric data type, where n specifies the width of the column.

A system designer may design multiple screens or special windowing capabilities, such as pop-up windows for designing screens. Such designs enhance readability for visual displays.

Input Design

Input Design like output design is of a primary significance to a system designer. This is because the output is regarded as the foremost determinant for defining the performance of a system. The output of the system greatly affects the input design of the system.

Objectives of Input Design: The input design of an information system must meet the following objectives:

- The input design of the system must attempt to reduce the data requirements. It should also avoid capturing unnecessary data such as constant and system-computable data.
- The input design must avoid processing delays during data entry. Capturing automatic data can reduce delay.
- The input design must avoid data entry errors. This can be achieved by checking the errors in the data entry program. This technique of checking

data entry programs for errors is known as the input validation technique.

- The input design must keep the process simple and easy to use.

Input Layout: The layout of the input design must contain the following items:

- Headings and date of data entry.
- Data heading and value.
- Data type and width of the column.
- Initials of data entry operator.

5. Feedback from the User

The system designer requires the involvement of the user in the detailed design of the system as well. This time the involvement of the user is for providing feedback. The feedback of the user on the system design will increase the receptivity of the information system being designed.

The system analyst should demonstrate the proposed information system to the users of the system. This step also assures that the detailed design project is progressing according to the specifications being made.

6. Database Design

A database is an arrangement of inter-related records. The database design serves as a data resource for the information system of an organization. This phase is considered as an important phase in order to achieve an optimum performance including the storage and fast retrieval of data.

A system designer must keep the following points in mind while designing a database:

- All the data tables and record types are identified.
- The fields, the key fields for each table and relations between various tables are identified.
- The data type and the width of each field of the tables are determined.
- The data tables are normalized.
- Data dictionary is properly documented.

7. Design Procedure

Procedures are the rules, standards or methods designed to increase the effectiveness of an information system. Procedures specify the tasks required for implementing the information system and aid designers as well as users in designing procedures. Procedures can be classified as follows:

- **Data Entry Procedures:** These procedures are designed for data entry, such as the data entry sequence.

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- **Run Time Procedures:** In this procedure, an action is to be performed by the users to achieve the intended results. For example, a procedure may instruct a user to load the printer with a specific size of paper.
- **Error Handling Procedures:** These procedures help the users in detecting and rectifying errors.
- **Security and Backup Procedures:** These procedures provide information regarding the actions performed in order to protect a system against any damage.
- **Software Documenting Procedures:** These procedures provide programmers with instructions on how to document the programs.

While designing documents a system designer should keep the following points in mind.

- He must understand the purpose and the quality standard of each procedure.
- He must develop a step-by-step direction for each procedure.
- He must document all the procedures.

8. Design Documentation

Detailed design starts with the performance specifications provided by the conceptual design and ends with a set of design specifications for the construction of an information system. The design documents should contain comprehensive details of all the design phases. This stage consists of the following:

1. System objectives.
2. Design constraints.
3. Inputs/Outputs.
4. Data files.
5. Procedures or manuals.
6. Proposed system, which contains summary and detailed flowcharts.
7. Input/Output specifications.
8. Program specifications.
9. Database specifications.
10. Cost of installation and implementation.
11. System test conditions.

The system documentation should also include a user-manual and operator-manual. A user-manual prepares the users and makes them understand the implementation of the system. Therefore, the system documentation should be simple and easy to understand. On the other hand, an operator-manual is written for computer operators. The operator-manual should include an operator's view of the system, specifying start, stop and restart sequences. It should also contain various

procedures that guide the operators regarding the security, privacy and integrity of data.

2.4 DEVELOPMENT OF INFORMATION SYSTEM, IMPLEMENTATION, TESTING AND CONVERSION

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The systems development life cycle comprises different phases, namely *system analysis*, *design*, *coding*, *testing*, and *implementation and maintenance* (see Figure 2.4). In this section, we will examine each phase in detail.

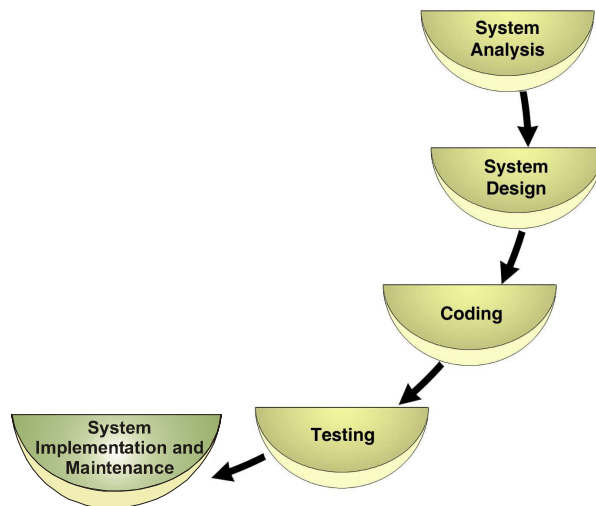


Fig. 2.4 The System Development Life Cycle

System Analysis

System analysis is a process of examining the system with the potential goal of improving or modifying it. It consists of understanding the working of the existing system, defining the problems, identifying their reasons or the business opportunities that we want the system to seek. The aim of this phase is to determine the requirements of the proposed system or the features of the system. The system analysis phase comprises three activities, namely *system investigation*, *feasibility study* and *requirements definition*.

System Investigation

This is the first step involved in system analysis that is performed to determine whether the user's request to change or improve the existing system is valid. To determine this, an investigation team is made which includes one or two system analysts and representatives of the departments where the new system will be installed. This team interviews the staff to study the problems they have with the existing systems. This study gives them the idea of the way the workers want the

new information system to function. After investigation, the team prepares a written report that summarizes the objectives and scope of the problem.

Feasibility Study

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If the preliminary report concludes that the need of a new information system is justified, then a more comprehensive study of the proposed system begins by a larger investigation team. The objective of this team is to determine the feasibility of the proposed system. In the feasibility study, the information needs of the users, resource availability, cost estimates for system development, benefits of the system to the organization after it is developed and the cost to be incurred on its maintenance are determined. While conducting feasibility study, the important aspects that are examined are the *technical feasibility*, *operational feasibility* and *economic feasibility* (see Figure 2.5).

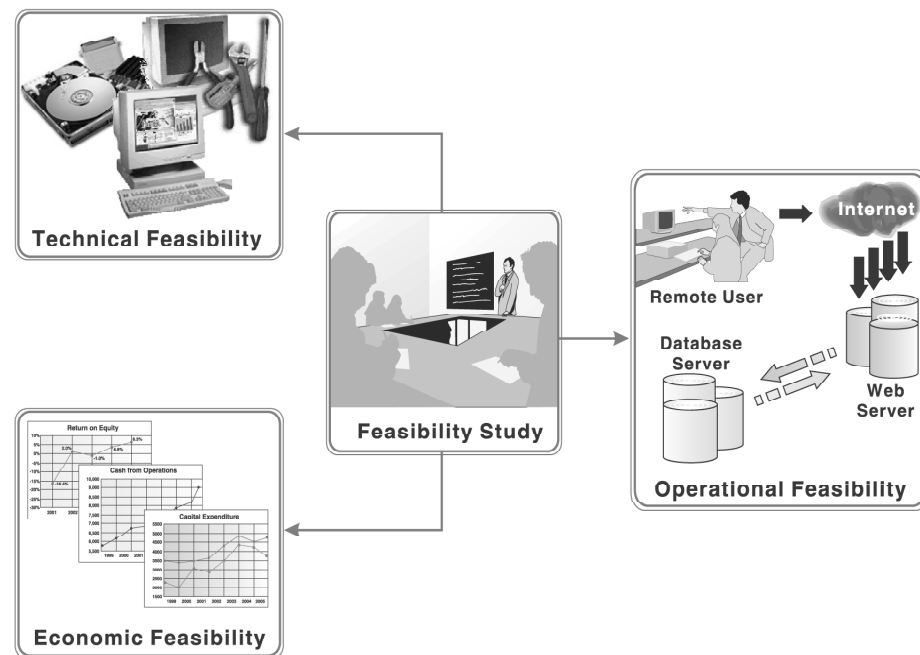


Fig. 2.5 Different Aspects of Feasibility Study

Technical Feasibility

Technical feasibility assesses the current resources (such as hardware and software) and technology, which are required to accomplish the user requirements in the software within the allocated time and budget. For this, the software development team ascertains whether the current resources and technology can be upgraded or added in the software to accomplish specified user requirements. The following are the purposes of technical feasibility:

- To analyse the technical skills and capabilities of the system development team.

- To determine whether the existing hardware can be used for the proposed system.
- To ascertain that the technology chosen for system development has large number of users so that they can be consulted when problems arise or improvements are required.

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Operational Feasibility

Operational feasibility assesses whether the new system performs all the intended operations. The following are the purposes of operational feasibility:

- To determine whether the problems anticipated are of high priority or not.
- To determine whether the solution suggested by the system development team is acceptable or not.
- To analyse whether users will adapt to a new software or not.
- To determine whether the organization is satisfied by the alternative solutions proposed by the system development team or not.

Economic Feasibility

Economic feasibility determines whether the required system is capable of generating financial gains for an organization or not. It involves the cost incurred on the software development team, estimated cost of hardware and software, cost of performing feasibility study, and so on. For this, it is essential to consider the expenses made on purchases (such as hardware purchase) and the activities required to carry out software development. In addition, it is necessary to consider the benefits that can be achieved by developing the software.

A system is said to be economically feasible if it focuses on the following issues:

- Cost incurred on system development to produces long-term gains for an organization.
- Cost required to conduct full system investigation.
- Cost of hardware, software, development team and training.

Once the feasibility study is performed, a written proposal called the **feasibility report** is made. It includes the recommendation that states whether the system development should continue or not. This report may also include information about changes in the software scope, budget, schedule and suggestions of any requirements in the system.

Requirements Definition

Once it is determined that the proposed system is feasible, the next thing that the analyst needs to identify is the system requirements, that is, what functions the system is going to perform or what features it will include to perform its tasks.

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Determining the requirements of a system that does not exist is a difficult task. To gather the system requirements, various methods can be adopted. Some of them are as follows:

- **Interview:** The analyst meets the users to understand the problems with the existing system. The users are free to discuss their problems and give their opinions to solve the problems.
- **Questionnaire:** Questionnaires help the analyst to gather information about various aspects of a system from many users in a very short time. As compared to interviews, questionnaires require less effort and time.
- **On-the-job Observation:** Generally, users are not able to express the process of how they work. Therefore, the analyst may spend time with the employees to observe the current system and detect the problems of the existing system.

Once the user requirements are identified, they are organized into a formal document known as **Software Requirement Specification (SRS)**. The SRS forms the basis for the design of the new information system. It contains the final description of the system that must be implemented. In general, it includes:

- What is accomplished conceptually by the system?
- What are the required inputs and outputs of the system?
- Which processes are required to operate the system?

System Design

The objective of **system design** is to devise a solution for the problem identified during system analysis. While the system analysis phase deals entirely with the problem domain, system design is the first phase of transforming the problem into a solution. It consists of the following three activities.

- **Interface Design:** It focuses on designing the interface to provide communication between the end users and the system.
- **Data Design:** It focuses on identifying the data used by the proposed system, defining specific data types and storage mechanisms, and ensuring data integrity by using business rules and other run time enforcement mechanisms.
- **Process Design:** It focuses on designing the processing and control procedures, i.e., the procedures to process the data and produce the output.

Coding

In this phase, the design of the system is translated into a code in any programming language. The aim of this phase is to implement the design in the best possible way. Typically, in larger organizations, system software developers are part of their staff for this purpose. However, they may install or modify and then install a

purchased system that meets the requirements of a new system. The selection of the option depends upon many factors, such as the cost of each option, time available to develop the system, etc.

Testing

The **testing** is performed to ensure the quality of the developed system. In this phase, the errors that may prevent the system from producing output according to user's requirement are identified and removed. Before the actual testing begins, a document known as **test plan** that specifies the objective, scope, method and purpose of the testing is made. This document acts as a guideline to the tester while performing various testing activities.

The developed system would be tested using the four levels of testing, namely *unit testing*, *integration testing*, *system testing* and *acceptance testing*.

- **Unit Testing:** It tests the individual units (that is, the modules or the programs) of the system for their correctness. The errors found in the units are removed and the units are validated for further use.
- **Integration Testing:** At this level, all the units validated during unit testing are combined together to form a subsystem. The subsystem is then tested to ensure that all the modules in the system continue to work in accordance with user requirement even after integration.
- **System Testing:** It involves testing the system as a whole. The subsystem (i.e., the software) is integrated with other elements, such as hardware, people and database to form a computer based information system. This system is then checked for errors using the system testing activities, including recovery testing, security testing, stress testing and performance testing. This stage of testing determines whether the developed system works according to the way it was envisioned.
- **Acceptance Testing:** It involves testing the system with respect to user needs, requirements and business processes. This is done to determine whether or not the system satisfies the acceptance criteria. It enables the users to test the system themselves and analyse whether it is meeting their requirements or not. On the basis of the results of the tests, the user accepts or rejects the system.

Once all the tests are conducted, a test report is made that summarizes the outcome of the testing in terms of items tested, summary of results and the effectiveness of the testing.

System Implementation and Maintenance

Once the system is developed, it is implemented and made operational. The implementation of the system involves two main activities, which are training and conversion. In most cases, training takes place before conversion. However, if training is done on the job, it may occur after conversion.

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- **Training:** It is not easy for the users to get accustomed to a new system immediately. To make the users capable of handling the system independently, training is provided. During training, the users are taught how to use and work with the system.
- **Conversion:** It is the process of converting an old system to a new system, where the new system may be either a replacement of a manual system or a modification to an already existing information system. To accomplish the conversion, different strategies can be used, which are as follows:
 - o **Parallel Conversion:** In this strategy, the old system is used in parallel with the new system for some time. The benefit of this strategy is that the operations are not effected in case the system fails as the old system can still be used. However, this strategy is expensive as it requires resources to run two systems.
 - o **Direct Cutover Conversion:** In this strategy, the old system is replaced with the new system. This approach is inexpensive as only one system runs. However, it may be risky because if the system fails there is no system in backup to resume the business operations.
 - o **Phased Conversion:** In this strategy, instead of implementing the entire system at once, the system is broken into different modules and these modules are employed one at a time.
 - o **Pilot Conversion:** In case the organization is large, initially the new system can be deployed in one department only. Once all the problems are addressed, it can be deployed in other departments too.

Once deployed, systems are often used for many years. However, over a period of time, requirements of the users and the business environment may change. Further, there may be some errors in the system which must be rectified as soon as they are discovered. Thus, system needs maintenance. Maintenance can be defined as the process of changing the hardware, software, documentation or procedures for correcting errors, meeting new requirements or improving efficiency of the system. The main objective of maintenance is to ensure that the system is able to accommodate changes after the system has been delivered and deployed. The following are the purposes served by the maintenance activity.

- **Providing Continuity of Service:** Software maintenance process focuses on fixing errors, recovering from failures, such as hardware failures or incompatibility of hardware with software.
- **Supporting Mandatory Upgrades:** Software maintenance supports upgradations, if required, in a software system. Upgradations may be required due to changes in government regulations or standards.
- **Improving Software to Support user requirements:** With time, user's requirements may be changed. Software maintenance provides a framework using which all the requested changes can be accommodated.

- **Facilitating Future Maintenance Work:** Software maintenance also facilitates future maintenance work, which may include restructuring of the software code and database used in the software.

2.5 EVOLUTION AND ELEMENT OF MIS

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Over the past decade the evolution of management information system has been influenced by several factors. As the Internet has evolved so has the management information system. From the early start of Yahoo and the Netscape browser to the dominance of Google and the emergence of Mozilla, the information management system has benefited from the advances within the Internet. The ability to send e-mails back and forth allowed information to be passed on and managed through the e-mail and POP medium. This led to several advances within the structure and inbound systems.

Conceptually, management information systems and information technology are two very different things. Management information system is an information management concept and has no technological component. Indeed, technologies will change and have changed in the past but management information system and its requirement and characteristics will broadly remain the same. Only MIS with changing time and technology regimes will have different technology platforms. In the early 1970s, MIS was mostly run on the mainframe computers with COBOL programs. In the 1980s and 1990s, it changed to a personal computer-based solution using networking, databases and 4GL tools. Today, MIS runs on advanced computer networks with wireless connectivity with hugely advanced software tools, but the broad characteristics of MIS have remained the same. In the 1960s and 1970s also, it was instrumental in providing information, which helped in management decision-making, just like today. Only the degree and quality of information has improved. However, the character of MIS has not changed with the changing technology. Technology has always been and will be a platform for MIS. However, the technology intervention to provide a platform for MIS has increasingly grown over time and some confuse MIS with the technology on which it runs. Technology has become an integral part of MIS but one must appreciate that MIS is a much larger concept critical to management decision-making.

Elements of MIS

Information systems are a type of data processing systems, which collect the data from different sources, process that data and generate information from the data to be used for different applications within the organization. For example, in a business context, an information system collects data from various systems such as finance and sales systems from a supplier side. The information system processes the data and generates information for the customer. Customers provide feedback to the supplier depending on the information processed by the information system. Figure 2.6 shows the information system in business context.

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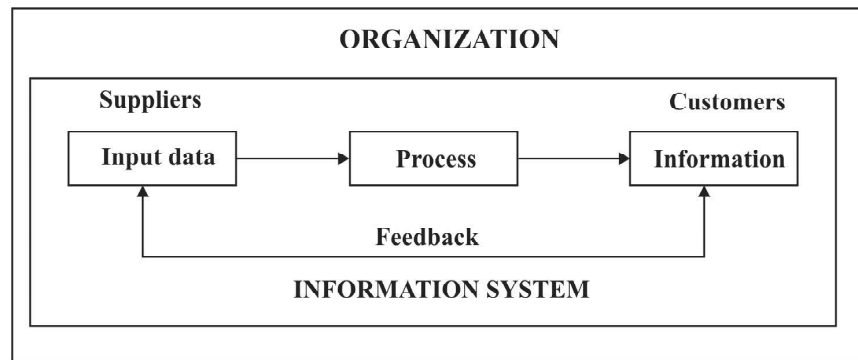


Fig. 2.6 The Information System in a Business Context

Information systems are basically systems that help in maintaining and managing the information. An information system helps to manage and store information to perform various functions, such as decision-making, documentation of business activities and generation of reports for analysis of organizational operations. You need to understand the concept of information and system for acquiring basic knowledge of information systems. Various terms used in information systems are as follows:

- *Data* is a raw material that can be a number, a fact, a sound, a picture or a statement gathered from different sources. In the real world data can represent anything related to business processes and employee details.
- *Information* is a meaningful data or a processed data. It defines the relation between different data.
- *System* is a collection of components that helps in achieving a common objective. For example, in a human-machine system, the machine element consists of hardware and software to perform computation, and people make decisions based on this computation.

Check Your Progress

5. Name three design concepts that should be adhered to in designing the system.
6. Define conceptual design of information system?
7. Name the different phases of the system development life cycle.
8. List the purposes served by the system maintenance process.

2.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Growing mobile digital platforms, growth of online software-as-a-service and development of cloud computing are the major information system trends that have greatly influenced the businesses in a positive way.

2. The management information system (MIS) deals with the methodical study of a seemingly disparate set of subjects that includes management systems, information systems, information theory and information technology. It deals with the purpose, planning, construction, implementation and operation of a set of systems (information gathering, assimilating and disseminating systems).
3. The focus on supplying the right information to the right person at the right time makes MIS a powerful tool essential for business organizations. If any of the three entities— person, information and time—is not right, then the MIS fails in its objective.
4. A manager is said to be a control master of an organization because he is the one who keeps a close tab on the activities within the organization and corrects any deviations from the planned result.
5. The three design concepts that should be adhered to in designing the system are abstraction, refinement and modularity.
6. The conceptual design stage allows a system analyst to choose an effective information system 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. A conceptual design is a prerequisite for the detailed design.
7. The system development life cycle comprises different phases, namely system analysis, design, coding, testing and implementation and maintenance.
8. The following are the purposes served by the system maintenance process:
 - (a) Providing continuity of service
 - (b) Supporting mandatory upgrades
 - (c) Improving software to support user requirements
 - (d) Facilitating future maintenance work

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2.7 SUMMARY

- Information remains ‘valuable’ only when supplied ‘timely’ and ‘accurately’ to a management. This insatiable need for information in a business organization has given rise to the discipline of management information system (MIS).
- The focus of an MIS is to supply the right information to the right person at the right time. This triad of the right person, the right information and the right time makes MIS a powerful tool essential for business organizations.
- Managers perform multiple roles within an organization. The role of the management can be divided into three categories—interpersonal, informational and decisional roles.

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- 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 system design phase is carried out at following two levels: conceptual level or conceptual design and physical level or physical design.
- The performance requirements are further refined, detailed and finalized in the detailed design of the system that is known as the system specifications.
- The systems development life cycle comprises different phases, namely *system analysis, design, coding, testing, and implementation and maintenance*.

2.8 KEY WORDS

- **Insatiable:** It refers to something (desire or hunger) that is impossible to satisfy.
- **Titular:** It refers to holding or constituting a purely formal position or title without any real authority.
- **Liaison agent:** It refers to a person who liaises between two organizations to communicate and coordinate their activities.

2.9 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What is an instinct-based decision-making approach?
2. Why is it good to be a data-driven manager rather than feeling-driven manager?
3. Why is information management so important for managers?
4. List the steps involved in the conceptual design of information system.
5. What items should be there in the layout of the input design?
6. What is Software Requirement Specification (SRS)?

Long-Answer Questions

1. Explain the growing trends in modern businesses that demand for the use of MIS.
2. Describe the role of the management under different categories.
3. Discuss the detailed design of a system.

4. What are the different aspects of feasibility study?
5. Elaborate on evolution and elements of MIS.

Information System

2.10 FURTHER READINGS

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UNIT 3 MANAGEMENT INFORMATION SYSTEM (MIS)

Structure

- 3.0 Introduction
- 3.1 Objectives
- 3.2 Management Information System: An Overview
 - 3.2.1 Characteristics and Basic Requirements of MIS
 - 3.2.2 Functions of MIS
- 3.3 Structure of MIS
- 3.4 Approaches to MIS Development
- 3.5 Computerized MIS
- 3.6 Prerequisites of an Effective MIS
- 3.7 Limitations of MIS
- 3.8 Answers to Check Your Progress Questions
- 3.9 Summary
- 3.10 Key Words
- 3.11 Self Assessment Questions and Exercises
- 3.12 Further Readings

3.0 INTRODUCTION

Management Information System (MIS) is a term used to refer to a class of information systems, which provides the management with the information required for decision-making. The three words, which constitute the term, management information system, have a role to play in its design and functioning.

Management is the unseen force that drives an organization. It is the lifeblood of an organization. People performing various management roles in an organization are called managers. These managers are the key people within an organization who are responsible for the smooth functioning of the organization.

Information is the key ingredient for taking decisions; that is why management values information. Information improves the quality of decision-making, which is the most important task of management. Information is created after processing data, mostly transaction level data. This transaction level data has to be captured, stored and then processed to create any meaningful information for managers.

A system can be defined as a set of interacting entities having interrelationships, interconnections with each other, forming an integrated whole. System in the context of MIS in today's time means a process (technology enabled) for capturing data, storing it and then processing/analysing it to provide information.

Information systems that help a management in taking decisions are called management information systems. Management information systems (MIS) consist

of a set of information systems working towards the common goal of achieving greater efficiency in decision-making at each level of management. Typically, management information systems deal with internally-generated information. The in-house data is processed (summarized/aggregated) to create reports, which helps a management at different levels in taking decisions. A management information system is normally designed in order to achieve information flow, which is based on the 'need to know' principle. This means that any manager would be given only that type of information to which he is entitled and has any use. This hierarchical rule-based information delivery to the different levels of management is put in place to avoid both information overload and enable security of information.

Many modern systems have come up in recent times to help managers in their tasks like Enterprise Resource Planning (ERP) system, which is a transaction processing/support system but comes in-built with the best practices of the industry and helps in generating integrated scenarios for managers at different levels. Customer Relationship Management (CRM) system helps in the management of customers by creating profiles and making available complex analytical tools to managers for processing customer data. Similarly, there are systems to help managers deal with supply chain data called Supply Chain Management (SCM) system. All these modern systems basically help in achieving greater efficiency by making the job of management decision-making better and therefore falls under the category of management information system.

Thus, a management information system is a set of systems, which helps management at different levels to take better decisions by providing the necessary information.

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3.1 OBJECTIVES

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

- Discuss the definition, characteristics and basic requirements of MIS
- Explain the functions and structure of management information system
- Analyse the approaches to MIS development
- Examine the pre-requisites of an effective MIS
- Assess the limitations of MIS

3.2 MANAGEMENT INFORMATION SYSTEM: AN OVERVIEW

A management information system is not a monolithic entity but a collection of systems, which provides a user with a monolithic feel. The different subsystems working in the background have different objectives, but work in concert with each other to satisfy the overall requirement of managers for good quality

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information. Management information systems can be installed by either procuring ‘off-the-shelf’ systems or commissioning a completely customized solution. Sometimes, management information systems can be a mix of both, i.e., an ‘off-the-shelf’ system but customized according to the need of the organization.

However, before we proceed any further, we must have a clear understanding of what managers do in an organization and why they need management information systems. The former issue has already been dealt with at length.

Managers are the key people in an organization who ultimately determine the destiny of an organization. They set the agenda and goal of an organization, plan for achieving the goal, implement that plan and monitor the situation regularly to ensure that deviations from the plan are controlled. This set of activity ensures the smooth functioning of the organization and helps it attain its objectives and hence these managers are vital for a successful organization. The managers in turn conduct these activities collectively called management functions, by doing something that others in the organization do not i.e., decide. They decide on all such issues that have relevance to the goals and objectives of an organization. The decisions range from routine decisions taken regularly, to strategic decisions which are sometimes taken once in the lifetime of an organization. The decisions themselves differ in terms of:

- Complexity
- Information requirement for taking the decision
- Relevance
- Effect on the organization
- Degree of structured behaviour of the decision-making process

The different types of decisions require different types of information as is required information to reach a decision. Information systems, which supply relevant information to managers to enable them to take decisions are collectively termed as management information systems. They have common characteristics and even though their actual implementation in an organization may differ according to the needs of an organization, their basic characteristics remain the same. The information technology platform on which management information system is based may also vary in terms of complexity and scale, but the technology component does not change the broad characteristics of the management information system. Technology is the only medium through which a solution is delivered.

3.2.1 Characteristics and Basic Requirements of MIS

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

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 sub-types 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:

- 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. 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.

Characteristics of MIS

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

- **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.

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- **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’ (i.e., 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.

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3.2.2 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 an 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 as follows:

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.

Assistance: Providing assistance to the higher management by analysing 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.

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Check Your Progress

1. In what terms the decisions of managers differ?
2. List the phases to which the scope of MIS lies.
3. How does a centralized data management helps an MIS?

3.3 STRUCTURE OF MIS

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.

Physical Components of MIS

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.

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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

(a) 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 3.1.

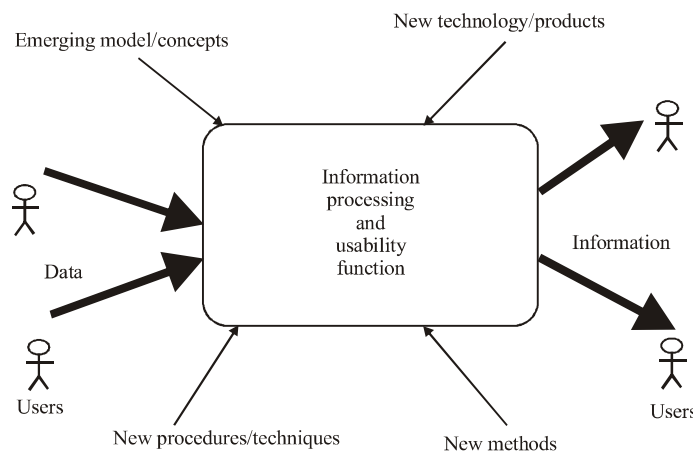


Fig. 3.1 Information Processing and Usability Function

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(b) 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 3.2.

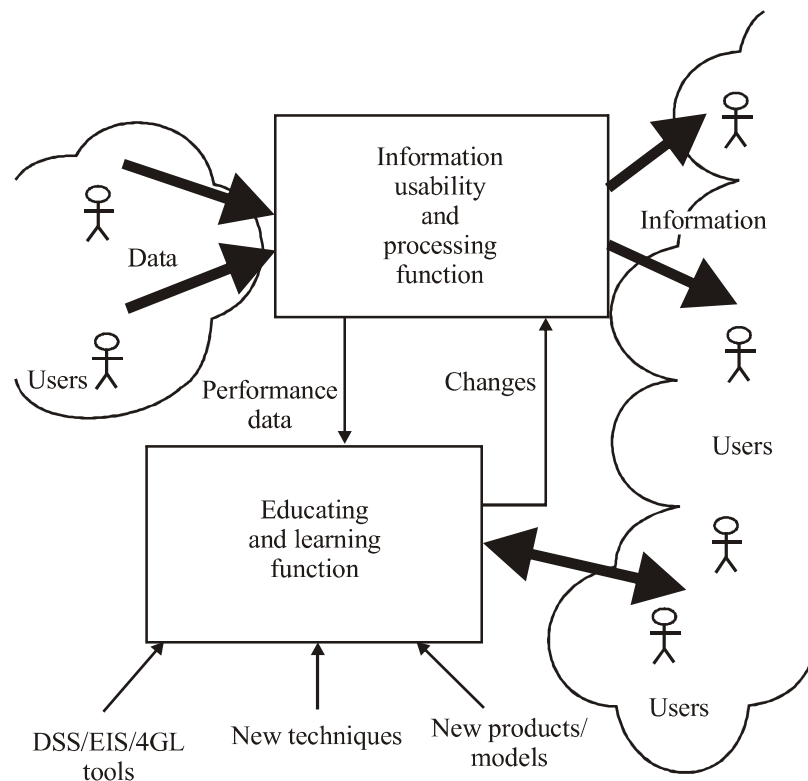


Fig. 3.2 Information Usability and Processing Function

(c) 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.

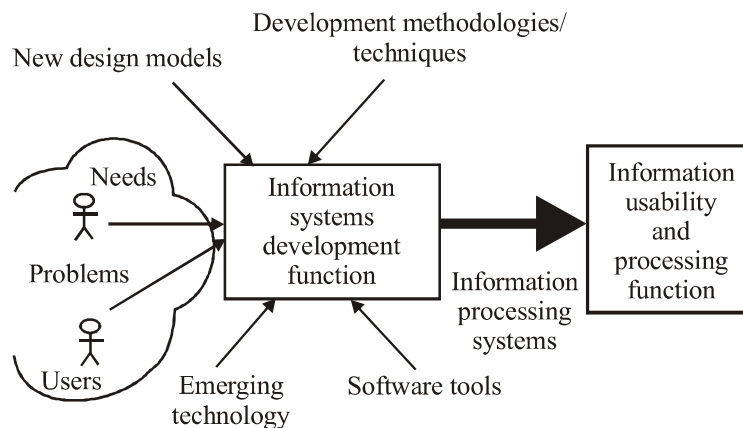


Fig. 3.3 An Information Systems Development Function

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 3.3).

(d) 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 proste 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

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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 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.

(e) 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 3.4):

- Adequate support for a corporate strategy.
- Efficient Management Information System with Executive Information Support.

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- 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.

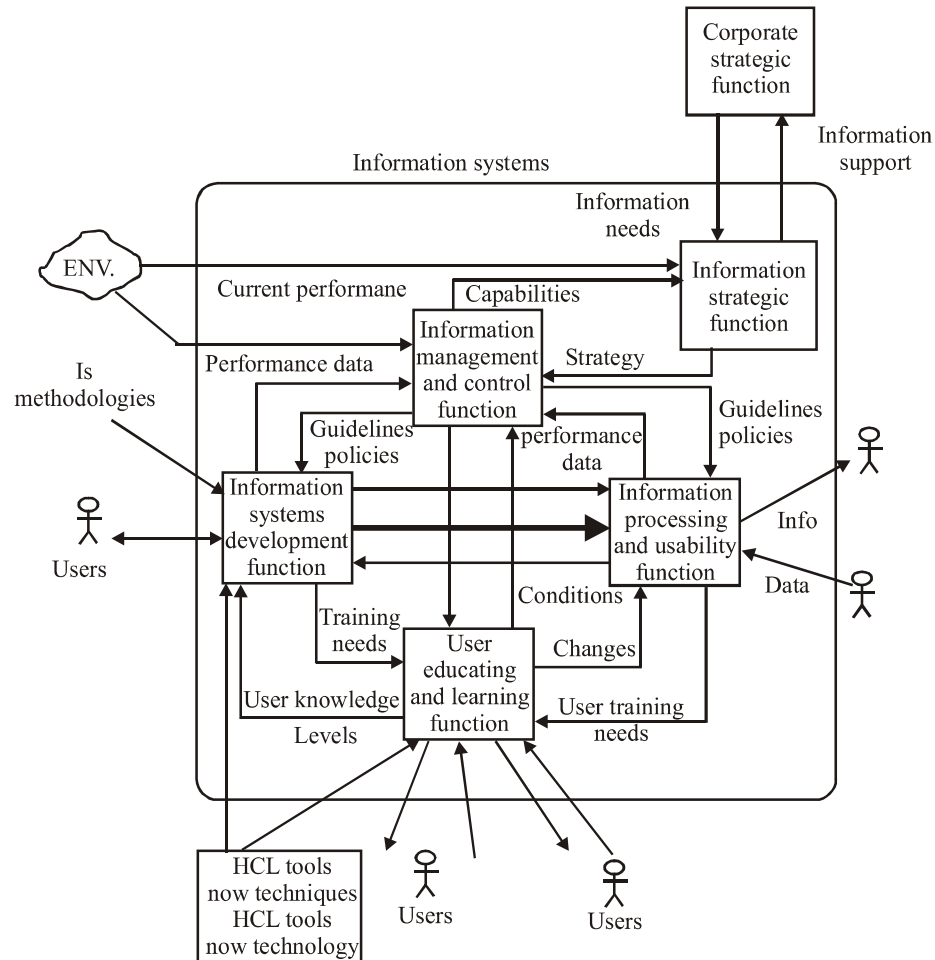


Fig. 3.4 Information Systems Functional Model

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 as follows:

- **Structured:** Refers to the structure of MIS that is pre-planned and easily programmable, because of the well-defined nature of the structure. The structured decision is frequently repeated during the decision-making process.

- **Unstructured:** Refers to the structure that is not pre-planned and is non-programmable. The decision here occurs with a less frequency and is irregular.
- **Semi-structured:** Refers to the decisions that are more or less structured and contain some elements that are programmable and some non-programmable.

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3.4 APPROACHES TO MIS DEVELOPMENT

The development process of an information system within an organization follows a sequence of events. An information system is a system that collects and processes data that can be further used by the system analyst for planning and decision-making. The stages involved in a system development process are as follows:

1. Understanding a problem.
2. Deciding a plan for the solution.
3. Adding code to the planned solution.
4. Testing the program to which the code is added.

An information system can be designed efficiently when the development process is divided into smaller phases. In general, the development process of an information system involves the following phases:

1. System Investigation
2. System Analysis
3. System Design
4. System Construction and Testing
5. System Implementation
6. System Maintenance

We will discuss each of these stages one by one in the following discussion.

1. System Investigation

The system investigation is the introductory step in a system development project. In the system investigation stage, the request made by a user is handled. The request made by the user can be a request for changing, improving or enhancing the user's request. A user invites a system analyst so that the problem can be easily defined and can be resolved later. This stage is not responsible for the design study and details of the system. The substages involved in the system investigation are:

Defining the Problem: A user calls a system analyst so that can help the user in defining and resolving the problems in the system development process. The system analyst identifies the problem and prepares a written statement of the scope and

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objectives of the problem. The problem can also be defined on the basis of interviews or meetings with the user that aid the system analyst to understand the problem more distinctively.

After the problem is defined, a written statement of the problem is sent to the user and the user gives his response to these statements. On the basis of the response given by the user, errors and misunderstandings regarding the problem are resolved. Thus a proper understanding and definition of the problem is essential to understand the cause of the problem. A system problem may occur because of the following reasons:

- The system is working slowly.
- A security problem.
- The information required in the system development stage is not processed by the existing system.
- The existing system is unable to manage the workload.
- The existing system may not be cost-effective.
- The accuracy and reliability problem may also arise.

Although, problem definition is considered as the preliminary step, it is generally avoided in the system development process.

Feasibility Study: The feasibility of a project for the system development process is thoroughly examined during the system investigation stage. The objective of the feasibility study is to assess alternative systems so that the most feasible system for the development process can be proposed. The feasibility study can be addressed by answering questions, such as:

- Can this system meet the required business needs?
- Is it suitable for the use of the system development process?
- What are the risks involved with this system?
- Is the problem associated with the system worth solving?

This study should be relatively brief, as the purpose of this stage is only to get an idea of the scope of the project. After the feasibility study of the project, the result can be presented to the user management. The presentation, which is based on the feasibility study, marks a crucial decision point in the life of the project. Therefore, a feasibility study provides an overview of the problem and acts as an important checkpoint that should be completed before executing other resources. Following are the four major categories that are required to assess the feasibility of a proposed system:

- **Organizational/Behavioural Feasibility:** Organizational or behavioural feasibility, as the name indicates, determines the feasibility of the system in terms of the organization and the behaviour of its employees. The strategic plan of an organization for information system determines the organizational feasibility of the system. The behavioural feasibility reflects the behaviour of the employees of an organization. Behavioural feasibility on a broad platform

incorporates the execution of the organizational plans, which involves teamwork and harmony among the employees with no space for discrimination and animosity among them. Behavioural feasibility leads to the smooth functioning and implementation of the organizational plan. The information system must be viewed as a subset of the whole organization. This means there is a lot more study other than the organizational feasibility.

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- **Economic Feasibility:** Economic feasibility study deals with the economy of the system project. The costs and returns are evaluated and therefore, it is determined whether the returns justify the investment, which was planned, in the system project. The questions raised by the system analysts in the system investigation stage resolve the following issues:
 - o The cost of conducting a system investigation on the complete system.
 - o The cost of the hardware and software involved in the application of the project.
 - o The benefits, such as reduced costs, improved customer service or improved resource utilization.
- **Technical Feasibility:** The major concern of technical feasibility is to observe whether the hardware and software of the organization meet the needs of the proposed system. It also determines whether the requirements can be developed in the required time. In this study, the following points can be examined:
 - o Does the necessary technology acquire the proposed suggestions?
 - o Is the proposed technology capable of managing the data required by the new system?
 - o Does the proposed system provide sufficient responses to the queries irrespective of the number of locations and users?
 - o Can the system be expanded or is it flexible?
 - o Does the proposed system provide technical security, such as accuracy, reliability, accessibility and data security?
- **Operational Feasibility:** Operational feasibility is responsible for the operations of management, employees, customers and suppliers involved in a project. It also determines the use and support of the proposed system. We can say that the operational feasibility examines the system's operation, while developing and installing the system. The operational feasibility includes the following questions:
 - o Will the implementation of the project be smooth?
 - o Will the management, employees, customers and suppliers provide adequate support to the project?
 - o Will the existing business methods be acceptable to the users?
 - o Have the users been involved in the planning and development of the system project?

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The proposed system is assessed on the basis of the following categories:

- Is the system being developed as per the rules, regulations, laws, organizational culture and union agreements?
- Are the users actively participating in the development of the project?
- Is the system legally feasible?
- Is the system schedule feasible?

Legal Feasibility: Legal feasibility of the system refers to the viability of the system. In other words, legal feasibility verifies whether the system abides by all the laws and regulations. The scheduled feasibility of the system evaluates whether the system finishes its tasks within the provided time of development. It is recommended for a system to complete all the tasks well before the resources are exhausted.

A project can be considered to be feasible only if the project proposal passes all the tests. In this stage, the infeasible projects are discarded unless these projects get resubmitted as new proposals.

System Investigation Methods: The system investigation can be performed primarily by the following methods:

- **Reviewing Organizational Documents:** It is essential for a system analyst to learn about the organization before getting involved in the project. It is also required to be aware of the operations and the management of the organization. This can be examined by studying the organizational charts and the written procedures of the organization. These procedures describe the methods in which the organization operates. In addition, it identifies the steps involved during the organizational operations.
- **Conducting Interviews:** Written procedures do not provide the system analyst with the views of the users for the current operation. The system analyst needs to conduct interviews of the selected persons. These interviews allow the system analyst to learn more about the nature of the system project request. The system analyst must be certain while addressing the problems of the users, so that the purpose of the interview can be accomplished. This method provides details that can further help the system analyst to understand the project economically, operationally and also technically.

The following format is recommended for the system investigation process:

1. **Project Title:** It refers to the name given to the project.
2. **Problem Statement:** It includes the statement of the problem in a concise manner, possibly in a few lines.
3. **Project Objectives:** It states the objectives of the project defined by the problem.
4. **Preliminary Ideas:** It provides possible solutions, if any, occurring to a user and a system analyst.

5. **Project Scope:** It provides an overall cost estimate.

6. **Feasibility Study:** It indicates the time and cost required in the process.

2. System Analysis

The system analysis stage is incorporated with the detailed study of various operations involved within the business system. The primary objective of this phase is to determine a solution to resolve a problem. In most of the cases, the system analysts are from a technical background and therefore, the problem can be easily resolved. Sometimes the system analysts follow an approach in which they quickly move to the program design stage, which should be avoided. It is always recommended that a logical model of the system should be developed. The logical model can be designed by using various modern tools, such as data flow diagrams, an elementary data dictionary and rough descriptions of the relevant algorithms. This phase requires a detailed study of the following subjects:

- The information requirement of an organization and the users.
- The existing information systems that include the activities, resources and products of the organization.
- The expected information system that may be required to meet the information requirements of the users.

After the completion of the system analysis stage, the system analyst is provided with a set of system requirements of a proposed information system.

3. System Design

The system analysis phase answers the ‘what’ question in the system development process. The system design answers the ‘how’ question. In other words, it specifies how the objectives of a system project can be accomplished. While designing a project, the system design mainly emphasises on the following activities:

- **User Interface:** This activity focuses on designing the interactions between the users and the computer systems.
- **Data Design:** This activity focuses on the design of the logical structure of the database. This also focuses on the files that are used in the proposed information system.
- **Process Design:** This activity focuses on the design of the software resources, such as programs and procedures required in the proposed information system.

The system designers make use of their knowledge of business operations to specify the physical design of an information system. This phase must specify the following resources that may be required while designing:

- Hardware resources
- Software resources, such as programs and procedures
- People resources, such as users and system staff

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4. System Construction and Testing

The next stage in the development process of an information system is the construction and testing of the system. To create the system, codes are added to the required programs and they are, debugged and documented. The system is required to be tested in order to ensure the accuracy and reliability of the system.

The construction of the system is performed on the basis of the specifications described in the system design phase of the system development process. In addition to the activities performed during system development, some activities are performed after the completion of the basic development. Such kind of activities comes under the implementation and maintenance phase of the system development process.

5. System Implementation

After the construction and testing stage in the system development phase, the system implementation is performed. This stage involves:

- Hardware and software acquisition
- Site preparation
- User training
- System installation

This stage is also followed by testing the system components and procedures. The implementation phase in the system development is considered to be the most crucial stage of the System Development Life Cycle (SDLC), because this phase is very important for assuring the success of a developed system. It should be kept in mind while implementing a system that even a well-designed system can fail, if not properly implemented.

6. System Maintenance

Once a system is properly implemented, it is quite necessary to maintain the integrity of the system. The system maintenance involves tasks such as monitoring, evaluating and modifying a system, so that the system can be further enhanced. A system needs to be maintained not only because of programs get damaged, but also because there are certain residual errors that always remain in the system. These errors need to be removed as soon as they are traced. The process of removal of residual errors is an unending process and continues until the system stabilizes. Therefore, it is the responsibility of the system analyst to maintain the functioning of the system at an acceptable level of the system development process.

3.5 COMPUTERIZED MIS

Initially in businesses and other organizations, internal reporting was produced manually and only periodically as a by-product of the accounting system and with

some additional statistic(s), and gave limited and delayed information on management performance. Data was organized manually according to the requirements and necessity of the organization. As computational technology developed, information began to be distinguished from data and systems were developed to produce and organize abstractions, summaries, relationships and generalizations based on the data.

Early business computers were used for simple operations, such as tracking sales or payroll data, with little detail or structure. Over time, these computer applications became more complex, hardware storage capacities expanded and technologies improved for connecting previously isolated applications. As more and more data was stored and linked, managers sought greater detail as well as greater abstraction with the aim of creating entire management reports from the raw, stored data. The term computerized MIS describes such applications providing managers with information about sales, inventories and other data that would help in managing the enterprise. The successful computerized MIS 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.

Let us first understand the two terms individually, information and system. Information is that data which has been shaped into a form that is meaningful to human beings (see Figure 3.5). Data represents some raw facts and figures that are derived from some observations, experiment or events. Data until organized into a meaningful form cannot help in the decision-making process.

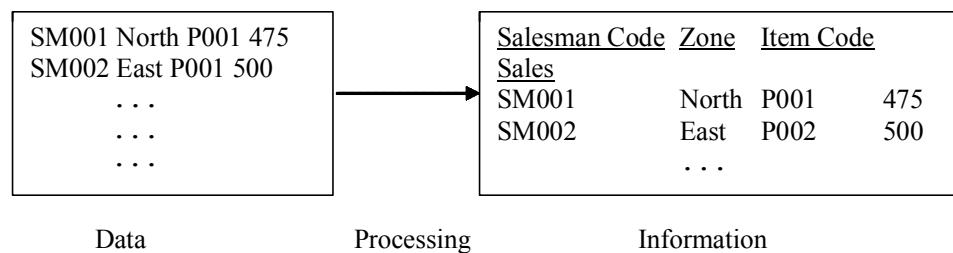


Fig. 3.5 Data and Information

The second term, that is, system may be defined as a set of interrelated components that are put together to achieve a common task or goal. Often, a system is composed of several subsystems, which may further be composed of other subsystems. Subsystems are focused to achieve the sub-goals and contribute to the main goal. They can take input from other subsystems (or systems), process it and produce output.

Information system is thus concerned with processing the raw facts into information and transferring this information to the users. It also takes feedback from the users so that input can be given.

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An information system can be manual (that uses pen, pencil or paper technology) or computer based. Here, however, the focus is on Computer Based Information System (CBIS) that uses Information Technology (IT) to perform its various activities. The term information technology refers to all the components that a system needs to operate, including the following:

- **Software:** Operating system software, database management software, web browsers, etc.
- **Hardware:** Servers, computers, input/output (I/O) and storage devices, etc.
- **Telecommunication:** Telecommunication channels, telecommunication processors (modems, switches, routers, etc.), software to support the Internet and other private networks (either wireless or wire-based), etc.

Note: The term information technology and information system are often used interchangeably.

3.6 PREREQUISITES OF AN EFFECTIVE MIS

Management information systems are designed to provide feedback on operations in a specified time interval and consist of an integrated set of subsystems. MIS may be used as an input for higher level support systems. MIS can be extended by the systems that use it as their primary input. MIS provides the user many important tools to support the credibility of the organization. Information is essential to support information tracking, making enquires and assessments to explore opportunities. MIS helps in carrying out inspection, tracking of resources and auditing in a dynamic environment which is essential for every individual. In short, the gathering and executing of information is essential for the management of processes such as recruitment, training, assessment, evaluation that is related to personnel management and also for funding the venture as well as quality management. To achieve this, an MIS, that is effective and efficient, yet flexible is required.

MIS is designed to provide the information that is exceptional in nature from the business point of view. Exceptions regarding MIS may be abnormal events, surprising developments, shocking news or something that was not consistent with the exceptions. The MIS must rectify all the above mentioned points and report the same to the concerned management. It should, therefore, identify all such possible issues and should provide measures for comparisons with the actual performance. Unless such features are included, MIS would supply mere data and not information.

However, every report that the systems generate, initially has to be designed by a specialist. If MIS is incorrectly tailored to the requirement of its clients or the data provided by it is wrong, then it cannot perform as per the requirement. This system was also integrated with customer services systems, used by call centre staff and Internet resources for the mortgage quotation system.

The intensity of managerial functions related to planning, organizing, directing and controlling varies according to different levels in the management hierarchy. The term supervisor pertains to those who have the responsibility to direct the work of a selected group of people. Normally the term indicates the first level of the management hierarchy. If the three hierarchy has top, middle and lower as the basic levels, supervisor belongs to the lower level.

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Using MIS, one is able to:

- Gather information and store it.
- Retrieve information and modify it as required by the manager, clients or financier.
- Control information flow.
- Work with due regards to statutory obligation, such as the Data Protection Act (DPA).
- Handle resources to its optimum use.
- Generate reports according to the requirements of the end users.
- Handle records and ensure their availability when needed for quality control.
- Cater to the need of the Common Inspection Framework (CIF).
- Manage returns to stake holders, financiers and accreditation bodies.
- Analyse and record the outcome for keeping track.
- Manage information related to the market condition.
- Act as a host for functions related to other information.

MIS can also help in producing a wide variety of reports, such as:

1. Timed reports that are generated after every given time period.
2. Specialized reports on divisions and sub-divisions within business.
3. Custom reports that are asked by employees.
4. Production schedules.

MIS, when properly developed and used in an organization brings in a lot of benefits for the organization. The following is a list of the benefits of MIS:

- **MIS Increases Productivity:**
 - o MIS reduces time, errors and costs associated with processing information.
 - o To increase productivity, MIS follows OnLine Transaction Processing (OLTP). OLTP is the gathering of data as input, processing that input data and updating the data to create information from the processed data.
 - o Another way by which modern MIS improves productivity, is by allowing customers to process their own transactions through the use of a Customer Integrated System (CIS).

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- **MIS Enhances the Quality of Decision-Making:**

- o MIS helps the top management to operate in a better way, find solutions to problems/opportunities or help them in decision-making by providing the relevant information.
- o MIS support for decision-making falls in following two categories:
 - (i) MIS helps you analyse a situation by providing all the relevant information about the situation in order to reach a decision.
 - (ii) MIS actually makes some sort of recommendation or gives some insight into what decision to take.

- **MIS Improves Communication and Helps Develop Team Work:**

- o MIS helps to manage information and facilitates communication between diverse teams.
- o A collaborative management information system is a specific system to improve team work.

- **MIS Facilitates Organizational Transformation:**

- o MIS helps organizations to remain competitive or enter new markets and transform the way business is done.

3.7 LIMITATIONS OF MIS

Even though MIS has many benefits, it has limitations as well. MIS is sometimes considered a solution for every bane within an organization. While MIS may solve some critical problems but it is not a solution to all the problems of an organization. The limitations of MIS may be stated as follows:

- MIS is as good as its design. MIS if designed in an improper manner, does not serve the management, and hence is of little relevance to the management.
- MIS is as good as its users. If the users do not know how to leverage the information available from MIS, then MIS is of little use.
- MIS is no good if the basic data, which goes into it, is not good. MIS will only facilitate the ‘garbage in garbage out’ process.
- MIS lacks a decision support capability and has to depend on managers for decision-making. Even if MIS has performed its tasks with efficiency, the managers may turn out to be incompetent and may take wrong decisions negating all the benefits of MIS. There is no mechanism to guarantee that the managers in the decision-making process do not make a mistake.
- MIS lacks expert knowledge and hence is incapable of providing solutions to complex problems.

Check Your Progress

4. Mention different approaches that describe the structure of MIS.
5. How is decision-making important to MIS?
6. What are the stages involved in a system development process?
7. Name the system investigation methods.
8. Define Computerized MIS?

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3.8 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The decisions of managers differ in terms of complexity, information requirement for taking the decision, relevance, effect on the organization, and degree of structured behaviour of the decision-making process.
2. The different phases to which the scope of MIS corresponds to include analysis, design, planning, construction, etc. These also include many other activities, such as implementation, utilization, evaluation and handling of information systems.
3. A centralized data management helps an MIS to exercise version control as well as provide an integrated view of data to the managers. While in a non-centralized system, data is entered, updated and deleted from different locations which makes it difficult to provide the correct information to managers.
4. A variety of different approaches which describe the structure of MIS are as follows:
 - Physical components
 - Information system processing functions
 - Decision support
 - Levels of management activities
 - Organizational functions
5. 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.
6. The stages involved in a system development process are as follows:
 - (a) Understanding a problem
 - (b) Deciding a plan for the solution
 - (c) Adding code to the planned solution
 - (d) Testing the program to which the code is added

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7. The system investigation can be performed primarily by reviewing organizational documents and by conducting interviews.
8. The term computerized MIS describes such applications providing managers with information about sales, inventories and other data that would help in managing the enterprise. The successful computerized MIS 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.

3.9 SUMMARY

- Management Information System (MIS) is a term used to refer to a class of information systems, which provides the management with the information required for decision-making.
- Managers are the key people in an organization who ultimately determine the destiny of an organization. They set the agenda and goal of an organization, plan for achieving the goal, implement that plan and monitor the situation regularly to ensure that deviations from the plan are controlled.
- The scope and role of MIS changes from stand alone systems, such as DSS (Decision Support System) and EIS (Executive Information System) to the integrated component of information management.
- The broad functions of MIS comprise of improvement in decision making, increased efficiency, better connectivity, data processing, proper planning, control, and assistance to the higher management.
- The physical components like hardware, software, manual procedures, database and operating systems of the information system in an organisation help understand the structure of MIS easily.
- A business venture these days is open to global competition and every organization develops its own system and methodology to compete globally.
- An information system is a system that collects and processes data that can be further used by the system analyst for planning and decision-making.
- In the system investigation stage, the request made by a user is handled. The request made by the user can be a request for changing, improving or enhancing the user's request.
- A user calls a system analyst so that can help the user in defining and resolving the problems in the system development process. After the problem is defined, a written statement of the problem is sent to the user and the user gives his response to these statements.
- The feasibility of a project for the system development process is thoroughly examined during the system investigation stage.

- The system analysis stage is incorporated with the detailed study of various operations involved within the business system. The primary objective of this phase is to determine a solution to resolve a problem.
- MIS may be used as an input for higher level support systems. MIS provides the user many important tools to support the credibility of the organization. Information is essential to support information tracking, making enquires and assessments to explore opportunities. MIS helps in carrying out inspection, tracking of resources and auditing in a dynamic environment which is essential for every individual.

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3.10 KEY WORDS

- **Monolithic entity:** It refers to an organization or system that is large, powerful, indivisible and slow to change.
- **Titivation:** It refers to smarten up something to make a thing neater or more attractive.
- **Prerequisites:** It refers to the things that are required as a prior condition for something else to happen or exist.

3.11 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the characteristics and basic requirements of MIS?
2. List the factors that management should consider for efficient use of the system.
3. Write a short not on decision-making process and the types of decisions.
4. What do you understand by the feasibility study of a project?
5. Write short notes on the following stages of MIS development process:
 - (a) System Analysis
 - (b) System Construction and Testing
 - (c) System Implementation
6. What are the benefits of MIS for an organization?

Long-Answer Questions

1. Elaborate the broad functions of MIS.
2. Describe the phases involved in the development process of an information system.
3. Explain the significance of computerized MIS with the help of examples.

4. Discuss the prerequisites of an effective MIS.
5. Examine the limitations of MIS.

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3.12 FURTHER READINGS

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UNIT 4 MIS AND DECISION SUPPORT SYSTEM

*MIS and Decision Support
System*

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Structure

- 4.0 Introduction
- 4.1 Objectives
- 4.2 MIS vs. Data Processing
- 4.3 MIS and Decision Support System
- 4.4 MIS and Information Resource Management
- 4.5 DSS and AI
 - 4.5.1 Artificial Intelligence: An Overview
 - 4.5.2 DSS Models and Software
- 4.6 Answers to Check Your Progress Questions
- 4.7 Summary
- 4.8 Key Words
- 4.9 Self Assessment Questions and Exercises
- 4.10 Further Readings

4.0 INTRODUCTION

We have already discussed about the foundations and concepts of information system, characteristics and structure of MIS in earlier units. In this unit, you will study about MIS and Decision Support System (DSS). The main purpose of a business information system is to produce such information that will reduce uncertainty in a given situation. MIS fulfils the information needs of an organization to a large extent, but they are not sufficient for meeting all the needs of information and decision-making. In some situations, where the nature of decision is complex, the decision-makers would require additional information, analysis, and an appropriate DSS model to support decision-making.

The unit focusses on the classification of information, comparison between the capabilities of MIS and DSS. In addition to this, you will also learn about the benefits of an ERP system and how advantageous it can be for wide-ranging business activities. The unit also explores the concept and benefits of Artificial Intelligence (AI), components and types of DSS, and web-based decision support systems.

4.1 OBJECTIVES

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

- Classify the information on the basis of its user and application
- Differentiate between MIS and Decision Support System
- Explain the functioning of Enterprise Resource Planning (ERP) system

- Discuss the benefits of AI and usage of AI as problem solver
- Describe the types and components of DSS
- Explore the major application areas of DSS

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4.2 MIS VS DATA PROCESSING

Accessing the information needs of organization for business execution is a complex task. The complexity can be handled if the information is classified on the basis of its user and application. The classification of information is as follows:

1. Organizational Information

Organizational information is the information that is required by departments and divisions in an organization. It may contain the number of employees, products, services, locations, the type of business, turnover and variety of the details of each one of these entities.

2. Functional Information

Functional information is the information required by functional heads in conducting management functions. This information is purely local to that function and by definition does not have a use elsewhere. Examples are purchases, sales, production, stocks, receivables, payables, outstanding, budget, statutory information.

Functional information is normally generated at equal time intervals, such as weekly, monthly or quarterly, for understanding the trends and making compressions against the time scale. Such information is used for planning, budgeting and controlling the operations. Functional information is used for assessing particular aspects of business, such as stocks of finished goods, receivables, and so on.

Functional information can be assessed on the basis of a few parameters, such as work design, responsibility and functional objectives.

3. Knowledge Information

Knowledge information creates an awareness of those aspects of business where the manager is forced to think, decide and act. Such information shows the trends of the activity or a result against a timescale. For example, the trends in scale production technology, the deviations for budgets, target norms, competitor's information, industry and business information, plan performance and target and its analysis. Middle and top management use this information.

4. Decision Support Information

Decision support information is required by the middle and top management for decision-making. This information does not act as a direct input to the decision-making procedure or formula but supports the manager in decision-making.

Information is used in a decision support system for building model and problem solving. The support may act in two ways: one for justifying the needs of a decision and the other as an aid to decision-making. For example, information on a particular aspect such as utilization, profitability standards, requirement versus availability; information for problem solving and modeling; information on the business status; non – moving inventory, overdue payments and receivables.

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5. Operational Information

Operational information is required by operational and lower level management. The purpose of this information is finding fact and taking such decisions and actions that will affect the operations at a micro level. The source of operational information is largely internal through transaction processing and the information relates to a small time span and is mostly current.

6. Strategic Information

This is the information needed for long range planning and directing the course the business should take.

7. Tactical Information

This type of information is needed to take short range decisions to run the business efficiently. Tactical information requires specifically designed processing of data. Most of it is obtainable from day to day collection of routine data.

Determining the Information Requirement

The main purpose of a business information system is to produce such information that will reduce uncertainty in a given situation. The difficulties in determining a correct and complete set of information are as follows:

- The capability constraint of the human being as an information processor, a problem solver and a decision-maker.
- The nature and variety of information.
- Reluctance of decision-makers to spell out the information for political and behavioral reasons.
- The ability of the decision-makers to specify the information.

4.3 MIS AND DECISION SUPPORT SYSTEM

A Decision Support System (DSS) is an interactive computer-based system that serves decision-making needs of managers. It provides managers with the information that enables them to make both semistructured and unstructured decisions. DSS employs various analytical models to perform low level analysis of data and produce information. A manager can apply his knowledge to the system generated information and get a more clear view of the problem, making it easy

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for him to find an appropriate solution to the problem. The use of DSS usually increases the manager's ability to make correct and balanced decisions.

A DSS system possesses an interactive interface which makes it easier to use and provides real time responses to user queries. The use of various DSS tools helps in each stage of the decision-making process that includes viewing a complex problem, designing a model to analyse the problem, developing alternatives to get a solution, and choosing a solution from the available alternatives. While the use of DSS often increases with the level of management, they are used at all levels and most often the users are also the non-managerial staff.

MIS and DSS

MIS fulfils the information needs of an organization to a large extent, but they are not sufficient for meeting all the needs of information and decision-making. In some situations, where the nature of decision is complex, the decision-makers would require additional information, analysis and an appropriate DSS model to support decision-making. Some of the major differences in the information and decision support capabilities of MIS and DSS are as follows:

- MIS deals with mostly structured problems, whereas DSS provides information that helps in analysing and finding solutions to semistructured and unstructured problems.
- MIS provides information on business performance that helps managers to control and administer the day-to-day business activities. On the other hand, DSS provides information and various decision support techniques that help managers to analyse specific problems or opportunities.
- MIS produces reports based on routine flow of data and the formats of these reports are predefined. In addition to regular reports, it may produce exception reports which help managers to analyse and control the cause and effect of the exception and take appropriate action. On the other hand, DSS is interactive and provides quick responses to user queries. To obtain a sales analysis report, for example, containing figures related to performance of sales based on the sales region, salesperson, etc., a sales manager need MIS. However, to know the effects of changes in different factors like expenses on promotion of a product, and compensation to salesperson on the performance of sales, sales managers can interactively use DSS.
- MIS produces information by extracting and manipulating the business data, whereas DSS produces information by performing analytical modelling of the business data.

4.4 MIS AND INFORMATION RESOURCE MANAGEMENT

Earlier, in large organizations, different information systems were used to serve different business functions like sales, marketing, production, manufacturing, etc.,

separately. The business processes in each business function were disparate and not capable of sharing information with each other. It was difficult for the managers to assemble the data fragmented into separate systems in order to present an overall picture of the organization's operations and take firm wide decisions. At the time a customer places an order, for example, the sales personnel might not be able to tell him whether the desired items are in inventory or are to be produced. To overcome such difficulties, in recent years, many organizations have opted to replace the several distinct information systems with a single integrated system that can support the business activities for different business functions. Such systems are called enterprise systems.

An **enterprise system**, also known as **Enterprise Resource Planning (ERP) system**, is a cross functional information system that provides organization-wide coordination and integration of the key business processes and helps in planning the resources of an organization. With the help of ERP systems, information can flow seamlessly across the firm. Also, different business processes from sales, production, manufacturing, logistics, and human resources, can be integrated into organization wide business processes.

An ERP system is driven by the ERP software suite which includes a set of integrated software modules and a common centralized database. The software modules support the basic business processes under different functional areas, and the database stores data from and feeds the data to various applications supporting the internal business activities. Some examples of business processes supported by ERP software include accounts payable, general ledger, cash management and forecasting, personnel administration, payroll, time management, inventory management, product pricing, billing, etc. Initially, ERP software was designed for automating a firm's internal 'back office' business processes, but now it can also communicate with customers, suppliers and other business partners. Figure 4.1 shows a typical example of an ERP system.

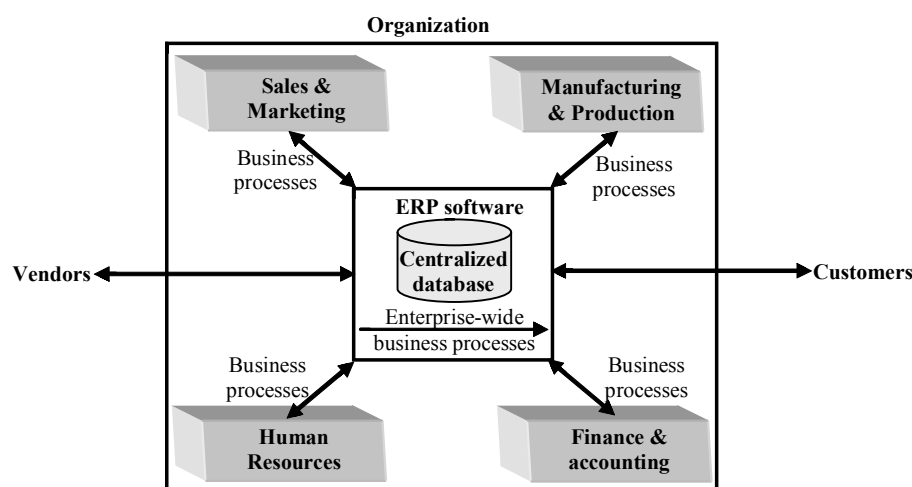


Fig. 4.1 A typical example of an ERP System

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For implementing ERP systems, organizations need to identify the business processes to be automated and then map those processes to the processes provided by ERP systems. All this requires a great amount of effort. Moreover, organizations may find that the business processes of these systems are not able to support the way that organization's business processes work. In such cases, the software may need to be customized to satisfy the requirements of the organizations. This may not only deteriorate the system's performance but also need compromising the information and process integration. Thus, to obtain the maximum benefit from ERP software, the organizations should change their way of working according to the business processes of software instead of customizing the software.

Nowadays, a variety of ERP software offered by different software vendors are available in the market. Table 4.1 lists some major ERP software along with their vendors.

Table 4.1 Major ERP Software and their Vendors

ERP Software	ERP Software Vendor
SAP R/3	SAP
Oracle manufacturing	Oracle
PeopleSoft	PeopleSoft
iRenaissance	Ross systems
MFG/Pro	QAD
Triton	Bann

Benefits of ERP Systems

ERP systems offer the following benefits to organizations in which they have been implemented.

- Communicate the critical firm wide information on the business performance to managers all across the organization quickly, so as to enable them to make better decisions and at the right time.
- Reduce the cost involved in transaction processing, hardware, software and IT support staff in a significant manner.
- Improve the quality and efficiency of customer service, production and distribution by integrating the company's internal business processes in sales, finance, production, custom logistics, etc.
- Help to create a more uniform organizational culture where everyone uses similar type of processes and information to do business.

Check Your Progress

1. List the types of information an organization needs for business execution.
2. What is the use of functional information?
3. What is ERP system and why is it important?
4. Mention the functions of an ERP software.

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4.5 DSS AND AI

Having discussed DSS in the previous section of this unit, let us now study Artificial Intelligence (AI) in detail.

4.5.1 Artificial Intelligence: An Overview

Artificial Intelligence (AI) refers to the capability of a system to perform tasks that are generally related to human beings. In other words, it is a branch of science that deals with making systems behave like human beings. AI is used in a variety of application areas, such as in games, robotics and expert systems. AI involves the task of creating intelligent computers, which can perform activities similar to the activities performed by a human being, but more effectively. The main objective of AI is to create an information processing theory, which can help develop intelligent computers. Banks use software systems created using AI to organize operations, invest in stocks and manage properties.

The concept of AI is considered to have originated from the Turing test proposed by Alan Turing in 1950. The test was proposed to check the intelligence of machines. According to the Turing test, an interrogator communicates with a machine and a human being. Both the machine and the human being provide answers to the questions asked by the interrogator. The machine tries to imitate the human. If the interrogator is not able to judge which answers are given by whom, then the machine is said to possess intelligence.

Research and development in the field of AI progressed after the Turing test, with the aim of providing intelligence to computers. In 1956, John McCarthy gave the term 'Artificial Intelligence' to this field of research. Defence Advanced Research Projects Agency (DARPA) and Office of Naval Research (ONR) initiated work in the field of AI. The developmental activities were initially limited to concepts such as pattern recognition and later on moved to broader concepts like developing computers as intelligent as human beings.

Benefits of AI

AI techniques have influenced society in a great manner. The use of AI systems provides several advantages to humans. They are described as follows:

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- AI makes a wide range of information available with the help of expert systems, which contain domain-specific knowledge gathered from experts in a particular area. The knowledge gained from the experience of the experts can be used for problem solving by doctors, lawyers, students, etc., to analyse and learn about a particular situation. For example, MYCIN is an expert system used by doctors for diagnosing particular disease.
- AI systems help in reducing the work of human beings, thus making their life easy. For example, robotics is an application area of AI that deals with creating robots. Robots are programmed in such a manner that they can be instructed to perform a task repetitively, without any boredom and tiredness, which are characteristics possessed by human beings.
- AI helps in building secure systems. Pattern recognition and voice recognition are nowadays being used to recognize the user of a particular system, based on voice, fingerprints and touch so that unauthorized access to confidential systems can be restricted.
- AI techniques facilitate the automated learning process. These systems accept some input from the user and based upon the input given by the user decide the level of the learner. The material for learning a particular subject is provided by the system on the basis of the learner's level.
- AI helps to create systems that help in solving problems. The systems are unbiased and treat everyone equally without caring for emotions. Thus, the systems offer frank advice to the users.

Problem Solving through AI

AI is being used to solve problems such as intelligent game playing and proving theorems using a computer system. In intelligent game playing, a computer is programmed to play a game such as chess and tic-tac-toe in the same way as human beings play. The chess game—developed by Arthur Samuel—was the first game in which AI was used for intelligent game playing. Mathematical theorems were proved using AI. The Theorem Prover System developed by Gelernter uses AI to prove geometrical theorems. Computer researchers and software developers consider that computers can be easily used with AI for intelligent game playing and proving theorems because computers are fast and can explore a large number of solution paths. After exploring the solution paths, the computers can also efficiently select the most suitable solution path for solving a problem.

In the area of decision-making, AI has been used for common sense reasoning in which reasoning about physical objects and their relationships with each other is done. Common sense reasoning also includes reasoning about actions and their consequences. AI is also used to develop software for vision processing and speech recognition. In addition, it helps to solve the problem of natural language understanding and for problem solving in specialized areas such as medical diagnosis and chemical analysis. There are also various specialized areas, such as engineering

design, scientific discovery and financial planning, in which it is necessary to obtain expertise. AI can be used to create complex programs for solving problems in these specialized areas. It is easier to learn perpetual, linguistic and common sense skills than expert skills. As a result, currently AI is being used to solve problems related to areas in which only expert skills are required instead of common sense skills.

4.5.2 DSS models and software

The decision support systems can be broadly classified into two types, namely *model-based DSS* and *data-based DSS*.

- **Model-Based DSSs:** These systems are standalone systems and they are not connected with other major corporate information systems. The capability of analysis of these systems is supported by some strong theory or model along with a good user interface that makes them easy to use. The use of various models in these systems helps them to perform what-if and other similar analysis. They are used for creating simulation models, performing production planning and scheduling, and creating statistical and financial reports.
- **Data-Based DSSs:** These systems can analyse huge amount of data from different sources, such as organizational data, data from enterprise systems, and data from the Web. The data collected from different sources is stored in the data warehouses. A data warehouse is a database that can store present and past data extracted from various operational systems, and provide certain reporting and query tools. Using these systems, managers are able to extract information from the large pool of data which otherwise would have remained hidden and unused. The extracted information helps managers in making better decisions. Note that the corporate information systems are major class of systems that uses data-based DSS. The main techniques that are mostly used in data based DSS for analysing the data are OnLine Analytical Processing (OLAP) and data mining.
 - o **OLAP:** It is based on queries and can provide fast answers to complex business requests. It enables managers and analysts to interactively examine and manipulate the data available in the data warehouse from different view points.
 - o **Data Mining:** It helps in extracting useful information by finding patterns or rules from the existing data. This information is then used to predict future trends and behaviours.

Components of DSS

A DSS is composed of three main components (see Figure 4.2), namely *DSS database*, *DSS software system* and *user interface*.

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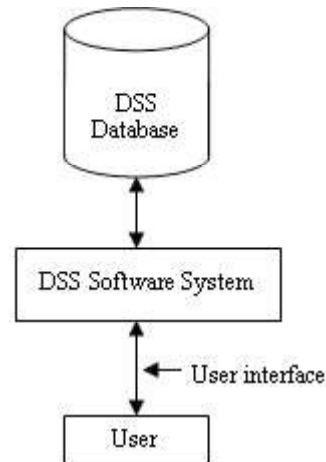


Fig. 4.2 Components of Decision Support System

- **DSS Database:** It contains data from various sources, including internal data from the organization, the data generated by different applications, and the external data mined from the World Wide Web, etc. The DSS database can be a small database or a standalone system or a huge data warehouse supporting the information requirements of an organization. To avoid the interference of DSS with the working of operational systems, the DSS database usually contains a copy of the production database.
- **DSS Software System:** It consists of various mathematical and analytical models that are used to analyse the complex data, thereby producing the required information. A model predicts the output on the basis of different inputs or different conditions, or finds out the combination of conditions and input that is required to produce the desired output. A DSS may comprise different models where each model performs a specific function. The selection of models that must be included in a DSS mainly depends on user requirements and the purposes of the DSS. Note that the DSS software contains the predefined models (or routines) using which new models can be built to support specific types of decisions. Some of the commonly used mathematical and statistical models are as follows:
 - o **Statistical Models:** They contain a wide range of statistical functions, such as mean, median, mode, deviations, etc. These models are used to establish relationships between the occurrences of an event and various factors related to that event. It can, for example, relate sale of product to differences in area, income, season, or other factors. In addition to statistical functions, they contain software that can analyse series of data to project future outcomes.
 - o **Sensitivity Analysis Models:** These are used to provide answers to what-if situations occurring frequently in an organization. During the analysis, the value of only one variable is changed repeatedly and the

resulting changes on other variables are observed. The sale of a product, for example, is affected by different factors such as price, expenses on advertisements, number of sales staff, productions, etc. Using a sensitivity model, price of the product can be changed (increased or decreased) repeatedly to ascertain the sensitivity of different factors and their effect on sales volume. Excel spreadsheets and Lotus 1-2-3 are often used for making such analysis.

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- o **Optimization Analysis Models:** They are used to find the optimum value for a target variable under given circumstances. They are widely used for making decisions related to optimum utilization of resources in an organization. During optimization analysis, the values for one or more variables are changed repeatedly keeping in mind the specified constraints, until the best values for the target variables are found. They can, for example, determine the highest level of production that can be achieved by varying job assignments to workers, keeping in mind that some workers are skilled and their job assignment cannot be changed. Linear Programming techniques and Solver tool in Microsoft Excel are mostly used for making such analysis.
- o **Forecasting Models:** They use various forecasting tools and techniques, including the regression models, time series analysis, and market research methods, etc., to make statements about the future or to predict something in advance. They provide information that helps in analysing the business conditions and making future plans. Note that these systems are widely used for forecasting sales.
- o **Backward Sensitivity Analysis Models:** Also known as goal seeking analysis, the technique followed in these models is just opposite to the technique applied in sensitivity analysis models. In place of changing the value of a variable repeatedly to see how it affects other variables, goal seeking analysis sets a target value (a goal) for a variable and then repeatedly changes other variables until the target value is achieved. To increase the production level by 40 per cent using the backward sensitivity analysis, for example, first, the target value for the production level can be set and then the required changes to be made in other factors, such as the amount of raw material, machinery and tools, number of production staff, etc., to achieve the target production level can be ascertained.
- **DSS User Interface:** It is an interactive graphical interface which makes the interaction easier between the DSS and its users. It displays the results (output) of the analysis in various forms, such as text, table, charts, or graphics. The user can select the appropriate option to view the output according to his requirement. A manager, for example, would like to view comparative sales data in the tabular form, whereas an architect creating a design plan would be more interested in viewing the result of analysis in a

graphical format. The present day DSS built using the Web-based interfaces provides its users some special capabilities like better interactivity, facility for customization and personalization, and more ease of use.

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DSS Applications and the Digital Firm

Some of the main application areas of the decision support systems are as follows:

- **Supply Chain Management (SCM):** The various decisions in a supply chain involve finding the best alternatives that are most efficient and cost-effective for moving the goods through the supply chain. An SCM system helps managers with various supply chain decisions, such as assessing the optional inventory stocking levels, creating the production schedules and making transportation plans by using data about stock, supplier performance, production schedules, and costs. The primary objective is to reduce overall costs while increasing the speed and accuracy of filling customer orders. The decisions in SCM are supported by both model-based and data-based DSS.
- **Customer Relationship Management (CRM):** DSS supporting customer relationship management focuses on meeting the customer centric requirements. They bring together customer information from different systems into a huge data warehouse and then use some analytical tools to divide the information into small parts for one-to-one marketing and predictive analysis. Predictive analysis uses the data mining technique, past data, and assumption about future conditions to forecast results of events, such as the probability a customer will buy a particular product or respond to an offer. It tracks the different methods that a company uses to interact with its customers and then analyses these interactions to optimize customer satisfaction and customer retention. It uses various CRM analysis tools to identify a profitable customer, to reduce customer attrition rate, and to divide customers into smaller groups that could benefit from more targeted marketing.
- **Price Optimization:** DSS meant for optimizing the price mainly helps managers in predicting the customer behaviour to changes in price. A manager, for example, can determine the price that will boost the sale of a product while yielding the maximum profit. In addition, a manager can also use DSS along with the sales history to analyse and decide the right time and the right price for selling the product in order to have maximum profit. The DSS used for pricing decisions are mostly model driven and deploy mathematical models for analysing the data.
- **Asset Utilization:** DSS facilitates better management of costs and revenues by providing information, such as overtime costs and utilization rates. Moreover, it also helps managers in increasing the profit margins by making best utilization of the available assets. For this, data driven DSS is used for getting the required information.

- **Geographic Information System (GIS):** It is a special category of DSS that uses data visualization technology (use of charts, graphs, tables, maps, digital images, three-dimensional images and animations to provide information) to help managers in analysing and displaying data more efficiently for planning and decision-making. Moreover, by using data visualization technology, a user can view patterns and relationships in large amount of data that would otherwise be difficult to recognize if the data would be presented as text. These systems support decisions that require knowledge about the geographic distribution of various resources. Manufacturing units, for example, can identify the best locations for setting up new plants, banks can identify the best locations for installing new branches or Automatic Teller Machine (ATM) terminals and governments can calculate emergency response times to a natural disaster.

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Web-based Decision Support Systems

The advancement in web technologies and growth of electronic media like client–server computing and the Internet have led to the development of web-enabled DSS software which provide decision support to a large number of users, including company’s employees, managers, customers, suppliers and other business partners. The special web-based DSS that mainly supports the decision-making process of customers is known as the Customer Decision Support System (CDSS). It helps the customers in selecting a product or service by providing access to the online database along with the software.

Study and surveys conducted by companies have revealed that customers’ decision for purchasing product and services have become more information centric. People first gather information from multiple sources like Web directories, the Internet search engines, newsgroup discussions and online catalogues and then compare and analyse this information before they actually interact with the product or the sales staff. In addition, people are also using Web based DSS to manage their assets and retirement savings themselves, thus making Web based DSS most popular in the financial services area.

Check Your Progress

5. What is Artificial Intelligence (AI)?
6. What was the first game in which AI was used for intelligent game playing?
7. Briefly mention the techniques used in data-based DSS.
8. What are the components of DSS?

4.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

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1. There are various types of information an organization needs for efficient business execution, such as:
 - (a) Organizational Information
 - (b) Functional Information
 - (c) Knowledge Information
 - (d) Decision Support Information
 - (e) Operational Information
 - (f) Strategic Information
 - (g) Tactical Information
2. Functional information is used for understanding the market trends and making compressions against the time scale. Such information is used for planning, budgeting and controlling the operations. It is also used for assessing particular aspects of business, such as stocks of finished goods, receivables etc.
3. An Enterprise Resource Planning (ERP) system is a cross functional information system that provides organization-wide coordination and integration of the key business processes and helps in planning the resources of an organization. ERP systems can help sleemless flow of information across the firm. Also, different business processes from sales, production, manufacturing, logistics, and human resources, can be integrated into organization wide business processes.
4. Initially, ERP software was designed for automating a firm's internal 'back office' business processes, but now it can also communicate with customers, suppliers and other business partners. Business processes supported by ERP software include accounts payable, general ledger, cash management and forecasting, personnel administration, payroll, time management, inventory management, product pricing, billing, etc.
5. Artificial Intelligence (AI) refers to the capability of a system to perform tasks that are generally related to human beings. To be more precise, it is a branch of science that deals with making systems behave like human beings. AI is used in variety of application areas, such as in games, robotics and expert systems.
6. The chess game, developed by Arthur Samuel, was the first game in which artificial intelligence was used for intelligent game playing.
7. The two techniques used in data-based DSS are Online Analytical Processing (OLAP) and data mining. OLAP is based on queries and can provide fast

answers to complex business requests. It helps in extracting useful information by finding patterns or rules from the existing data.

8. A DSS is composed of three main components, namely DSS Database, DSS Software System and User Interface.

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4.7 SUMMARY

- Organizational information is the information that is required by departments and divisions in an organization.
- Functional information is the information required by functional heads in conducting management functions.
- Knowledge information creates an awareness of those aspects of business where the manager is forced to think, decide and act. Such information shows the trends of the activity or a result against a timescale.
- Decision support information is required by the middle and top management for decision-making. This information does not act as a direct input to the decision-making procedure or formula but supports the manager in decision-making.
- Operational information is required by operational and lower level management. The purpose of this information is finding fact and taking such decisions and actions that will affect the operations at a micro level.
- Strategic information is needed for long range planning and directing the course the business should take.
- Tactical information is needed to take short range decisions to run the business efficiently.
- A Decision Support System (DSS) is an interactive computer-based system that serves decision-making needs of managers. It provides managers with the information that enables them to make both semi structured and unstructured decisions.
- An enterprise system, also known as Enterprise Resource Planning (ERP) system, is a cross functional information system that provides organization-wide coordination and integration of the key business processes and helps in planning the resources of an organization.
- Artificial Intelligence (AI) refers to the capability of a system to perform tasks that are generally related to human beings.
- AI is being used to solve problems such as intelligent game playing and proving theorems using a computer system.
- The decision support systems can be broadly classified into two types, namely model-based DSS and data-based DSS.

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- A Decision Support System is composed of three main components, namely *DSS Database*, *DSS Software System* and *User Interface*.
- The main application areas of the decision support systems include Supply Chain Management (SCM), Customer Relationship Management (CRM), Price Optimization, Asset Utilization, Geographic Information system (GIS).
- Web-enabled DSS software which provide decision support to a large number of users, including company's employees, managers, customers, suppliers and other business partners. The special web-based DSS that mainly supports the decision-making process of customers is known as the Customer Decision Support System (CDSS). It helps the customers in selecting a product or service by providing access to the online database along with the software.

4.8 KEY WORDS

- **Decision Support System:** It refers to an information system that supports business or organizational decision making.
- **Data Warehouse:** It refers to a large store of data accumulated from a wide range of sources within a company and used to guide management decisions.
- **Forecasting Models:** It refers to the tried and tested frameworks which help in predicting the outcomes more easily in the field of business and marketing.
- **Attrition Rate:** It refers to the calculation of the number of individuals or items that vacate or move out of a larger, collective group over a specified time frame.

4.9 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write short notes on:
 - (a) Knowledge Information
 - (b) Strategic Information
 - (c) Tactical Information
2. How can DSS help make decisions?
3. When did the research and development in the field of AI progress?
4. Outline the functions of model-based DSS and data-based DSS.

5. What are the main application areas of the decision support systems?
6. What is Geographic Information System (GIS)?

Long-Answer Questions

1. Differentiate between the decision support capabilities of MIS and DSS.
2. Explore the benefits that ERP systems offer to the organizations.
3. Discuss the advantages of AI systems to humans.
4. Explain the three components of DSS in detail.
5. How does web-based decision support system help in decision making?

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4.10 FURTHER READINGS

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BLOCK II

COMMUNICATION USAGE OF MIS

NOTES

UNIT 5 MIS AND ITS USES

Structure

- 5.0 Introduction
- 5.1 Objectives
- 5.2 MIS and Operations Research
- 5.3 Executive Information and Decision Support Systems
- 5.4 Artificial Intelligence and Expert System
 - 5.4.1 Merits and Demerits of Expert Systems
 - 5.4.2 Applications and Precautions of AI
- 5.5 Pitfalls of MIS
- 5.6 Answers to Check Your Progress Questions
- 5.7 Summary
- 5.8 Key Words
- 5.9 Self Assessment Questions and Exercises
- 5.10 Further Readings

5.0 INTRODUCTION

A management information system (MIS) is a computerised database that collates, summarizes and analyses any type of information that is useful to the management of a company. The MIS can manage information in all other aspects of the company's operations such as human resources, sales, inventory control, social media marketing and anything else the management team needs to know about the company.

In this unit, you will study in detail about the varied functions of management information system in an organization. In addition to this, you will also learn about the purpose of decision making, decision tree, and use of DSS in production management. The unit also explores on the role and benefits of executive Support System (ESS) for an organization, expert systems, and pitfalls of MIS.

5.1 OBJECTIVES

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

- Discuss MIS and operations research
- Describe the use of DSS in production management
- Explain the benefits and role of executive support system (ESS) in the organization

- Assess artificial intelligence and computerized expert systems
- Understand merits, demerits and limitations of experts systems

5.2 MIS AND OPERATIONS RESEARCH

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A number of optimization techniques, such as linear and dynamic programming are available for taking decisions during a decision-making process. Various other techniques in this category are integer programming, queuing models and inventory models. These optimization techniques assume that the decision-maker knows all the alternatives and the outcomes of the alternatives. All these optimization techniques are used by a decision-maker to reach an optimal decision to complete the objective of the function.

Decision-Making and MIS

The role of a management information system is important to understand the concept of decision-making. Decision-making concept is also used for designing an information system. The support that the management information system provides to the decision-making process in various ways is discussed as follows:

- **Support for Decision-Making Process:** MIS plays its role in all the stages of the decision-making process. Following is the discussion of a decision-making procedure with respect to the role played by MIS at three phases of the procedure.
 - o **Intelligence Stage:** Internal and external feedback could be provided by the management information systems. Internal information is generated from the functional areas but the external information is collected from various sources, such as newspapers and personal contacts. Availability of a large amount of information at this stage makes it necessary to scan the data sources to get the relevant information. As a result, the information system is used to scan the business environment of an organization. Procuring the required information from an intelligence phase that belongs to decision-making process, MIS must be designed so as to answer pre-specified and ad hoc queries made by a decision-maker. In other words, the information system design must have models, such as historical planning along with a query language capability that provide decision support capability for the system.
 - o **Design Stage:** Management information systems provide support by quantifying and automating a decision-making process during the design stage while considering structured decisions. At this stage, various alternatives are developed and evaluated. On the other hand, for semistructured and unstructured decisions, the support of a management information system provides the abilities as follows:
 - To reach a decision in an interactive process, which includes decision support system capability.

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– To make ad hoc queries for information in the organizational databases. Therefore, information systems should be designed to incorporate various models of business operations and advanced statistical and optimization techniques. These techniques can then be used to manipulate information that is already collected in the intelligence stage to develop and evaluate various alternatives.

- o **Choice Stage:** Management information systems should provide summarized and organized information to the decision-makers at this stage of the decision-making process. It is the stage in which a course of action is selected and feedback is collected on the implemented decision. MIS also provides the feedback support to a decision-maker in case he/she wants to return to the preceding stages of the decision-making process in order to gather more information. Models, such as optimization and suggestion should be used to select the most appropriate alternative, which helps the decision-makers in selecting the best course of action.

Decision Types

The decisions taken by an organization are different in many ways. These affect the development of alternatives and the choice available among the alternatives. The different decisions also affect the support provided by the design of an information system for carrying out decision activities. The decisions are classified on the basis of the following factors:

• Purpose of Decision-Making

On the basis of the purpose of the decision-making activities, the organizational decisions are divided into the following three different categories:

1. **Strategic Planning:** It comprises of the decisions in which a decision-maker develops objectives and allocates resources to achieve these objectives. The decisions in this category are of a long time period and involve large investment and effort. Such decisions are taken by executives who are a part of the conceptual process and are at the helm of the corporate ladder. Examples of such decisions may include introduction of a new product and acquisition of another firm.
2. **Management Controls:** They are those decisions which are taken by the management control plan executives who are centrally placed in the corporate ranks. These managers deal with the use of resources in the organization. Analysis of variance, product mix and planning decisions fall in this category of decisions.
3. **Operational Controls:** They are the decisions for dealing with the day-to-day problems that affect the operation of an organization. For example, decisions, such as production scheduling and inventory control fall in this category. The product to be produced for the day or the items and their quantities to be ordered are operational control decisions. Such type of

decisions are normally taken by executives who are at the lower level of the company.

MIS and its Uses

Note: Due to the overlapping nature of some decisions, the boundaries for classifying decisions in these categories are not very concrete and therefore, these decision types should not be taken as discrete ones.

• Programmability Levels of a Decision

According to the programmability levels of a decision, the decisions are of the following two types:

1. **Programmed or Structured Decision:** It refers to the decisions that are well defined and require application and implementation of some specified procedure or decision rule in order to reach a decision. Such decisions require little time for developing alternatives in the design phase. Programmed decisions are made by operating procedures or by using other accepted tools. More modern techniques for making such decisions involve Operations Research (OR), mathematical analysis, modelling and simulation.
2. **Non-programmed or Unstructured Decision:** It refers to the decisions, which are not well defined and have no pre-specified procedure or decision rule. These decisions may range from one time decisions relating to a crisis to decisions relating to recurring problems. The unstructured decisions consume sufficient time in the design phase of the decision-making process. These decisions can be solved using judgement and intuition. Modern approaches to such decisions include special data analysis on computers and heuristic techniques. Decisions of this kind are usually handled by strategic planning level managers. As a result of their unstructured nature, these decisions cannot be used as representatives for lower-level decisions and are difficult to automate. For example, planning for R & D is an unstructured decision.
3. **Semi-Structured:** These decisions are supposed to fall somewhere between the structured and unstructured decisions. These decisions require some human judgement and also need some agreement on the solution method. For example, introduction of a new product is semi-structured decision.

Note: There is no distinct line of difference or boundaries between the two types of decisions; rather they exhibit a continuum for the classification of decisions.

• Knowledge of Outcomes

‘Knowledge of outcomes’ is another approach for classifying decisions. An outcome defines what is going to happen if the decision is taken or the course of action is taken. The knowledge of outcome plays an important role when you have more than one alternative. On the basis of the level of knowledge of outcomes, decision-making can be classified into three categories:

1. **Decision-Making Under Certainty:** It takes place when the outcome of each alternative is fully known and there is only one outcome for each

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alternative. In such a situation, a decision-maker is required to compute the optimal alternative or outcome.

2. **Decision-Making Under Risk:** It occurs when there is a possibility of multiple outcomes of each alternative and a probability of occurrence can be attached to each outcome. Such decision-making is also similar to the decision-making under certainty where instead of optimizing the outcomes, the general rule is applied to optimize the expected outcome. A decision-maker is assumed to be reasonable for choosing a particular decision. A decision-maker, for example, has to choose from the given two options, one offering a 2 per cent probability of a profit of ₹1,00,000 and the other an 80 per cent probability of a profit of ₹10,000. The decision-maker chooses the second alternative because it gives a higher expected value. This is explained as follows using the formula:

$$\text{Outcome} \times \text{Probability} = \text{Expected Value}$$

$$1,00,000 \times 0.02 = 2,000$$

$$10,000 \times 0.80 = 8,000$$

3. **Decision-Making Under Uncertainty:** It takes place when each alternative has a number of outcomes, and the possibility of occurrence of the alternatives is unknown. Optimization criteria cannot be applied for making these types of decisions because there is no knowledge of these probabilities. Decision-making under uncertainty arises when different people in an organization take decisions by applying different decision rules. Some, for example, may assign equal probabilities to all the outcomes for each alternative, so as to treat the decision-making as decision-making under risk, whereas others may adopt different criteria, such as maximax and maximin criteria to minimize regret.

Methods for Choosing Alternatives

A decision-maker uses various methods for choosing the best alternative among the available alternatives. The methods that are used for choosing alternatives generally assume that all the alternatives are known.

Decision Theory and Decision Analysis

The decision theory and decision analysis refer to the techniques for analysing decisions under risk and uncertainty. In the process of decision-making, a decision-maker wants to achieve his goal, purpose or objective. The decision-maker chooses one particular alternative from various alternatives, which is termed as the 'strategy' of the decision-maker. All alternatives and outcomes are assumed to be known to the decision maker. There are certain factors termed as 'states of nature', which affect the outcome for different strategies. The strategy or alternative, along with the state of nature, determines the degree to which the goal is actually achieved. This measure of achievement of the goal is termed as 'Pay-off'. The pay-off matrix

is used as a method of presenting data in decision analysis. A pay-off matrix is a good representation of a decision problem because the alternatives available to the decision-maker are represented in rows, and the states of nature in columns. Each cell of the matrix, which is an intersection of a strategy and a state of nature, contains the pay-off. If the state of nature is known with certainty, then the decision-maker has the option to choose the strategy providing the maximum pay-off. Figure 5.1 shows the pay-off matrix.

Strategies	States of Nature				Pay-off
	N1	N2	N3	N4	
S1		a ←			
S2					
S3					

Fig. 5.1 Pay-off Matrix

Assume, for example, that a marketing manager of a computer manufacturing company chooses from the following three alternatives:

1. Launch a new PC having latest technology.
2. Leave the PC as it is and do nothing.
3. Modify the existing PC to improve its design and processing power.

There are three states of nature that affect the pay-off from each of the alternative strategies. These states of nature are as follows:

- Conditions remain the same as they are.
- A competitor may launch a new PC with the latest technology.
- The government may impose high excise duty on manufacture of PCs and reduce excise on laptops to encourage the use of laptops.

Figure 5.2 shows the various pay-offs from the combination of a strategy and a state of nature.

(Pay-off in lakh of rupees)

Strategies	States of Nature		
	Government Ban (0.20)	Same Conditions (0.40)	Competitor (0.40)
New Product (S1)	-13	10	3
Do Nothing (S2)	-2	5	1
Modify (S3)	-5	7	5

Fig. 5.2 Pay-off Matrix Combining Strategy and States of Nature

Each cell, which is an intersection of a strategy and a state of nature, contains the probabilities for the occurrence of each state of nature, either based on historical data or on personal judgement of the decision-maker. It can be seen that there are three states of nature with known occurrence probabilities. This problem situation is called decision under risk. To make a decision under such a situation, a decision-maker should compute the anticipated worth of each option. The expected value

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is determined by multiplying each pay-off by the probability of occurrence of the state of nature (given in columns) and adding these values across all states of nature (across the rows). In the above example, the Expected Value (EV) of strategy S3 is:

$$\begin{aligned}\text{EV of S3} &= (-5)(0.20) + (5)(0.40) + (7)(0.40) \\ &= -1 + 2.0 + 2.8 = 3.8\end{aligned}$$

The maximum expected value, that is ₹ 3.8 lakh, is found to be of strategy S3, which is to modify the PC. In addition, if the decision is made based on the expected value objective function, strategy S3 will be selected.

The decision-maker is aware of the probabilities of various states of nature while making a decision under risk. However, the decision-maker is unaware of the probabilities of the different states of nature in case of decision-making under uncertainty. Figure 5.3 shows the pay-off matrix for which the decision-maker does not have the knowledge of probability of occurrence of the states of nature.

(Pay-off in lakh of rupees)

Strategies	States of Nature		
	Government Ban (0.20)	Same Conditions (0.40)	Competitor (0.40)
New Product (S1)	- 13	10	3
Do Nothing (S2)	- 2	5	1
Modify (S3)	- 5	7	5

Fig. 5.3 The Pay-off Matrix where Probabilities of Nature are Not Known

Therefore, a decision-maker cannot apply the maximization/minimization of expected value criteria as in the case of decision under risk. In such decision problems, the following decision rules or decision criteria may be applied:

1. Criterion of ‘minimize regret’ refers to the selection of strategy that minimizes the maximum regret for each decision taken by a decision-maker. The decision-maker might regret if he is not able to select the appropriate strategy in terms of particular states of nature. The regret of the decision-maker is the difference between the highest pay-off for a state of nature and the pay-off for the other strategies for the same state of nature regret matrix. Figure 5.5 showing the regret matrix displaying minimum of maximum requests for strategy S3, which includes modification of a PC. The regret of the decision-maker is computed by subtracting the value in each entry in the column from the highest value in the column. The decision-maker needs to select the strategy that is going to give him the minimum of such maximum regrets. Figure 5.4 shows the pay-off matrix showing the differences between the highest pay-off for a state of nature and the other pay-off for the same state of nature.

Strategies	States of Nature		
	Government Ban	Same Conditions	Competitor
New Product (S1)	$-2(-13) = 11$	$10 - 10 = 0$	$5 - 3 = 2$
Do Nothing (S2)	$-2(-2) = 11$	$10 - 5 = 5$	$5 - 1 = 4$
Modify (S3)	$-2(-5) = 3$	$10 - 7 = 3$	$5 - 5 = 0$

Fig. 5.4 The Pay-off Matrix showing the Differences between the Highest Pay-off for a State of Nature and the Other Pay-off for the Same State of Nature

Strategy	Maximum Regret
S1	11
S2	5
S3	3 ← Minimum of maximum requests

Fig. 5.5 The Regret Matrix

In the current case, the minimum regret is 3 lakhs. The decision-maker should select strategy S3, which modifies the product. This is the minimum regret, if all the other strategies available to a decision-maker are taken into consideration. But at the same time, 3 lakhs is the maximum regret, which the decision-maker experiences for strategy S3.

2. Maximax rule or criterion of optimism refers to the optimistic attitude of a decision-maker that enables him to select the strategy that is able to provide him the maximum pay-off under the most favourable condition. In this example, the decision-maker selects strategy S1, which gives him a maximum pay-off of 10 lakhs for launching a new PC. Figure 5.6 shows the maximum pay-off to the decision-maker by implementing the strategy S1.

Strategy	Maximum Pay-off
S1	10 ← Maximax
S2	5
S3	7

Fig. 5.6 The Maximum Pay-off Matrix

3. Criterion of rationality assumes equal probabilities of various states of nature and as a result, is considered a rational approach of decision-making. This criterion is also termed the Laplace Criterion. This criterion becomes the decision problem under risk after attaching the possibilities to the states of nature. After attaching the possibilities, the expected pay-off for each strategy is calculated and the strategy holding the highest expected pay-off is selected. In the example that we have been discussing, the expected pay-off for each strategy is given in Figure 5.7. The probability of each table is assumed to be equal to $1/3$ since there are three states of nature.

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Strategy	Maximum Pay-off
S1	$1/3 (10 + 3 - 13) = 0$
S2	$1/3 (5 + 1 - 2) = 1.3$
S3	$1/3 (7 + 5 - 5) = 2.3$

Highest EV

Fig. 5.7 The Expected Pay-off Matrix

Therefore, as per the discussed criterion, strategy S3 should be selected because of the highest expected pay-off.

4. The maximum rule or criterion of pessimism indicates that a decision-maker has a pessimistic attitude and therefore, selects the strategy, which gives him the maximum pay-off even if the worst condition occurs. Here, the decision-maker does not like to take any risk and as a result, thinks about the safest position in the worst situation. Therefore, the decision-maker selects strategy S3, since in the worst situation, which is the case of a government ban, the decision-maker sustains the minimum loss of ₹ 2 lakhs due to this decision. Figure 5.8 shows the matrix for the minimum pay-off.

Strategy	Maximum Pay-off
S1	-13
S2	-2
S3	-5

Minimum Pay-off

Fig. 5.8 The Minimum Pay-off Matrix

Decision Tree

Decision tree is an important method for presenting the analysis of a project. It helps in displaying the graphical representation of a sequence of decisions and actions. The analysis of the project presented by a decision tree resembles the branches of a tree with the root of the tree as the starting point of the decision sequence. Figure 5.9 shows the decision tree sequence.

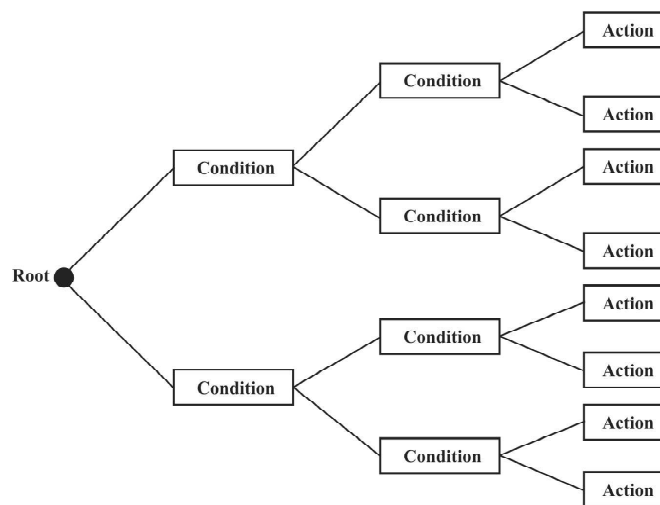


Fig. 5.9 Decision Tree Sequence

The function of a decision tree that helps in structuring the problem is composed of the following two options:

1. Problem structuring includes understanding the logical processing of a problem. Consider the case of a computer firm that offers the following discount policy to its customers.

If the payment is made within a week,

4 per cent discount is allowed on orders above ₹ 11,000.

3 per cent on orders up to ₹ 6,001 to ₹ 11,000.

2 per cent on orders up to ₹ 6,000.

However, if the payment is made after a week, only 1 per cent discount is allowed.

The above discount policy can be presented with the help of the following decision tree as shown in Figure 5.10.

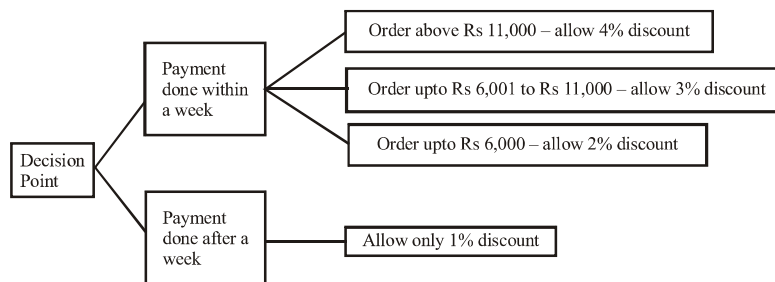


Fig. 5.10 Decision Tree for Discount Policy

2. Problem analysis includes the analysis of a problem. Suppose a company named ABC wants to take decisions for the distribution channel for the marketing of its products. The available alternatives with the company are:

A. Selling Agent

B. Direct Sales

The company may have high or low market penetration and market share. The probabilities and net gains are as shown in Figure 5.11.

Channel	Low Penetration	High Penetration
Selling Agents	0.20	0.80
Net Gains	20 lakhs	80 lakhs
Direct Sales	0.40	0.60
Net Gains	30 lakhs	40 lakhs

Fig. 5.11 The Probabilities and Net Gain

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Figure 5.12 shows the decision for the example as discussed above.

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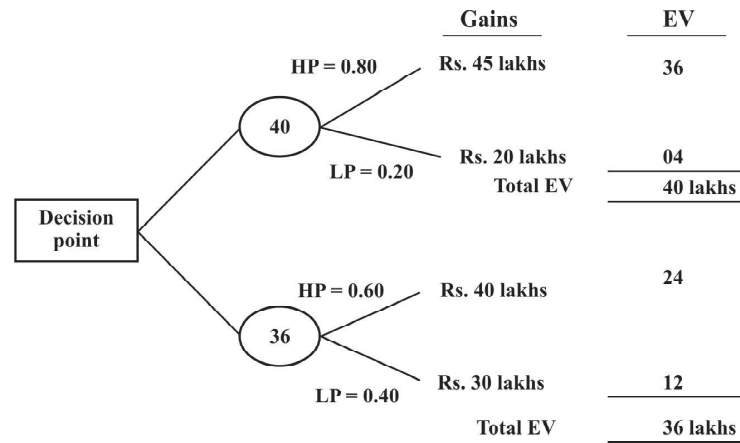


Fig. 5.12 The Decision Tree

Here, LP means low penetration and HP means high penetration:

Expected pay-off for selling agent = $(0.80)(45) + (0.20)(20) = 40$ lakhs

Expected pay-off for direct sales = $(0.60)(40) + (0.40)(30) = 36$ lakhs

Therefore, the decision taken by the decision-maker is as follows:

As the channel option selling through the agent would give a higher pay-off, which is equal to 40 lakhs, the company selects this channel for marketing its products. However, when large numbers of decisions need to be taken and each decision affects the subsequent decision, the rollback procedure is adopted. In this procedure, a decision-maker starts at the end of the branches and works from the back to the front till the decision point of the decision tree is reached. This is done to calculate the selected pay-off for all the branches of all the nodes of a tree. The choice of maximizing the expected pay-off on the whole is found by analysing the possible outcomes at each decision point.

Use of DSS in Production

Production management refers to application of management functions to the production in the factory. It is the job of coordinating and controlling all the activities required to make a product. (Source: www.yahoo.com)

Production managers are concerned with taking critical decisions like diversification of product, assessment of product quality, assessing optimum production level and product mix, optimum stock level and reorder level, etc., in the shortest possible time. They are constantly working towards increasing efficiency of operations by reducing cost and lead time and improving the quality.

A decision support system became a necessity for many organizations after the number of products they manufactured went high. This was also the reason why decision support system in production function was among the first to be developed. Hence, it is quite comprehensive in its application to production or

product management. An ERP based decision support system in the area of manufacturing is especially developed for supporting the solution to management problems which are not properly defined and structured. Most of the time, manufacturing decision support system and production decision support system are used interchangeably.

ERP-based decision support systems in manufacturing help the process of decision-making in the following ways:

- Optimally plan, implement, schedule, sequence and supervise all processes of production.
- Identify and solve exceptions and deviations in performance in an economical way and in real time.
- Institutionalize lean manufacturing and six sigma processes and monitor production to drive continuous improvement.
- Develop staff efficiency and build a superior class job atmosphere.
- Capturing, management and analysis of production related data becomes easier especially in very large production houses.
- It tracks and matches the purchase order, inventory receipts and invoices generated by the vendors. It also helps in order tracking from the time of acceptance of an order till order fulfilment.
- It maintains the revenue cycle from invoice till cash receipt.
- Use of data related to past trends in production and forecasting techniques instead of partially informed, intelligent assumptions to predict about future production needs.
- Coordination of operations with partners and suppliers and coordination of all the elements of production to increase in overall utilization of a factory's production capacity, particularly in case of a complex system with multiple product manufacturing.
- In case of a company having more than one product, it can decide the optimum mix of the product using linear programming technique which uses cost of each of the inputs (stock, manpower as well as time) in those products.
- It helps in deciding the optimum order quantity and reorder level for each of the stock item using inventory control tool.
- In case the production requirement is fluctuating from time to time, it helps in planning, procurement, monitoring and control of inventory.
- The quality related module has the ability to assess the impact of any changes in the quality level due to each defect in any of the products. Hence, it helps in meeting quality parameters expected by the customers.
- It uses techniques like PERT (Project Evaluation and Review Technique) and CPM (Critical Path Method) to help a project manager in planning, scheduling and controlling the time required in finishing a project.

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- Complies with environmental, health and safety standards.
- Keeps a record of production decisions taken for future reference.

Six Sigma — *A systematic method for improving the operational performance of an organization by eliminating variability and waste.* (Source: www.mja.com)

Linear Programming — *A mathematical technique used to obtain an optimum solution in resource allocation problems, such as production planning.* (Source: www.authorstream.com).

Project Evaluation and Review Technique — *The Program (or Project) Evaluation and Review Technique, commonly abbreviated PERT, is a model for project management designed to analyze and represent the tasks involved in completing a given project. PERT is a method to analyze the involved tasks in completing a given project, especially the time needed to complete each task, and identifying the minimum time needed to complete the total project.* (Source: en.wikipedia.org).

Critical Path Method — *Abbreviated as CPM, a project management technique that analyses what activities have the least amount of scheduling flexibility (i.e., are the most mission-critical) and then predicts project duration schedule based on the activities that fall along the ‘critical path’. Activities that lie along the critical path cannot be delayed without delaying the finish time for the entire project. Projects planned with CPM typically are graphically represented in a diagram showing how each activity is related to the others.* (Source: www.webopedia.com).

The most widely used ERP based DSS for manufacturing is SAP R/3, which has specific modules like production planning, material management, quality management and supply chain management. A screenshot of SAP R/3 production planning module is shown in Figure 5.13.

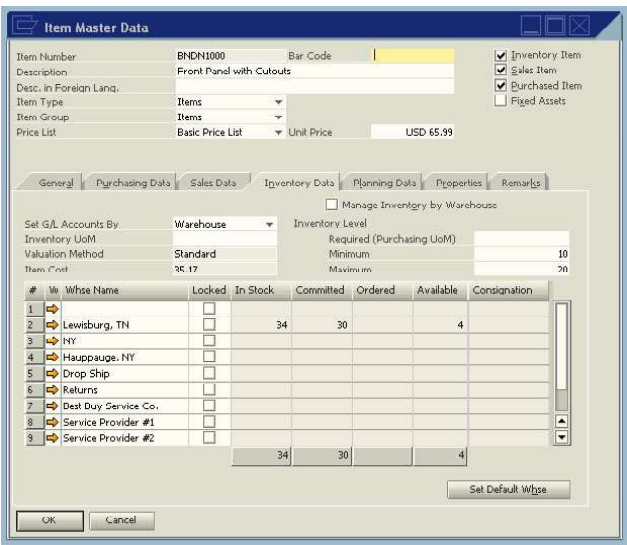


Fig. 5.13 Screenshot of SAP R/3 Production Planning Module

Check Your Progress

1. Name the modern techniques used for making structured decision.
2. What is a semi-structured decision?
3. Classify the decision-making on the basis of level of knowledge.
4. What is the pay-off matrix method?
5. What is Laplace Criterion?
6. What kind of decisions do production managers make?

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5.3 EXECUTIVE INFORMATION AND DECISION SUPPORT SYSTEMS

An Executive Support System (ESS)—an extension of MIS—is a computer-based information system that helps in decision-making at the top-level of an organization. The decisions taken with the help of ESS are non-routine decisions that affect the entire organization and, thus, require judgement and insight.

As compared to DSSs, ESSs offer more general computing capabilities, better telecommunications and efficient display options. They use the advanced graphics software to display the critical information in the form of charts or graphs that help senior executives to solve a wide range of problems. To make effective decisions, they use summarized internal data from MIS and DSS as well as data from external sources about events like new tax laws, new competitors, etc. They filter, compress, and track data of high importance and make it available to the strategic level managers.

ESSs help to monitor performance, track activities of competitors, identify opportunities, and forecast trends. They also assist senior managers in answering the following question:

- What business should we do?
- How are our competitors doing the business?
- Which units can be sold and which new units are to be bought?

Executive Support in the Enterprise

An **Executive Support System (ESS)** is designed to fulfil the information needs of the top level management. It integrates data from both internal and external sources and produces summary reports that help managers to deal with unstructured and semistructured problems. ESS assists higher level managers in making long term strategic planning by providing analysis of the enterprise performance, pinpointing the existing problems, identifying the new opportunities and tracking the activities of the competitor.

NOTES**The Role of Executive Support Systems in the Organizations**

Contemporary organizations emphasize the use of ESS at all organizational levels, so as to enable executives and subordinates at different levels to look at the same data in the same way. An ESS provides various analytical and online data display tools which helps managers to select, access, and modify data according to their requirements.

The use of ESS helps to overcome the problem of data overload that is common in paper reports, since by using ESS the data can be filtered and viewed in a graphical format. In addition, ESS's OnLine Analytical Processing (OLAP) tools can examine the data closely to provide details from the summary of the data, which helps the executives in analysing the data more accurately.

In traditional organizations with large number of incompatible systems, bringing data together and converting incompatible data into meaningful information was a major challenge. However, these days, well configured and implemented enterprise systems can provide managers with timely, complete, and correct firm wide information.

Today's managers need information on current market trends, competitor information, stock market information, and so on. Data from external sources (like the Web) are therefore made available to managers through ESS.

Nowadays, ESS is designed in such a way that managers can use them easily without much experience. One area that requires special attention while designing an ESS is to understand the information requirements of the executives. A major requirement of executives is the information to detect problems that indicates strategic threats.

Benefits of the Executive Support Systems

The various benefits of using the executive support systems are as follows:

- **Flexible to Use:** The system provides data and tools to the managers without addressing specific problems or imposing solutions. Using the system, executives can shape the problem and find solutions according to the requirement.
- **Better Clarity:** The use of graphics helps the user to look at more data in less time with greater clarity.
- **Speed up Decision-Making:** The use of analysis tools helps the executives to evaluate, compare and highlight trends in less time, which speeds up the decision-making process.
- **Enhance the Quality of Analysis:** The ability of an ESS to look at summary data very closely enhances the quality of analysis.
- **Monitor Performance:** These systems help organizations to monitor the firm wide performance against any changes in the external environment.

Moreover, the executives can also check the performance in their own areas of responsibility.

- **Quick Action:** The availability of data at the right time results in required actions being taken quickly. Problems can be handled before they become too destructive and opportunities can also be identified earlier.
- **Decentralized Decision-Making:** The information provided at lower levels allows managers to efficiently monitor activities of the lower level units reporting to them. This monitoring ability facilitates decision-making to be decentralized and to take place at lower operating levels.

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Executive Support Systems and the Digital Firm

Executive support systems are widely used in organizations for improving the management's decision-making capabilities. The changing customer expectations, the Internet technology, and emerging business models necessitate the need for special capabilities in the hands of managers for gathering competitive intelligence. The manager can use ESS to identify the changing market conditions, plan responses, track execution efforts, and learn from feedbacks. Some important ESS applications that help in gathering information for business intelligence and observing corporate business performance are as follows:

- **For Evaluating Performance:** ESS helps to monitor the performance of the senior managers and summarize the reports in the form of digital dashboard. Digital dashboard presents this key information on a single screen in the form of charts and graphs. This information helps the top executives to take necessary decisions for smooth functioning of the company operations. The dashboard of a telecommunication network service provider, for example, may display the number of customers waiting for executive response, or the number of query handled, time elapsed between two queries, etc. When the manager views an unusually high number of breakdowns in a particular location, he can immediately contact the area manager to discuss the quickest way to solve the problem. However, without the dashboard systems, the manager has to go through different channels to locate such problems.
- **For Enterprise Wide Reporting and Analysis:** Nowadays, application vendors offer enterprise wide ESS that is capable of analysing the operational data and, thus, presenting the management a whole picture of the firm's performance. The enterprise wide reporting capabilities of these systems enable organizations to establish new performance standards, including activity based costing. **Activity based costing** is a budgeting and analysis model that determines the processes, resources, and the costs involved while producing a particular product or service. It not only estimates the cost that has already been spent but also identifies those activities in the firm that produce costs. The managers can identify the profitable as well as the unprofitable customers and products of the organization which enable them

to find the changes that are to be made in order to optimize the firm's profitability.

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5.4 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM

Expert systems are an application area in which AI is being widely used. An expert system is a set of programs, which helps to manipulate knowledge to solve problems in specialized fields that may normally require human intelligence and expertise. The knowledge used in an expert system is acquired from sources such as experts in specialized areas. In the early 1970s, expert systems were used as research systems in different universities. The fields where the expert systems are currently being used are Chemistry, Biology, Engineering, Manufacturing, Aerospace, Military Operations, Finance, Banking, Meteorology, Geology and Geophysics.

An expert system is also known as knowledge-based system as it contains domain specific knowledge gathered from different experts. The knowledge base can be defined as a database stored within a computer, which is maintained in a systematic manner using formal representations and from which information can be retrieved for solving problems within a particular domain.

The information that is stored inside the database of an expert system is obtained from the domain experts either by interviewing them about their experience and how they handled different situations or by providing test cases to the experts and asking them to provide answers corresponding to the test cases. The expertise of the professionals can be reused later by less-skilled professionals or by the professionals who want to know the opinion of other experts on a particular situation.

The knowledge base of an expert system is maintained by a knowledge engineer, who is responsible for adding information obtained from the experts in a standardized representation format. A knowledge engineer interacts with experts for obtaining information and can also update the information stored in the knowledge base.

The information in the database is stored in the form of inference rules, which is a statement containing two parts: **if** clause and **then** clause. The data entered by the user of an expert system is checked against the **if** part of the inference rules, and when a match occurs, that part provides the solution for the problem. This process of moving from facts to conclusions is known as forward chaining and is a data-driven approach. The inference mechanism can also move in a backward direction, i.e., starting from the available conclusions the **then** part of the inference rules is checked and when a match occurs the **if** part of the inference rule is given as output. This process of moving from conclusions to facts is known as backward chaining and is a goal driven approach. Figure 5.14 shows how a user interacts with an expert system.

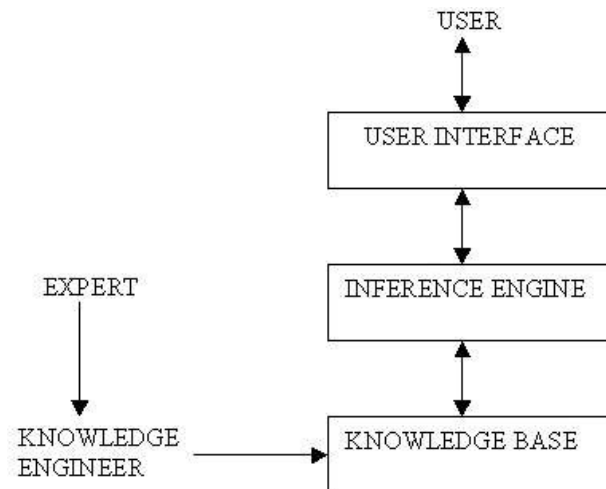


Fig. 5.14 Working of an Expert System

An expert system provides consistent answers every time a similar situation is encountered, unlike a human expert who can miss some aspects due to some reasons like mental tension or burden of work. The inference mechanism of the expert system provides them with the ability to reason like a human being that fulfils the objective of AI but unlike human beings it lacks common sense. There are certain problems, which are faced during the development of expert systems. Experts often find it difficult to explain and reason the logic behind a particular behaviour in a situation, as the action is often guided by intuition and common sense, which becomes difficult to convert in the form of rules. The conversion of facts into rules is simple but complex situations cannot be modelled adequately using rules.

AI and Computerized Expert Systems

The developments that have been made in the field of AI are remarkable. Scientists have become successful in developing many software systems that exhibit intelligent behaviour in the same manner as human beings do. Examples of such intelligent software systems are:

- DENDRAL
- MYCIN
- ELIZA
- A.L.I.C.E

DENDRAL: DENDRAL was the first expert system developed at Stanford University in 1965. It helps chemists in the analysis of a chemical compound, a substance that is formed by the union of two or more chemical elements in definite proportions. For example, ammonia is a chemical compound, which is composed of nitrogen and hydrogen. The expert system was programmed using LISP Processing (LISP) language.

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DENDRAL is composed of two sub-programs, Heuristic Dendral and Meta Dendral, that interact with each other for the analysis of chemicals. Heuristic Dendral accepts the name of the elements and their corresponding proportions as input. These inputs are checked with the information in the chemical knowledge-base to give back as output the possible chemical structure that exists. Meta Dendral accepts certain chemical structures as input and gives the relation between these chemical structures as output. The output of Meta Dendral is given as input to Heuristic Dendral for checking the feasibility of output.

MYCIN: MYCIN is an expert system developed by Stanford University in 1970, for use in the medical field. It is used for diagnosing and treating bacterial infections. MYCIN used LISP language for programming the expert system software. It follows the backward chaining procedure, an inference mechanism for diagnosing the cause of a disorder.

The process of diagnosis begins by supplying a lot of data about infection to the expert system. This data is gathered by the expert system by asking questions to the user regarding the symptoms. The expert system after obtaining sufficient information provides the user with the name of the bacteria responsible for the infection and the name of the antibiotic that will treat the infection. The probability of having given the correct diagnosis is also generated by the expert system.

MYCIN served as a base for the development of many other expert systems. For example, EMYCIN was an expert shell developed from MYCIN that led to the development of PUFF, an expert system meant for treating heart disorders.

NEOMYCIN is also an expert system, which was developed from MYCIN for the purpose of providing training to the doctors. It helped doctors in training by asking their views on different case studies based on the past experiences and scenarios faced by the expert doctors and telling the doctors what is wrong in their diagnosis.

ELIZA: ELIZA was the first software program, which was developed by Joseph Weizenbaum, to interact with human beings in their natural language. It used English language for understanding human problems and providing solution to problems by talking to them.

ELIZA acts as a psychiatrist while interacting with human beings. The person communicating with ELIZA presents the questions and problems by typing them in English. These questions are parsed by the software program for replying back to the user. ELIZA responds back to the user by simply rephrasing the sentence so that the context of the conversation is not lost.

The structure of the software is organized into two parts, language analyser and scripts. The language analyser analyses the sentence written by the user for parsing and analysing the context of conversation. Each script contains a particular context to which the context of the user is mapped.

For example, a person visits a restaurant and is not satisfied by the quality of food that is served at the restaurant. The person talks about this situation to

ELIZA. The conversation between the person and ELIZA will proceed in the manner given as follows:

Person: Hello ELIZA

ELIZA: Hello

Person: I'm feeling annoyed.

ELIZA: Why are you feeling annoyed?

Person: I went to a restaurant.

ELIZA: What happened at the restaurant?

Person: I ordered some food.

ELIZA: What food did you order?

In this manner the conversation will continue and the expert system will figure the reason why the person is annoyed. The script that is used in this scenario is a restaurant script, which will contain all the possible activities that can occur at a restaurant. The responses are given by the expert system by simply rephrasing the users sentences into questions and the user would feel like the expert system is taking interest in his problems like a human psychologist. In reality, ELIZA does not have feelings of affection for the person with whom it is communicating. It is a software which has been programmed to behave in a particular manner.

Artificial Linguistic Internet Computer Entity (A.L.I.C.E)

A.L.I.C.E is a program that can converse with a human being in natural language and was developed by Richard Wallace. The development of the program was inspired from ELIZA. A.L.I.C.E used a programming language known as Artificial Intelligence Mark-up Language (AIML), which is similar to eXtensible Mark-up Language (XML). This technique for communication is based on parsing and pattern matching.

The aim behind the development of A.L.I.C.E and AIML was to provide standardization in the field of natural language understanding as the use of mark-up language for programming provides ease in the development of systems. The advantage of using AIML over other mark-up languages is the support provided by AIML for the use of database.

It is possible to converse with A.L.I.C.E using both textual and audible means of communication, as it supports speech recognition and text to speech conversions, which gives it an edge over other chatting programs.

5.4.1 Merits and Demerits of Expert Systems

An expert system can be used to solve problems in practically every field and discipline. Such systems can also help in various stages of problem-solving process. As such, expert systems have been developed for a variety of complex applications. A few illustrative applications of expert systems are as follows:

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- Aerospace technology (NASA)
- Airline/civil aviation (scheduling/routing)
- Banking and finance (e.g., credit card limits)
- Criminology
- Education
- Food industry
- Health care management (e.g., diagnosing blood infections)
- Manufacturing design and assembly
- Geological data analysis and interpretation of oil exploration drilling sites
- Personnel management
- Security analysis and portfolio management
- Tax planning
- Foreign exchange management
- Gene cloning experiments
- Troubleshooting telephone network
- Configuring computer systems
- Strategic goal setting
- Quality control and monitoring

Limitations of Expert Systems

While expert systems are being used increasingly, it must be remembered that ES cannot be considered a panacea or magic wand. An ES does have its own limitations, some of which are as follows:

- Expert systems function in the domain of extracted, cognitive, logical thinking process. As such, ES are not generally adept at managing highly sophisticated sensory inputs.
- As ES are based on a narrow range of codified domain, they may not be able to tackle multidimensional problems.
- Due to the narrow range of knowledge incorporated in the ES, they typically do not respond well to situations outside their range of expertise. Hence, they remain what they are—machine experts!
- A typical ES may not be able to make available common sense knowledge and broad-ranging contextual information.
- ES typically lack human self-awareness and self-analysis tools. Introspection is not available, as ES also happen to be ‘non-self-referral’ systems.
- If a problem is not specific and has not been solved previously by an expert, or a number of experts, then that problem is not considered suitable for expert systems implementation.

Expert systems are capable of performing only within a specific, logical-oriented realm of expertise. Herein lies the major limitation of expert systems, as computers basically have only memory and not necessarily intelligence!

5.4.2 Applications and Precautions of AI

While the technological aspects of AI are almost in place by now, initial applications have clearly demonstrated that AI can provide great leverage for corporate organizations.

Some of the illustrative AI applications are as follows:

- Manufacturing/production planning and scheduling
- Project management
- Factory management
- Sales, distribution and field services
- Diagnosis and troubleshooting
- Financial management
- Currency/interest rates swaps
- Portfolio management
- Asset liability management
- Reading/interpreting financial information
- Criminology
- Geology (drilling/oil exploration sites)

Precautions of AI

Notwithstanding the advances in AI, it must be remembered that AI systems are not a replacement of human decision-making capability. They are meant to replicate/emulate human decision-making ability for certain types of clear and well-defined problems—the chess matches between Gary Kasparov (Natural Intelligence) and Deep Junior (Artificial Intelligence) being a classic example of AI.

Like other computer-based information systems, the overall purpose of AI systems/applications in businesses is to help the organizations/managers achieve the goals.

No doubt, AI has started getting acceptance and credibility. The success of AI as a mass-market technology, however, depends on a number of practical factors, such as the following:

- Cost
- Personnel with requisite skills
- Corporate management attributes
- The demonstration of a variety of commercial AI success stories to be a role model for others to follow

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5.5 PITFALLS OF MIS

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There are many challenges in managing information systems in organizations, which are important for a manager to understand.

Understanding the need and aligning MIS with business

The success of MIS depends significantly on understanding the need for an Information System and aligning business with IS/IT. Generally, information systems are developed or acquired without understanding the specific needs of the organization for such systems. The goals of the information system and the reasons for implementing it, along with the sub-systems or major tasks involved, are not always clearly defined. Many a time IS/IT systems are conceived which may not be aligned with the mission and goals of the organization. As a result, the ISs may not be contributing any value to the organization.

Requirement analysis

Many a time, the manager (user) is not very clear about his/her requirements and thus it is left to the IT specialist, who does not know much about the business. Thus there remains a communication gap between the user and the IT specialist. As a result, the newly developed and implemented information system does not cater to the needs of the user.

Project management

Information system to be successful must be developed/implemented within time, budget and meet the quality standards. This calls for a proper IS project management. There may be many challenges in managing an IS/IT project, such as the following:

- **Unrealistic deadlines:** Many IT projects are estimated using optimistic measures. Sometimes unrealistic deadlines are difficult to manage
- **Failure to manage risk:** The project risks either are not well identified or are not managed fully leading to the failure of the project
- **Lack of project management skills:** The IT project manager may be lacking the knowledge of project management tools and techniques. Instead of understanding IT project as a socio-technical project, s/he focuses only on the technical aspects of the projects
- **Non-involvement of customers and end-users during the project:** There is a big communication gap between the user and the technical professionals. The clients and end users are not involved during the project, which poses a great challenge to the success of an IT project

Re-engineering of business processes

Mere automation of the business process may not make the operation efficient and effective; rather it is redesigning of the business processes that is more important to improve the performance of the business. Re-engineering of the business processes would change the structure as well as the way an organization does its business and thus leading to change in the organizational culture.

Change management

Many IS/IT systems are considered as IT solutions and are not considered as a part of the business solution and hence there is no change management strategy in place.

Integrated information systems like ERP Systems, being a transformation and an expensive solution, is not an easy decision, and thus needs to be dealt with great care. While emphasizing on the challenges of ERP system implementation, Kalakota and Robinson (2000) cautioned the organizations when they said that an ERP implementation is like the corporate equivalent of a brain transplant. The risk was certainly disruption of business, because if you do not do ERP properly, you can kill your company, guaranteed. They stressed this fact further and said that the fact cannot be denied that the implementation of ERP system is a complete business transformation which provides a competitive edge over other competitors but the costs and risks are also quite high. There have been different ERP implementation experiences from different companies. Many companies like Hershey Food, Nike, A-DEC, etc; sustained losses running into hundreds of millions of dollars. In the case of FoxMeyer Drugs, a \$5 billion pharmaceutical wholesaler, the Company had to file for bankruptcy protection, and then was bought out by its arch competitor McKesson Drugs.

Security and ethical issues

Security and ethical issues are other challenges in managing information systems. There is always a threat to the security of an information system, which needs to be managed to protect data resources in an organization. Similarly managers are often challenged by the ethical responsibilities generated by the use of information systems/technology.

Check Your Progress

7. What is an Executive Support System (ESS)?
8. What is the main purpose of expert systems?
9. List the names of a few intelligent software systems.
10. Mention some domains where expert systems are used to solve problems.

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5.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

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1. The modern techniques used for making programmed or structured decisions involve Operations Research (OR), mathematical analysis, modelling and simulation.
2. A semi-structured decision falls somewhere between the structured and unstructured decisions. These decisions require some human judgement and also need some agreement on the solution method. For example, introduction of a new product is semi-structured decision.
3. On the basis of the level of knowledge of outcomes, decision-making can be classified into three categories:
 - (a) Decision-making under certainty
 - (b) Decision-making under risk
 - (c) Decision-making under uncertainty
4. The pay-off matrix is used as a method of presenting data in decision analysis. A pay-off matrix is a good representation of a decision problem because the alternatives available to the decision-maker are represented in rows, and the states of nature in columns. Each cell of the matrix, which is an intersection of a strategy and a state of nature, contains the pay-off. If the state of nature is known with certainty, then the decision-maker has the option to choose the strategy providing the maximum pay-off.
5. Laplace Criterion is a criterion of rationality which assumes equal probabilities of various states of nature and as a result, is considered a rational approach of decision-making. This criterion becomes the decision problem under risk after attaching the possibilities to the states of nature.
6. Production managers are concerned with taking critical decisions like diversification of product, assessment of product quality, assessing optimum production level and product mix, optimum stock level and reorder level, etc., in the shortest possible time.
7. An Executive Support System (ESS) is an extension of MIS. It is a computer-based information system that helps in decision-making at the top-level of an organization. ESS helps in taking non-routine decisions that affect the entire organization, and, thus, require judgement and insight.
8. An expert system is an application of Artificial Intelligence (AI), which intends to help make decisions and solve problems using the facts and rules, taken from the knowledge of many human experts in a particular field. A knowledge engineer, a kind of programmer, creates an expert system.
9. Some of the intelligent software systems are: DENDRAL, ELIZA, A.L.I.C.E and MYCIN.
10. Banking and Finance, Food Industry, Personnel Management, Troubleshooting telephone network, Quality control and monitoring,

Manufacturing design and assembly, Geological data analysis are some of the domains where expert systems are used to help in various stages of problem-solving process.

MIS and its Uses

5.7 SUMMARY

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- Optimization techniques assume that the decision-maker knows all the alternatives and the outcomes of the alternatives. All these optimization techniques are used by the decision makers to reach an optimal decision to complete the objective of the function.
- MIS plays an important role in all the stages of the decision-making process. The three stages of the decision-making process are intelligence stage, design stage, and choice stage.
- Internal information is generated from the functional areas but the external information is collected from various sources, such as newspapers and personal contacts.
- Management information systems provide support by quantifying and automating a decision-making process during the design stage while considering structured decisions.
- Management information systems should provide summarized and organized information to the decision-makers at the choice stage.
- The organizational decisions are divided into the following three different categories: Strategic Planning, Management Controls, and Operational Controls.
- ‘Knowledge of outcomes’ is another approach for classifying decisions. An outcome defines what is going to happen if the decision is taken or the course of action is taken.
- Decision tree is an important method for presenting the analysis of a project. It helps in displaying the graphical representation of a sequence of decisions and actions.
- Production management refers to application of management functions to the Production in the factory. It is the job of coordinating and controlling all the activities required to make a product.
- The Program (or Project) Evaluation and Review Technique, commonly abbreviated PERT, is a model for project management designed to analyze and represent the tasks involved in completing a given project.
- The most widely used ERP based DSS for manufacturing is SAP R/3, which has specific modules like production planning, material management, quality management and supply chain management.
- An Executive Support System (ESS) is a computer based information system that helps in decision-making at the top-level of an organization. The decisions

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taken with the help of ESS are non-routine decisions that affect the entire organization and, thus, require judgement and insight.

- AI involves the task of creating intelligent computers, which can perform activities similar to the activities performed by a human being, but more effectively. The main objective of AI is to create an information processing theory, which can help develop intelligent computers.
- Expert systems are an application area in which AI is being widely used. An expert system is a set of programs, which helps to manipulate knowledge to solve problems in specialized fields that may normally require human intelligence and expertise.
- An expert system can be used to solve problems in practically every field and discipline. Such systems can also help in various stages of problem-solving process.
- Expert systems are capable of performing only within a specific, logical-oriented realm of expertise. Herein lies the major limitation of expert systems, as computers basically have only memory and not necessarily intelligence.
- AI systems are meant to replicate/emulate human decision-making ability for certain types of clear and well-defined problems.
- The success of MIS depends significantly on understanding the need for an Information System and aligning business with IS/IT.
- Information system to be successful must be developed/implemented within time, budget and meet the quality standards.

5.8 KEY WORDS

- **Ad hoc Query:** It refers to a query that cannot be determined prior to the moment the query is issued. It is created to obtain information as the need arises.
- **Heuristic Technique:** It refers to a technique designed for solving a problem more quickly when classic methods are too slow, or for finding an approximate solution when classic methods fail to find any exact solution.
- **Maximax Criterion:** It refers to an optimistic decision making criterion which is the option in a set of choices that maximizes potential gain irrespective of risk.
- **Maximin Criterion:** It refers to the situation where decision maker should select the course of action whose worst loss is better than the least loss of all other courses of action possible in given circumstances.
- **Lean Manufacturing:** It refers to a methodology that focuses on minimising waste within manufacturing systems while simultaneously maximizing productivity.

5.9 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. State the differences between programmed and non-programmed decisions.
2. What is a decision tree and how it works?
3. Write short notes on:
 - (a) Project Evaluation and Review Technique
 - (b) Critical Path Method
4. List the benefits of an Executive Support System (ESS).
5. Mention the merits and demerits of expert systems.
6. What are the applications of Artificial Intelligence (AI)?

Long-Answer Questions

1. Explain how an ERP-based decision support system eases the process of decision making.
2. Discuss the role of executive support system in an organization.
3. What are the limitations of expert systems?
4. What are the challenges that organizations face in managing information systems?

5.10 FURTHER READINGS

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UNIT 6 MIS IN INDIAN ORGANIZATIONS

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Structure

- 6.0 Introduction
- 6.1 Objectives
- 6.2 Recent Developments in Information Technology
- 6.3 Installation of Management Information & Control System in Indian Organization
- 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

6.0 INTRODUCTION

Over a period of time, Management Information System (MIS) has emerged as the key factor to facilitate and attain decision making in an organization. It provides timely and correct information necessary for decision-making and facilitates the organizations to effectively plan, control and operate. A management information system is vital for an organization as it processes data into information and is then communicated to the various departments in an organization for apposite decision-making.

In this unit, you will study about the importance of MIS in Indian organizations, about the recent developments in information technology. The unit goes on discussing the installation and benefits of management information and control system in Indian organizations. In addition to this, you will also study about the concept and different levels of information management.

6.1 OBJECTIVES

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

- Discuss the recent developments in information technology
- Comprehend the widening scope of information systems
- Describe the installation of MIS and control system in Indian organization
- Assess the different types of reports
- Explore the benefits of MIS for an organization
- Examine the concept of information management
- Understand the different levels of management

6.2 RECENT DEVELOPMENTS IN INFORMATION TECHNOLOGY

Nowadays, every organization uses IT. A medicine shop one finds round every street 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 knowledge of the business.

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 another MIS for the next 5–10 years should be taken into account. 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 extent 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 the 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

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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 purpose 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 micromarketing. 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

MIS in Indian Organizations

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 time cycle to procure requirements and to develop, manufacture and market a new product has become significantly shorter.

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Check Your Progress

1. What does a MIS integrates in an organization?
2. Name a few businesses that are built on the Internet technology.
3. What is micromarketing?

6.3 INSTALLATION OF MANAGEMENT INFORMATION & CONTROL SYSTEM IN INDIAN ORGANIZATION

MIS is a set of systems that enables management at different levels to take better decisions by providing the necessary information.

The role of IT in developing good MIS is to enhance the timeliness and quality of information. However, the subject of MIS does not include a study of IT even though MIS has an overwhelming IT component.

MIS is not a monolithic entity but a collection of systems that seem monolithic to the user. The various subsystems in the background have different objectives but work in concert with each other to satisfy the manager's requirement for information. An MIS can be installed by either procuring off-the-shelf systems or by commissioning a customized solution. Sometimes, MIS can be a mix of both, i.e., an off-the-shelf system customized to suit the needs of the organization.

Characteristics

Since management information is a specialized information system category, it conforms to certain characteristics that are generic in nature. These characteristics remain more or less the same even when the technology around such management information system changes:

- **Management Oriented:** MIS is designed top-down. This means that the system is designed around the felt needs of management at different levels for information.
- **Management Directed:** Since MIS is for the management, it is imperative that it also should have a very strong management initiative. Management is involved in the design process of MIS and also in its continuous review and

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upgradation to develop a good quality system. The system is structured based on the directions provided by management. This minimizes the gap between management expectations and the actual system.

- **Integrated:** MIS is integrated with the operational and functional activities of management. An integrated system enables managers to receive information from different departments and locations within the organization. A lack of integration does not help managers, since it fails to meet their need for information.
- **Common Data Flows:** Since MIS is required to be an integrated system, the data, in its storage, retrieval, dissemination and processing has to be handled in an integrated manner. The integrated approach to data management avoids data redundancy and simplifies operations.
- **Strategic Planning:** An MIS undergoes much planning before being designed or built because it must satisfy the information needs of managers today and should be usable for the next five to ten years, with some modifications. Sometimes, when planning is ignored, systems perform well in the present but they become obsolete with time.
- **Bias Towards Centralization:** Since MIS is required to give the correct version of the latest information, the data repository should be centralized, because it facilitates version control and an integrated, common view of data across the organization. In a decentralized system, data is entered, updated and deleted from different locations and it is impossible to provide the correct information to managers. In a decentralized system, the news of an employee's retirement is noted by the HR department, but not by finance, which continues to pay his salary. Suffice it to say that this would not happen in a centralized system. In a centralized system, the superannuating employee's details are deleted from the master file, the data from which is shared by all departments, thereby eliminating the risk of generating his salary for the next month.
- **ICT Enabled:** Competition requires information to be timely and accurate for effective decision-making, both of which are ensured if information is managed using IT. Hence, MIS has a very high degree of technology intervention in it. In fact, all MIS run on an ICT platform to enable smooth functioning of the system and to ensure timely and accurate results.

Types of Reports

Reports provide the following information to the data driven manager:

1. Whether activities are being performed as planned. For example, a production manager would check the production schedule against a production report, to see if the production process is under control. If there is a difference between the schedule and the report, the manager knows he will have to take corrective action.

2. Provides a glimpse of the bigger picture. If an HR manager notices a high attrition rate among the employees of his firm, he might want to check if competition in the industry has gone up or if the benefits package offered by his organization is inadequate.

We can see that a modern manager relies heavily on data to take decisions and he accesses the data using reports. Reports are of many types.

- **Scheduled Reports:** These reports are generated regularly. They could be generated on a daily, weekly or monthly basis. They contain recent information. The manager uses such reports to analyse information from the context of the recent past. These reports contain the first inklings of problems or opportunities.
- **On-Demand Reports:** These reports are unscheduled in nature and are created based on need. They enable the analysis of a particular issue in greater detail. These reports are the result of a reaction to an event.
- **Exception Reports:** These reports are generated in response to an occurrence that is out of the ordinary and are used to study situations that require control. For example, if the average absenteeism is 2 per cent and rises sharply to 20 per cent, an exception report is generated to get the manager concerned to dig deeper.
- **Predictive Reports:** These reports give the manager a preview of the future and are used for planning.
- **Summary Reports:** These are general reports that provide aggregated data and summarized information to the manager so that he gets an overview of an issue.
- **Regulatory and Statutory Reports:** These reports are created in order to follow rules and statutes, and are submitted to regulatory bodies.

Reports enable the manager to unearth the issues that underlie problems and provide him with the information he needs to take decisions. However, information can be of various degrees of value to a manager. Information that he already has is of little value to him, and incorrect information is useless. So we must understand the meaning of valuable information.

Benefits

An MIS, when properly developed and used in an organization, benefits the organization. The benefits of MIS for an organization include:

- **Increased Productivity:**
 - i. MIS reduces the time, errors and costs associated with processing information.
 - ii. To increase productivity, MIS follows OnLine Transaction Processing (OLTP), wherein data is gathered as input, processed and updated to be output as information.

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iii. MIS enables customers to process their own transactions through a Customer Integrated System (CIS).

- **Enhanced Quality of Decision-Making:**

- Top managers use MIS to get relevant information to make the right decisions.
- MIS support for decision-making falls into two categories:
 - MIS enables managers to analyse a situation by providing the relevant information.
 - MIS might also include recommendations on what action to take.

- **Improves Communication and Develops Team Spirit:**

- MIS enables information management and facilitates communication between diverse teams.
- A Collaborative Management Information System (CMIS) is used to improve team work.
- One aspect of Electronic Data Interchange (EDI) is Electronic Funds Transfer (EFT), which enables payment without physically sending money.

- **Facilitates Organizational Transformation:**

- The use of MIS enables organizations to remain competitive, enter new markets and change the way they work.

Information Management

Information Management (IM) is distinct from Information Technology (IT) even though IT is used to manage information.

When management thinkers realized that information can be a key resource, they wondered how to manage it, because information can be a resource if it lends itself to processing, which includes one or more of the following operations:

- **Recording:** Saving transaction level data in a format for retrieval at a later date.
- **Sorting, Merging and Sequencing:** Ordering and sequencing the data in records.
- **Analysing:** Using data analysis methods, such as summarization and clustering, to analyse the data.
- **Retrieving:** Culling information from data repositories, based on various criteria.
- **Reproducing:** Generating information more than once.
- **Visualizing:** Providing information in a visually stimulating manner.

Data processing requires such complexity. Gathering information is another complex task that involves the capture and storage of transactions in databases, which have to be designed suitably, and then enable access to this data repository

using networks. The visualization aspect or data output is another complex operation that includes query optimization, graphics, analysis and information modelling. *MIS in Indian Organizations*

IT is a term that refers to technologies, such as networking, communication, database management, application software, computer hardware and system software, graphical display and the Internet-enabled technologies. The scope of IT use in organizations is in terms of the following:

- The IT platform, which is the hardware and software infrastructure of the organization.
- Information reach, which is the ability of the organization's IT platform to reach out and capture information both within and outside the organization.
- Information range, which is the diverse types of information and related services that the IT platform enables the managers to access in the organization.

A modern manager takes decisions for an organization. However, if managerial tasks are categorized as staffing, planning, controlling, organizing and leading, managers who work at different levels in an organization's hierarchy spend varying amounts of time on each activity. But most managers are expected to perform all these activities in their own spheres of influence. The manager needs information to perform all these activities. For example, when making a plan, a manager would need to know many things, which include the following:

- What is the objective of the plan?
- What are the parameters that need special attention while planning?
- What are the independent variables and what are the dependencies?
- How can this plan be made more realistic?
- What is the context under which planning is done?
- What are the key issues related to the plan?
- Who are the key people involved and affected by the plan?

Managers need answers to these questions to come up with a suitable plan. However, each question leads to a series of questions, and a vast amount of information is required to set the planning process in motion. A manager may not be fully aware of all the issues and might not be personally aware of the information against each issue. This is why he needs to rely on a system to provide him with this information. An MIS bridges this gap by providing him with the information from different angles, thereby making his task easier. It is the same when the manager is organizing or controlling activities that he has planned—he needs information.

Managers rely on reports for information. Reports are formatted documents wherein the information is arranged so well that the manager can understand it without analysis. Data visualization is a common tool used in reports, and can be done using graphs. The report structure, which is preformatted, also helps the manager locate information quickly—he knows where to look for information.

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If we agree that decision-making is a process, then we have to understand how it works and how information is used during the process. Decision-making enables us to identify a problem or opportunity, understand the context in which the problem or opportunity has occurred, generate alternative solutions to tackle the problem or take advantage of the opportunity, and choose amongst the many alternatives. At each stage of this process, information is required.

Information is required to identify the problem or opportunity, for without information, the decision-maker does not come to know of the existence of either the problem or the opportunity. For instance, if we continue to stay in a dangerous neighbourhood after spending the night at a party, we are in for trouble, and that trouble increases for lack of information. So information plays a key role in the identification of the problem.

Information is also required to understand the context of a problem. For example, in a dangerous area continuing to remain after a party becomes even riskier if we realize that this area has recently seen a string of murders by serial killers. If the information about the problem is qualified with the information about its context, our understanding of the problem improves. Thus, information plays a vital role in the contextualization phase as well.

When generating alternatives, the decision-maker needs to know what will work in that particular situation. For example, when we find ourselves stranded in an unsafe neighbourhood after a party, we should know what our alternatives are: to call a taxi, call a friend to ask for help or walk out of the neighbourhood. However, if we are unaware of the alternatives or the solutions to our problem, we cannot function. Thus, information plays a role here too.

Information plays its most vital role when the decision-maker has to choose between numerous alternative solutions, which are evaluated based on the information available. Alternative solutions are evaluated on the basis of their outcomes and then the alternative that maximizes the benefit or minimizes the hardship is chosen. Information about the outcome (likely) of each alternative is vital for this choice. For instance, if we decide to call a friend to come and pick up from a dangerous neighbourhood, rather than call a cab or walk, we have made a choice to trust someone we know rather than take a risk.

Thus, we see that information plays a vital role in the decision-making process. Simon has created a model for human decision-making, which is linked to information requirement.

Simon human decision-making model was developed to settle for a good enough solution. There is a trade-off between the time and cost of searching for an optimum versus the value of obtaining one. A good enough or satisfying solution can be obtained if a certain goal level is attained.

Simon's model for decision-making is a three-phase model of problem solving which involves intelligence, design and choice. Intelligence is used for searching the conditions that call for decisions. Design phase includes inventing,

developing and analysing possible courses of action. Choice, the third phase, is used for selecting a course of action from the available choices.

Decision-Making and Information Systems

Since an MIS is concerned largely with managerial applications, an appreciation of the theory of organization is a prerequisite for the successful application of MIS. Some professionals in MIS area bring forth this point in the cryptic definition of MIS as ‘the supply of right information, at the right time, at the right level’. Before discussing the use of MIS in decision-making, we will first discuss the basic structure of an organization, i.e., the hierarchy of an organization. The levels of management in the context of MIS refer to the classification of management originally developed by Anthony.

The different levels of management are generally referred to as a pyramid in a pictorial form to emphasize the fact that in any organization there are a few top positions, a large number of supervisory staff and a much larger number of operational staff. Placing these three staff positions in order, from top to bottom would lead to a structure loosely resembling the structure of pyramids.

We will now discuss how this pyramid represents the three categories of employees working in an organization. Anthony classified the three levels as strategic, tactical and operational. As the strategic management is concerned with long term policy decisions such as new plant location, new products and diversification they typically need a summary of plant/organizational level information as well as unstructured and even vague information pertaining to the environment, such as the competitors, changes in government fiscal policy, emerging technologies, and so on. The tactical management comprising functional managers needs some external information but a lot of organization-wide information to exercise control over budgeting, quality, service, inventory, etc. The operational management is only concerned with plant/organizational level information but in a far detailed manner such as individual operator specific, machine specific and shift specific performance measures. As we have already discussed the three attributes of data or information, let us now see how they are applicable to the above mentioned three levels. To be successful, the MIS as an organization must explicitly take into account this classification of management. Since the summary information to be provided to the tactical and strategic management must be culled out of operational information, the accuracy and timeliness of information collection and dissemination is important at the operational level. However, at the tactical and operational levels, relevance is the watchword. A relevant but slightly inaccurate data is better than irrelevant but accurate data. The context decides the trade-offs, particularly when the cost of data processing is involved. Some professionals call this process information filtering, meaning that only filtered information culled out of operational data must be presented to the middle and top management. Some others put it more effectively by emphasizing efficiency at the operational level and effectiveness at the tactical and strategic levels.

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Successful development of information systems insists a thorough knowledge of the organizational structure and dynamics of the enterprise. Because firms are goal oriented, the analyst must be clear as to what data exactly needs to be collected, stored and analysed. Since context of information is necessary, only operational information that has some relevance in decision-making process must be collected. Moreover, the information collected and processed must be suitable for the level of the firm in which it is to be applied. As an organization consists of three levels, we will now take into account the differences in the nature of decisions made by the middle and upper level management as the lower level management is not responsible for making any type of decisions. According to Anthony's classification, there are three levels of management, independent of the size of the organization: operational level, middle level and top level management. Operational decisions seek large volumes of internal data while the middle management is concerned with medium range (tactical) decisions that call for much less information. The top management which is more bothered with the long term (strategic) decisions calls for vital internal information as well as a lot of external information. Any successful information system should take into account all these diverse information needs of the firm.

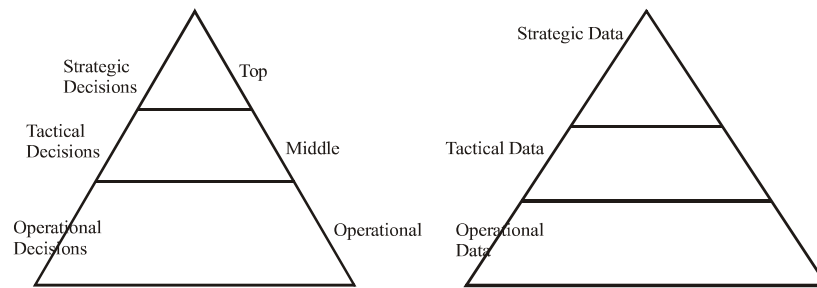


Fig. 6.1 Pictorial Representation of Management vs Information Pyramid

This is generally displayed pictorially in the form of management versus information pyramid (see Figure 6.1). The importance of information to management is further stressed by the fact that the aim of management is primarily decision-making. While there are several views regarding what constitutes management, it is generally accepted that all such activities pertaining to planning, organizing, coordinating, directing and controlling come within the ambit of management. Information systems should clearly differentiate between programmed and non-programmed decisions by properly structuring the appropriate information. Failure to identify basic anomalies may result in the breakdown of an information system. We are aware that many functional areas of management, such as personnel, marketing, production, finance and services are considerably affected by the information systems that are to be implemented in the firm. Care should be taken to identify the fact that in every functional area, the mapping of the informational pyramid must be carefully worked out. Table 6.2 is a typical example showing the three levels of information among the functional areas of management.

Table 6.1 Example of a Typical MIS

	Production	Finance	Personnel	Marketing
Strategic	New Plant Location	Alternative Financing	Welfare Policy	Competitor Survey
Tactical	Production Bottleneck	Variance Analysis	Performance Appraisal	Advertising
Operational	Daily Scheduling	Payroll	Leave Records	Sales Analysis

NOTES**Check Your Progress**

4. How can an MIS be installed?
5. What are reports and how they help managers in an organization?
6. What sort of information a manager needs when making a plan for the organization?
7. Briefly explain Simon's model for decision-making.

6.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. An MIS integrates business strategy, processes and the governing rules with hardware, software, database and communication systems. It goes in sync with business strategies and technology used i.e., if business strategies change, the MIS will also have to change.
2. Online shopping, online auction, comparative price checking, etc. are a few businesses that are built on the Internet technology.
3. Micromarketing is a marketing strategy in which advertising efforts are focused on a small group of highly-targeted consumers. Specific market segments are targeted with customized products and solutions.
4. An MIS can be installed by either procuring off-the-shelf systems or by commissioning a customized solution. Sometimes, MIS can be a mix of both, i.e., an off-the-shelf system customized to suit the needs of the organization.
5. Reports are formatted documents wherein the information is arranged so well that the manager can understand it without analysis. Data visualization is a common tool used in reports, and can be done using graphs. Reports enable the manager to unearth the issues that underline problems and provide him with the information he/she needs to take decisions.
6. When devising a plan for the organization, a manager needs to know many things such as the objective of the plan, parameters that need special attention, independent variables and dependencies, ways to make the plan

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more realistic, context under which planning is done, key issues related to the plan, key people involved and affected by the plan.

7. Simon's model for decision-making is a three-phase model of problem solving which involves intelligence, design and choice. Intelligence is used for searching the conditions that call for decisions. Design phase includes inventing, developing and analysing possible courses of action. Choice, the third phase, is used for selecting a course of action from the available choices.

6.5 SUMMARY

- 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.
- 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.
- Building, using, managing and obtaining productivity enhancement using IT are challenging tasks that require the involvement of management as well as employees.
- 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.
- IT has had a tremendous impact on work flow in organizations. It has led to extremely efficient 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.
- Networks and IT have made organizational boundaries less rigid. The time cycle to procure requirements and to develop, manufacture and market a new product has become significantly shorter.
- The role of IT in developing good MIS is to enhance the timeliness and quality of information.
- An MIS can be installed by either procuring off-the-shelf systems or by commissioning a customized solution. Sometimes, MIS can be a mix of

both, i.e., an off-the-shelf system customized to suit the needs of the organization. *MIS in Indian Organizations*

- Some generic characteristics of MIS include management-oriented, integrated approach to data management, management directed, undergoes strategic planning, bias towards centralization, and ICT enabled.
- Reports enable the manager to unearth the issues that underlie problems and provide him with the information he needs to take decisions. Reports are of many types such as Scheduled reports, on-demand reports, exception reports, predictive reports, summary reports, and regulatory and statutory reports.
- An MIS is very advantageous to an organization like it helps in mounting productivity of the company, provides enhanced quality of decision-making, improves communication and develops team spirit, facilitates organizational transformation.
- IT is a term that refers to technologies, such as networking, communication, database management, application software, computer hardware and system software, graphical display and the Internet enabled technologies.
- An MIS provide managers with the information from different angles, thereby making his task easier. It is the same when the manager is organizing or controlling activities that he has planned—he needs information.
- Reports are formatted documents wherein the information is arranged so well that the manager can understand it without analysis. Data visualization is a common tool used in reports, and can be done using graphs.
- Decision-making enables us to identify a problem or opportunity, understand the context in which the problem or opportunity has occurred, generate alternative solutions to tackle the problem or take advantage of the opportunity, and choose amongst the many alternatives.
- Information is required to identify the problem or opportunity, for without information, the decision-maker does not come to know of the existence of either the problem or the opportunity.
- Information is also required to understand the context of a problem. If the information about the problem is qualified with the information about its context, our understanding of the problem improves. Thus, information plays a vital role in the contextualization phase as well.
- Information plays its most vital role when the decision-maker has to choose between numerous alternative solutions, which are evaluated based on the information available. Alternative solutions are evaluated on the basis of their outcomes and then the alternative that maximizes the benefit or minimizes the hardship is chosen.
- Simon's model for decision-making is a three-phase model of problem solving which involves intelligence, design and choice. Intelligence is used

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for searching the conditions that call for decisions. Design phase includes inventing, developing and analysing possible courses of action. Choice, the third phase, is used for selecting a course of action from the available choices.

- The tactical management comprising functional managers needs some external information but a lot of organization wide information to exercise control over budgeting, quality, service, inventory, etc.
- The operational management is only concerned with plant/organizational level information but in a far detailed manner such as individual operator specific, machine specific and shift specific performance measures.
- The three levels of information among the functional areas of management includes strategic, tactical, and operational level.

6.6 KEY WORDS

- **Domain Knowledge:** It refers to the knowledge about the environment in which the business organizations operates.
- **Micromarketing:** It refers to a marketing strategy in which advertising efforts are focused on a small group of highly-targeted consumers.
- **Virtual teams:** It refers to a group of individuals who work together from different geographic locations and rely on communication technology such as email, FAX, and video or voice conferencing services in order to collaborate.
- **Customer Integrated System (CIS):** It refers to an extension or hybrid of the transaction processing system that places technology in the hands of the customer and allows them to process their own transactions.
- **Electronic Data Interchange (EDI):** It refers to the transfer of data from one computer system to another by standardized message formatting, without the need for human intervention.
- **Information Management (IM):** It refers to the collection and management of information from one or more sources and the distribution of that information to one or more audiences.

6.7 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. List some characteristics of MIS which are generic in nature.
2. Write a short note on reports are helpful to managers.

3. What are the operations used to manage the information?
4. What is the scope of information technology (IT) in organizations?

Long-Answer Questions

1. What are the recent developments in information technology?
2. How many types of reports are there? Explain.
3. Describe the benefits of MIS for an organization.
4. What are the different levels of management in the form of pyramid? Discuss.

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6.8 FURTHER READINGS

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UNIT 7 COMPUTERS AND COMMUNICATION

Structure

- 7.0 Introduction
- 7.1 Objectives
- 7.2 Information Technology and Global Integration
 - 7.2.1 Need for Information Systems in a Digital Firm
- 7.3 Online Information Services
- 7.4 Electronic Bulletin Board Systems
- 7.5 The Internet, Electronic Mail and Interactive Video
- 7.6 Answers to Check Your Progress Questions
- 7.7 Summary
- 7.8 Key Words
- 7.9 Self Assessment Questions and Exercises
- 7.10 Further Readings

7.0 INTRODUCTION

Today computers are an indispensable part of our life. They are critical for communication and act as the centrepiece of information technology. Humans are highly dependent on computers to access information, to create and express, to communicate and also to collaborate with others. The computer is available in many offices and homes and therefore there is a need to share data and programs among various computers. The IT revolution introduced widespread changes in how firms operate, brand themselves and market their products. Clients and customers are also global, with majority of the transactions carried out over the Internet. Some powerful worldwide changes have altered the business environment. Online information service plays significant roles for business that provides its subscribers with a wide variety of data transmitted over telecommunications lines.

The unit focuses on the all facets of computers and communications, various aspects of IT and need for information systems in a digital firm. The unit also discusses various online information services, its components and elements. In addition to this, you will also learn about electronic Bulletin Board Systems (BBS) and an overview of the Internet, electronic mail, interactive video has also been discussed in the unit. Creation of an e-mail account, viewing received mails, sending e-mails using attachments are the other topics of discussion. In this unit you will also learn about various communication channels through which communication signals are transmitted. You will be able to classify communication networks on the basis of their layout and geographical area they span.

7.1 OBJECTIVES

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

- Examine the various aspects of information systems
- Discuss the need for information systems in a digital form
- Assess the basic elements and major components of online search
- Discuss the online information services and electronic bulletin board systems
- Explain various ways to communicate through the Internet
- Describe the types of Internet connections provided by ISPs
- Discuss some of the common services like teleconferencing, data conferencing, video conferencing, voice mail, Fax

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7.2 INFORMATION TECHNOLOGY AND GLOBAL INTEGRATION

Traditionally, firms have been relying on human to human interaction for most of its activities. The IT 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 going global, with majority of the transactions carried out over the Internet.

7.2.1 Need for Information Systems in a Digital Firm

In this section we will discuss the various aspects of information systems and the factors that decide the organizational need for one.

Competitive Business Environment

In the last four decades, the following four powerful worldwide 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 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 24 × 7 support to their customers through their customer support offices located in India. Manufacturing organizations set up their manufacturing plant where market

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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.

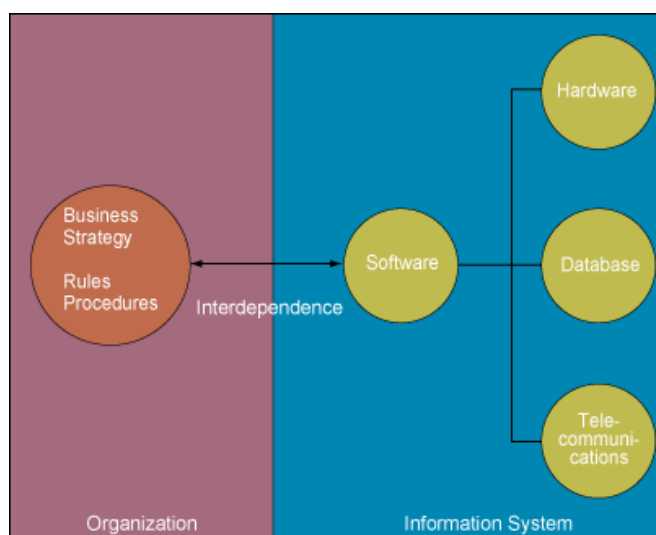


Fig. 7.1 *The Interdependence Between Organizations and Information Systems*

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 the date 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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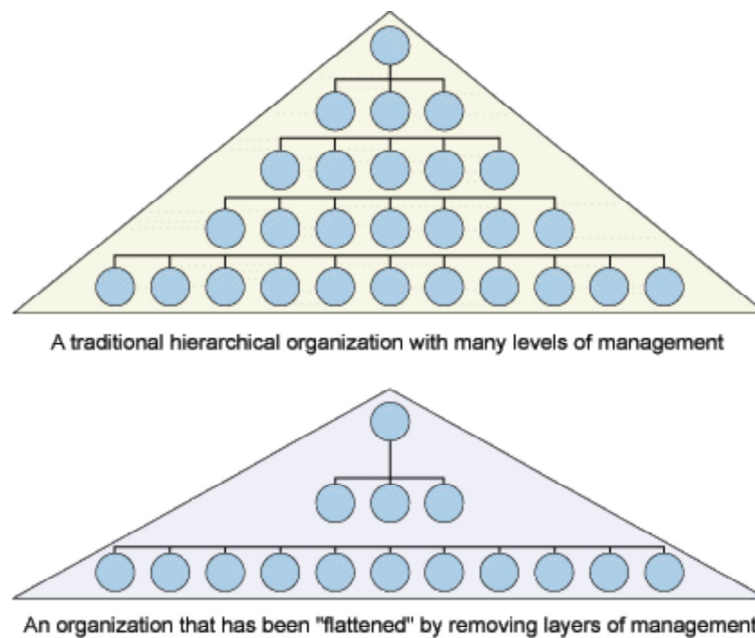


Fig. 7.2 Comparison of a Traditional Hierarchical Organization with a Modern Day Digitalized Organization

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

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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 totally digital.

What is an Information System?

An information system is defined as a collection of components that work together to achieve a goal. The goal of an information system is to make information available to its users. An information system has to first collect information. However, information is usually not available; only data or raw facts are available. The data is processed and stored in a form that is meaningful for its users. A different component of an information system is required for dissemination of information. An information system is designed for a specific set of users who access the system for a pre-defined purpose. To take an example, the railways reservation system is accessed by people who want to make train reservations. You will not find stock prices or be able to make airlines reservations using the railways reservation system. However, the railways reservation system can be used to make reservations in many different trains and get information on the features, services and schemes pertaining to the railways.

An information system may have to be modified if it does not meet users' expectations. A feedback mechanism has to be put in place that can collect users' feedback and modify the information system accordingly. Modifications are not expected to completely change the functionality or objectives of the system.

Designers of information systems consult users and relevant documents to decide the data that should be collected and stored in the system. An information system allows the user to access new data as it becomes available. Such a system

may also provide the facility to the user to analyse the data and present the result in an appropriate form, such as tables and graphs.

Designers of an information system need to understand the business environment and all the constituents of the information system in order to build a successful system. Complete hardware, software, database and networks are essential components – though not adequate – to build an information system. When an organization invests in information systems, the objective often is to improve the information processing capability that should result in improved performance. There are many ways of measuring performance such as cost of production, market share and return on investment. Let us say an organization wants to reduce the cost of production by using IT. The possibilities are to use SCM systems to better manage their vendors and suppliers or use an ERP system to better manage inventory and reduce inventory carrying cost and backorder cost.

Management is responsible for perceiving such opportunities and looking for appropriate solutions. It is also important that they share their vision and goals with their employees. This is important because the employees should feel themselves to be a part of the effort and identify with the goals. Management always has to work with limited resources in terms of finance, time and manpower. An IT project has to compete with many other initiatives in the organization for resource allocation. Therefore, it goes through an analysis phase where a cost-benefit analysis is done to justify the project.

Check Your Progress

1. What are digital firms?
2. Define information system?
3. What are the important things to consider while creating an information system?
4. What is the use of SCM in a firm?

7.3 ONLINE INFORMATION SERVICES

Online information service is significant for business that provides its subscribers with a wide variety of data transmitted over telecommunications lines. Online services provide an infrastructure in which subscribers can communicate with one another, either by exchanging e-mail messages or by participating in online conferences (forums). In addition, the service can connect users with an almost unlimited number of third party information providers. Subscribers can get up-to-date stock quotes, news stories, articles from many magazines and journals, in fact, almost any information that has been put in electronic form. For accessing the relevant data online, the subscribers have to pay the subscription amount defined by the service provider.

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The difference between an online service and a Bulletin Board Service (BBS) is in terms of scale and profits. Online services provide a variety of information and services; whereas BBS's normally concentrate on a single theme. In addition, BBS's are often operated on a non-profit basis whereas online services are always for profit. The largest online services are America Online, CompuServe, AOL, Prodigy and MSN adding access to the Internet services, such as e-mail, UseNet newsgroups, FTP access, and the World Wide Web. At first, these online services continued to offer a great deal of content available to their members only. But with the gaining popularity of World Wide Web most of these online services started recommending less content and as an alternative started relying on various Web sites to serve as a substitute for content they had previously offered. This eventually led many online services to largely cease being online services in the traditional sense and become more like the Internet service providers counterparts. As the Internet became popular, many ISP's began offering flat fee unlimited access plans. This forced online services that had been charging by the hour to also offer flat fee unlimited access plans to compete. One online service that defies classification is the Internet. In terms of users, it is the largest service, but it is not centrally controlled by any one organization, nor is it operated for profit.

Elements of Online Search

There are nine basic elements of an online search which are as follows:

- Searcher
- Search Formulation
- Input Search Formulation
- Workstation
- Link To Computer System
- Search Software
- Store Of Information
- Retrieved Items
- Printer

Components of Online Service

There are five major components of online search service:

- Database producer or information provider.
- Online service providers.
- Telecommunication links.
- Workstation.
- Linking tools.

7.4 ELECTRONIC BULLETIN BOARD SYSTEMS

A Bulletin Board System or BBS is an online service which is based on microcomputers, running appropriate software. Once logged in, users can upload and download software and data, read news and bulletins, and exchange messages with other users either through email or in public message boards. Many BBSes also offer online games, in which users can compete with each other and BBSes with multiple phone lines often provide chat rooms, allowing users to interact with each other more instantaneously. Ward Christensen coined the term Bulletin Board System as a reference to the traditional cork-and-pin bulletin board which are often found in entrances of supermarkets, schools, libraries or other public areas where people can post messages, advertisements or community news. By computerizing this method of communications, the name of the first BBS system was named as Computerized Bulletin Board System (CBBS). From 1970s to the mid 1990s, most BBSes were used to run as a hobby, i.e., free of charge by the system operator, while other BBSes charged their users a subscription fee for access, or were operated by a business as a means of supporting their customers. Bulletin Board Systems were, in many ways, a precursor to the modern form of the World Wide Web, social network services and other aspects of the Internet.

BBS systems offer a wide variety of services. This includes:

- **Software/Applications or Share Files**

BBS systems offer files that are either non-existent on the Web or are very hard to find. Some BBS systems specialize in hosting files of a particular theme or category. By providing a consolidation of files it saves the time of the BBS user from searching the Web endlessly.

- **Discussion Forums**

Discussion Forums are the main feature of many BBS systems. It provides a centralized place for BBS users to share ideas, opinions, and information. Discussion forums fall in one of three categories: Local, Locally Networked and Networked.

- **Local Forums:** It refers to the discussion forums also called message conferences that are unique to the BBS system users which are currently on. Messages in these areas are not distributed to other systems.
- **Locally Networked Forums:** Some message areas that are distributed within a local network. For example, the regionally based forums for a specific geographic location.
- **Networked Forums:** Networked discussion forums are sometimes referred to as Echomail since its echoed across multiple BBS systems which are distributed nationwide and sometimes worldwide. There are several large

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BBS networks just for Discussion forums, the largest of which is known as FidoNet.

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• E-Mail

E-mail has been around long before the Internet. There are two kinds of e-mail when it comes to BBS Systems: one is sent from a user to another user on that specific BBS system and the other is sent via network to another BBS system which is sometimes referred to as Netmail.

• Online Games

Online games, commonly referred to as Door Games, are another feature of BBS systems. Games range from the very simple to very complex strategy games. Some games are simply for the user's individual entertainment. Other games allow the users to compete for high scores and others are often educational in nature. Inter BBS games allow the users of one BBS to unite as a team to play against the users of another BBS or a league consisting of several BBS systems.

• Chatting

Another favorite past time of BBS users is just sitting back behind the keyboard chatting with others online. Some BBS systems offer services similar to the IRC (Internet Relay Chat) on the Internet: Private Chats, Public Chats and Chat Rooms.

• Offline Mail

Offline mail is a way for BBS users to read and reply to discussion forum messages while offline. BBS users can select the discussion forums of personal interest and download mailbags to their personal computers. The BBS user can open the mailbag and read, reply and generate new messages with a program called an Offline Mail Reader. This method of reading and writing messages is advantageous to everyone involved.

As the use of the Internet became more widespread, traditional BBSes rapidly faded in popularity. Today, the Internet forums occupy the social and technological space as BBSes did, and the term BBS is often used to refer to any online forum or message board. Most BBSes are now accessible over telnet and typically offer free e-mail accounts, FTP services, IRC, etc.

Check Your Progress

5. What is the significance of online information system?
6. List the five major components of online search service.
7. Who coined the term Bulletin Board System?
8. What are the three categories of discussion forums?

7.5 THE INTERNET, ELECTRONIC MAIL AND INTERACTIVE VIDEO

Today, the users' information demands are increasing rapidly. The Internet has given the solution by providing the facility of digital information services. Nowadays, various organizations and educational institutions are providing services. Distance learning is one of the most widely used information services.

Digital Information Services

The Internet provides various digital information services, such as table of content services, current awareness services, virtual reference services and electronic document delivery via information centres and libraries. Nowadays, various digital information services are getting merged with the financial services, student services and library automation services. Also, they are having links with e-commerce systems, e-government and off-campus electronic learning.

As the Internet has no barriers, providing information services anytime, anywhere has become easier. With the help of information technology and the Internet, libraries and information centres have shifted their services from centralized to distributed and networked services. The users can instantly access information from their desktops without having the need to move outside to get important information. The stock prices, catalogues of industrial supplies, reference works, legal research, weather forecast, and travel information can be accessed online. Using these services, users can avail the facility of online discussion groups, electronic bulletin boards, shopping, e-mail, and travel reservations.

Getting Connected to the Internet

Before you start using and exploring the Internet, the first step is to connect to the Internet. For this, you must fulfill some basic requirements. The various hardware and software requirements for getting online include a computer with a Web browser, modem, and an Internet connection. Besides, a telephone line or a cable line is required to connect the computer to the Internet.

A Computer with a Web Browser

To connect to the Internet, a computer with the following configuration is required.

- At least a 386 microprocessor chip with RAM not less than 16 MB is required. The higher the RAM, the higher will be the speed of your computer, and the faster the computer, the better will be the speed of information retrieval from the Internet.
- A color monitor having at least 640 × 480 resolution is required. Moreover, the computer should be capable of displaying a minimum of 256 colors.

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- A hard disk having minimum 200 MB of free space to install the Internet software (web browser) as well as to store the temporary Internet files is required.

To access the Internet, a Web browser must be installed in the computer. A Web browser is a software that is used to find and retrieve Web pages, view them on the monitor screen and send the information over the Internet. Netscape Navigator and the Internet Explorer are some of the commonly used Web browsers.

Modem

We know that the data in a computer is stored in a digital form. Transmission of this digital data over the telephone lines is not possible as the information travels in the form of analog waves over the telephone lines. Thus, it is essential to convert the digital information into analog form before it is transmitted. This is accomplished using a modem.

A modem (MODulator-DEModulator) is a peripheral device attached to computers (via a telephone line) which enables communication by converting digital signals into analog signals and vice versa. The data transmission begins when the sender transmits data, the sender's machine generates the digital data and the modem converts them to analog signals (called modulation) so that they can be easily transmitted over the telephone lines. When the data is received at the receiver's end, the analog signals are again converted back to the digital data (called demodulation) so that they can be easily understood by the computer. Modems are of two types, namely *internal modem* and *external modem*.

- **Internal Modem:** It is a card equipped within the computer with a lead coming directly from the computer to the phone.
- **External Modem:** It is a small box outside the computer and cabled between the computer and the phone. It consumes an additional power supply and needs to be switched off like any other peripheral device.

Data transfer of modem is calculated on the basis of bits per second (bps). Currently, a modem supports the speed of 28 Kbps (28,000 bits per second) to 56 Kbps (56,000 bits per second).

Choosing an Internet Connection Service

Before connecting to the Internet, you need to buy an Internet connection from an authorized Internet Service Provider (ISP). An **ISP** is an organization that provides access to the Internet. It charges a monthly fee and subscribes you as a user to connect to the Internet. When you get subscribed with an ISP, you are provided with the information, such as username, password, user software package, access phone number, etc. Once you get subscribed, using this information you can log on to the Internet and browse the Web any time as per your convenience. There are thousands of ISPs established all over India. Some of the common ISPs include

Mahanagar Telephone Nigam Limited (MTNL), Videsh Sanchar Nigam Limited (VSNL), Mantra Online, and Satyam Online.

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ISP provides a variety of the Internet connections which vary in the speed of accessing the Internet. The following are the types of Internet connections provided by ISPs.

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- **Dial-up Access:** It is a temporary and on-demand connection established between a computer and the ISP (and hence, the Internet) by using a standard phone line and a modem. It provides speed ranging from 2400 bps to 56 Kbps and, thus, is suitable for personal use at home. This connection is economical but slow as compared to other connections and causes errors in the transmission because of noise in the telephone line. In addition, while connected to the Internet, the phone cannot be used to make or receive other calls.
- **Integrated Services Digital Network (ISDN):** It is a dedicated connection that involves digitization of telephone network so that digital data, such as voice, graphics and text, are transmitted over the existing telephone lines. A special device called the ISDN adapter is required for the connection. It provides high speed of Internet access ranging from 64 Kbps to 128 Kbps. Thus, it is suitable for business and commercial purposes, such as video conferencing. It costs slightly more than a regular telephone line, but provides higher speed. Moreover, it causes fewer errors in transmission.
- **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 to 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.
- **Digital Subscriber Line (DSL):** It is also a dedicated connection that uses the standard telephone lines to transmit and receive information digitally. A special modem and adapter card are required to allow data transmission. 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.
- **Leased Line:** It is a permanent connection that uses a dedicated and high-speed telephone line rented for twenty-four hours a day and seven days a week. It is used by large-scale businesses to connect their geographically distant offices. A fixed monthly fee is charged based on the distance between the end points and the speed of the circuit. It provides high-speed Internet access ranging from 2.4 Kbps to 45 Mbps. Though it is very expensive, it provides the fastest Internet access.

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E-mail and Groupware

There are various ways to communicate through the Internet. Some of them require both the sender and the receiver to be online, such as groupware while others, such as e-mail do not employ such restrictions and the sender can send data even if the receiver is offline.

E-mail

E-mail or electronic mail is the most commonly used Internet service. It refers to the facility of sending and receiving messages electronically over a network of computers. Sending and receiving e-mails require a user to have an e-mail address (sometimes called an e-mail account or an e-mail ID) in any of the Websites that provides e-mail service. A number of Websites, such as www.yahoo.com, www.gmail.com, www.rediffmail.com and www.hotmail.com provide the facility to create free e-mail account. Note that since multiple users can access the Internet at the same time, the e-mail address must be unique for each Internet user.

An e-mail address is divided into two parts, namely the *username* and the *mail server name*. The two parts are separated by the symbol @. The structure of an e-mail address is as follows:

`username@mailservername.com`

For example, `itl.esl@gmail.com` is an e-mail address where,

`itl.esl` = the username

`gmail` = the name of the mail server

`.com` = a commercial Website

Though e-mail is a very popular service of the Internet because of its numerous advantages, it has few disadvantages also. The advantages and disadvantages of e-mail are as follows:

Advantages

- It is a very fast medium of communication. The messages can be sent in no time irrespective of the distance.
- It is a very economic medium of communication. You are only charged the cost of being online whether you are sending it overseas or down the road.
- Any form of data, such as text, graphics, sound, or video, can be sent through e-mails.
- It is a secure medium of communication, that is, no one can access anybody's e-mail account without knowing the password.

Disadvantages

- A slight error in the e-mail address of the recipient is enough to prevent the delivery of the message and even when you do everything right, there is always a chance of failure in one of the links between you and your recipient.

- Sometimes, viruses can enter your system through the attachments received in e-mails.

Creating an E-mail Account

The steps for creating an e-mail account are as follows:

1. Start the Internet Explorer.
2. Type the address of any e-mail service provider, for example, www.gmail.com in the address bar and press the **Enter** key. The home page of Gmail appears that allows the new users to create their mail accounts and the existing users to log on to their accounts.
3. Click the **Create an account** button. The **Create an account** Web page appears that asks for certain details like First name, Last name, Desired Login Name, Password, etc.
4. Fill up all the necessary details in the given text boxes.
5. Read the **Terms of Service** and click on the **I accept. Create my account** button.

A Web page showing the confirmation of your account creation appears. Now, you can receive and send e-mails.

Viewing Received E-mails

Once you log on to your e-mail account, you can view and read all the incoming e-mails and send e-mails to anyone. All the incoming e-mail messages are stored in the **Inbox** folder. The steps for reading the received e-mails are as follows:

1. Click **Inbox**. A list of all the received e-mails is displayed along with the information, such as the sender's name, the subject of the message and the date on which it is received.
2. Move the mouse pointer over the e-mail you want to read. The mouse pointer changes to a hand. Click the link to open it. The message appears on the screen.

Sending E-mails

The steps for sending an e-mail are as follows:

1. Open your e-mail account and click **Compose Mail**. The compose mail web page appears which provides the following text boxes.
 - **To:** To type the e-mail address of the recipient.
 - **Cc (Carbon copy):** To type the e-mail addresses of all the recipients getting a copy of the same mail—it is used to send the same message to several people.
 - **Bcc (Blind carbon copy):** To type the e-mail addresses of those recipient(s) whose addresses will not be visible to any other recipient(s).

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- **Subject:** To type the subject of the message.
- **Message box:** To type the message to be sent.

2. Fill in the text boxes present on the compose mail Web page.
3. Click the **Send** button to send the e-mail. The e-mail is immediately sent to the specified address(es) and a Web page is displayed informing that your message has been sent.

Sending attachments

As stated earlier, an e-mail can contain any kind of information. In other words, apart from the text messages, one can send file(s) containing a document, a presentation, a picture or a video clip. This file(s) can be sent through e-mail by attaching it to your text message. The file you attach to the message is known as an attachment. The steps for sending attachments are as follows:

1. Open your e-mail account and click **Compose Mail**. The compose mail Web page appears.
2. Type the recipient's e-mail address, subject of the message, and the message to be sent, in the specified fields.
3. Click **Attach a file**. The **Choose File** dialog box appears.
4. Locate and select the desired file to be sent and click the **Open** button. The name of the attached file is displayed below the **Subject** text box on the Compose Mail Web page.
5. Click the **Send** button to send the e-mail with the attachment.

Using Signature

You can create your personal signature that can be attached to each of your outgoing e-mail messages. A **signature** is a personalized text of one or more lines containing information like the sender's full name and address, a quote or favourite saying, or any other information. The steps for creating a signature are as follows:

1. Open your e-mail account and click the **Customize** button present on the right side. The Settings Web page appears with the **Web Clips** tab activated.
2. Activate the **General** tab to provide various options to customize, such as language, page size, picture, signature, etc.
3. In the **Signature** option, select the radio button beside the message box and type the desired text to be used as your signature.
4. Click the **Save Changes** button to save your signature. Now, the signature will be automatically attached to your every outgoing e-mail.

Groupware

Groupware is a software that helps to provide organization-wide communication and enables a group of people to work towards the common goal. The individuals or group of people at remote places in the organization can hold electronic meetings,

send or receive documents, share information, keep track of the project status, etc. Any message or idea sent by one member can be reviewed by every other member of the group, and they can also comment on and even make changes to that idea. A good groupware should cover all aspects of group activities and the management of the overall project. Some examples of groupware include Groove, Lotus Notes, and Open Text's Live Link. On the basis of the level of collaboration the groupware provides, it can be divided into three categories, which are as follows:

- **Electronic Communication Tools:** These tools help in information sharing by sending data, messages, or documents. Examples of such tools include voice mail, e-mail, fax, etc.
- **Electronic Conferencing Tools:** These tools also facilitate information sharing but in an interactive manner. Examples of such tools include online chatting, telephony, application sharing, video conferencing, data conferencing, etc.
- **Collaborative Management Tools:** These tools enable and manage collaborative work. Examples of such tools include Project Management Systems (PMS), online spreadsheet, workflow systems, electronic calendars, etc.

An extension of groupware is **collaborative media**—a software which enables a number of simultaneous users to add new and change existing information in a website. Wikiweb, Wikipedia and Wikimapia are some of the famous Websites that allow users to edit and add information. The main hurdle in the implementation of groupware is convincing people to use it. This is because groupware tends to shift the work culture of a company from competitive to cooperative.

Voice Mail and Fax

Voice mail and fax are among some of the services provided by telephone service providers. Voice mail allows communicating information in the form of audio, whereas fax allows communicating information in the form of graphics. In both these services, the sender and the receiver need not be present at the same time. The information is sent to a machine which can be viewed by the receiver at his own convenient time.

Voice Mail

Voice mail is a service in which the spoken message is converted into digital form, transmitted over a network, and stored on the disk (a voice mailbox) for later retrieval. The recipient is given a message that a new voice mail has been delivered in the mailbox. Whenever the user visits the mailbox, the voice message is restored and played back in audio form. This store and forward technology is very useful because it overcomes the restriction for real-time communication between the machines. Moreover, it facilitates the receiver in saving, deleting and forwarding messages to others. Voice mail can be helpful in automated call return, message

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forwarding, message broadcasting, etc. It is now being used for advertising also. It is more commonly used by school authorities for informing the guardians about the progress, attendance, etc., of the students.

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Fax

Fax (facsimile) system is used for transferring a copy image of any document. Fax transmission involves fax machines with inbuilt modems at both the ends connected with telephone network. The fax machine at the sender's side scans the image from top to bottom and from left to right, looking for black and white dots. These dots are then translated into data bits which are transmitted over the network through modem and reproduced in a hard copy by the fax machine at the receiver's side.

Earlier, the use of fax machines was not common as they were expensive and proprietary in nature. Thus, the Telecommunication Standardization Sector of the International Telecommunications Union (ITU) and the Electronic Industry Alliance (EIA) specified some standards. These standard specifications promoted the manufacturers to build machines in larger volumes, thereby reducing the cost as well as increasing the use of fax machines. According to these standards, various generations of fax machines are defined, including Group I, Group II, Group III, and Group IV. Note that the Group I and Group II machines were used earlier.

- **Group I:** These machines used frequency modulation for transferring data. The transmission was very slow; they took approximately four to six minutes to transmit one page.
- **Group II:** These machines used amplitude modulation for transferring data. The transmission speed was somewhat faster than the Group I machines; they took about two to three minutes to transmit one page.
- **Group III:** These machines transmit data at the rate of 2 Kbps to 14 Kbps.
- **Group IV:** These machines are highly specialized fax computer systems that use digital circuits to transfer data at the rate of 64 Kbps (around 3 seconds per page).

Teleconferencing

Teleconferencing is a technology that allows communication among several people at distant locations but connected via the telecommunications system, usually over a telephone line. It is similar to a telephone call but the conversation is extended to several people instead of only two. Thus, it can reduce the travelling cost, increase idea sharing with each other, and result in improved quality and increased productivity.

A business organization uses teleconferencing to connect to its remote clients and employees. Teleconferencing enables organizations to arrange meetings, demonstrate their product, present project updates, and even provide live training classes to various employees at remote locations. In addition, it can also be used to report monthly progress.

The simplest form of teleconferencing is to use the three-way calling service provided by the telephone companies. This service enables you to establish your own teleconference between yourself and the other two persons. Some of the teleconferencing service providers provide this service for more than three persons. Since it is low cost, most companies use teleconferencing service provided by the telephone companies rather than setting up their own teleconferencing systems.

The traditional mode of teleconferencing enables only voice sharing among the participants, but modern teleconferencing technologies, namely *data conferencing* and *video conferencing*, help in sharing information from both the ends simultaneously. While data conferencing allows sharing electronic documents with each other, video conferencing enables the participants to see each other, in addition to information sharing.

Data Conferencing

Data conferencing is a type of teleconferencing that allows sharing of computer data, such as graphics, drawings, documents, screen, applications, etc., interactively among multiple users at remote locations. All the participants can view the data, comment on it or manipulate it. In data conferencing, devices like keyboard, screen, mouse, etc., can be shared among the participants or one participant's computer can control other participants' computers.

Data conferencing is performed with the help of whiteboards, application sharing, and application viewing.

- **Whiteboard:** It is an online workspace visible to everyone participating in data conferencing. All the participants can simultaneously write and draw on the whiteboard and the changes made are viewed by everyone. Whiteboard employs different tools to support drawing and writing.
- **Application Sharing:** It is like remote control software that allows the participants at the remote machines to interactively work on an application installed on only one participant's machine.
- **Application Viewing:** It is similar to application sharing except that only one participant is allowed to make changes in the shared document while others can only view the document and provide suggestions.

Interactive Video/Video Conferencing

Video conferencing enables conversation among people geographically apart from one another with a facility to see each other while they converse. The newsreader on the TV, for example, talking to a reporter(s) at a faraway place(s) and reporting directly to the audience, uses the video conferencing facility. Video conferencing is an extremely useful means of communication because it saves the time and expense of travel and can often accomplish many of the things that a physical meeting can. The five basic components that are required to conduct a video conferencing are as follows:

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- **Camera:** To capture the images to be sent across the network.
- **Monitor or Television:** To display the images of the people participating in the video conference.
- **Microphone:** To record the sound at the sender's end.
- **Speakers:** To play the recorded sound at the receiver's end.
- **Coder/Decoder (Codec):** To compress and decompress video and audio data, allowing transmission across the network.

In addition to these components, the video conferencing software should also be installed on the system. Cu-SeeMee and Microsoft NetMeeting are some of the popular software used for video conferencing. Here, we will discuss video conferencing using Microsoft NetMeeting.

The steps for installing Microsoft NetMeeting are as follows:

1. Click **Start** and then click **Run** from the submenu that appears. The Run dialog box appears.
2. Type **conf.exe** in the **Open** text box and press the **Enter** key. The Microsoft NetMeeting wizard appears.
3. Follow the steps of the Microsoft NetMeeting wizard as instructed to install it.

After installing NetMeeting, you can conduct a video conference with the other person who also has all the basic components attached with his or her system. The steps for conducting video conferencing using Microsoft NetMeeting are as follows:

1. Start the NetMeeting software. The NetMeeting window appears.
2. Click the **Call** menu and then click **New Call**. The Place A Call dialog box appears.
3. Enter the name of the computer with which you want to have a video conference in the **To** list box and click the **Call** button. The NetMeeting message box appears on your screen and the NetMeeting-Incoming Call message box appears on the screen of the person on the other side.

After getting connected, you can begin the video conferencing over a local network or the Internet by using the digital camera, microphone and speakers.

Check Your Progress

9. Name the digital information services being offered by the Internet.
10. What does a modem do?
11. What do you mean by groupware?

7.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Information Technology (IT) has become an integral part of companies. Nowadays, 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.
2. An information system is defined as a collection of components that work together to achieve a goal. The goal of an information system is to make information available to its users. An information system has to first collect information. However, information is usually not available; only data or raw facts are available.
3. While designing an information system, designers of an information system need to understand the business environment and all the constituents of the information system in order to build a successful system. Complete hardware, software, database and networks are essential components – though not adequate- to build an information system. They also consult users and relevant documents to decide the data that should be collected and stored in the system.
4. 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.
5. Online information service is significant for business that provides its subscribers with a wide variety of data transmitted over telecommunications lines. Online services provide an infrastructure in which subscribers can communicate with one another, either by exchanging e-mail messages or by participating in online conferences (forums).
6. The five major components of online search service are:
 - Database Producer or Information Provider
 - Online Service Providers
 - Telecommunication Links
 - Workstation
 - Linking Tools
7. Ward Christensen coined the term Bulletin Board System (BBS) as a reference to the traditional cork-and-pin bulletin board which are often found in entrances of schools, libraries, supermarkets etc. where people can post messages, advertisements or community news.
8. The three categories of discussion forums are: Local Forums, Locally Networked Forums and Networked Forums.

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9. The digital information services being offered by the Internet include table of content services, current awareness services, virtual reference services and electronic document delivery via information centres and libraries.
10. A modem is an important part of network hardware that allows a computer to send and receive data through a telephone line or cable connection. To be more precise, it is the device that connects a computer to the Internet.
11. Groupware is a software that helps to provide organization-wide communication and enables a group of people to work towards the common goal. The individuals or group of people at remote places in the organization can hold electronic meetings, send or receive documents, share information, keep track of the project status, etc. Some examples of groupware include Groove, Lotus Notes, and Open Text's Live Link.

7.7 SUMMARY

- 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 political and geographical boundaries.
- 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.
- IT has transformed organizations in multiple ways. Organizations now have fewer hierarchical levels than before. 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.
- 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.
- 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.
- An information system is defined as a collection of components that work together to achieve a goal. The goal of an information system is to make

information available to its users. An information system has to first collect information. An information system may have to be modified if it does not meet users' expectations.

- An information system allows the user to access new data as it becomes available. Such a system may also provide the facility to the user to analyse the data and present the result in an appropriate form, such as tables and graphs.
- Online information service is significant for business that provides its subscribers with a wide variety of data transmitted over telecommunications lines.
- A Bulletin Board System or BBS is an online service which is based on microcomputers, running appropriate software. Ward Christensen coined the term Bulletin Board System as a reference to the traditional cork-and-pin bulletin board.
- A Web browser is a software that is used to find and retrieve Web pages, view them on the monitor screen, and send the information over the Internet.
- A modem (MOdulator-DEModulator) is a peripheral device attached to computers (via a telephone line), which enables communication by converting digital signals into analog signals and vice versa.
- Some of the common ISPs include Mahanagar Telephone Nigam Limited (MTNL), Videsh Sanchar Nigam Limited (VSNL), Mantra Online, and Satyam Online.
- An e-mail address is divided into two parts, namely the username and the mail server name. The two parts are separated by the symbol @.
- Groupware is a software that helps to provide organization-wide communication and enables a group of people to work towards the common goal. The individuals or group of people at remote places in the organization can hold electronic meetings, send or receive documents, share information, keep track of the project status, etc.
- Voice mail and fax are among some of the services provided by telephone service providers.
- Teleconferencing is a technology that allows communication among several people at distant locations but connected via the telecommunications system, usually over a telephone line.
- Data conferencing is a type of teleconferencing that allows sharing of computer data, such as graphics, drawings, documents, screen, applications, etc., interactively among multiple users at remote locations.
- Video conferencing enables conversation among people geographically apart from one another with a facility to see each other while they converse.

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7.8 KEY WORDS

- **Digital Firms:** It refers to the organizations that has enabled core business relationships through digital networks.
- **Lead Time:** It refers to the time between the initiation and completion of a production process.
- **Freight Management:** It refers to the process of overseeing the process of the transportation of freight.
- **Telnet:** It refers to a network protocol that allows a user on one computer to log into another computer that is part of the same network.
- **Groupware:** It refers to a software designed to facilitate collective working by a number of different users.

7.9 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What is the purpose behind the designing of an information system?
2. Briefly explain how an organization can reduce its production cost by using IT.
3. Outline the difference between an online service and Bulletin Board Service (BBS).
4. List the nine basic elements of online search.
5. What is a Bulletin Board System (BBS)?
6. What are discussion forums?
7. What are the types of modem?
8. What are the advantages and disadvantages of an E-mail?
9. Briefly mention about collaborative media?
10. What is video conferencing and where it is used?

Long-Answer Questions

1. Discuss the changes that have altered the business environment worldwide.
2. Describe the use of information system in management.
3. Describe the variety of services being offered by BBS.
4. What are the computer configuration requirements for connecting to the Internet?

5. What are the different types of Internet connections provided by ISPs?
6. Explain data conferencing and how it is performed.

*Computers and
Communication*

7.10 FURTHER READINGS

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UNIT 8 COMMUNICATION CHANNELS

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Structure

- 8.0 Introduction
- 8.1 Objectives
- 8.2 Communication Channels: Advantages and Disadvantages
- 8.3 Communication Networks
 - 8.3.1 Local Area Network (LAN)
 - 8.3.2 Wide Area Network (WAN)
 - 8.3.3 Video Conferencing
 - 8.3.4 Relevance to MIS and Usage in Business Process
- 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

Within an organization, information flows upward, downward and laterally. This information flow is called as communication and communication channels are the way information flows within the organization and with other companies. An effectual communication channel should be in place for the smooth flow of information between a manager and the employees.

There are three types of communication channels: formal, informal and unofficial. Formal communication channels send information including goals, policies and procedures of an organization. For example, business plan, customer satisfaction survey, annual reports etc. Informal communication channels includes quality circles, different training programs etc. Unofficial communication channels refers to interpersonal communication like social gatherings between co-workers. The unit deals with a thorough introduction to the communication channels, communication networks, data transmission, components and functions of telecommunications system. The unit also discusses communication networks' relevance to MIS and usage in business process.

8.1 OBJECTIVES

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

- Discuss variety of communication channels
- Discuss the advantages and disadvantages of communication channels

- Examine the components and functions of telecommunications system
- Explain the type of data transmission
- Classify and characterize the variety of transmission media
- Describe communication networks, broadband network services, network convergence

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8.2 COMMUNICATION CHANNELS: ADVANTAGES AND DISADVANTAGES

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.

Emergence of Communication Acts

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

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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 virtually to 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 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

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 telecommunication 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 (Automated Teller Machine), 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 data flow, 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.

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*.

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 (see Figure 8.1) that changes smoothly over time. An important application of the analog signals

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is the transfer of data across telephone lines. Analog signals are mostly used for carrying data, such as voice or sound.

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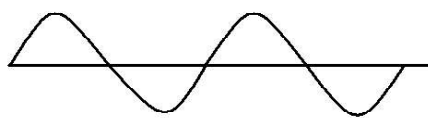


Fig. 8.1 Analog Signal

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 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 (see Figure 8.2).

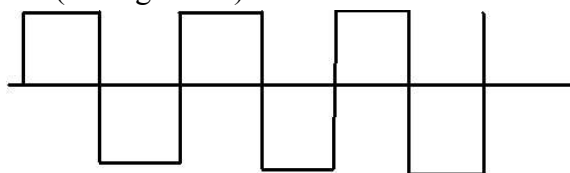


Fig. 8.2 Digital Signal

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*.

(i) 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 (see Figure 8.3).



Fig. 8.3 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 (see Figure 8.4). 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.

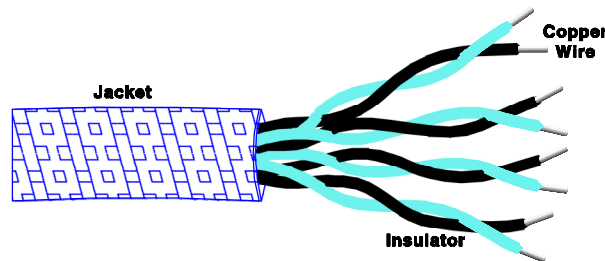


Fig. 8.4 Unshielded Twisted Pair Cable

- **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 (see Figure 8.5).

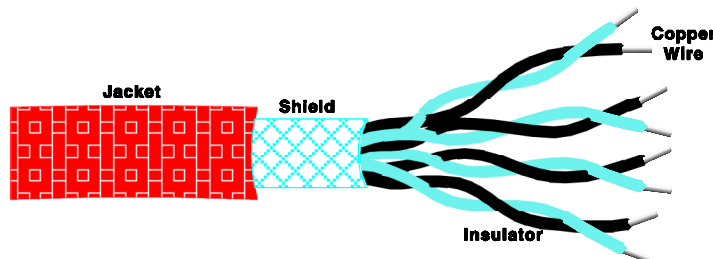


Fig. 8.5 Shielded Twisted Pair Cable

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NOTES**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.

(ii) Coaxial Cable

A coaxial cable, commonly known as **coax**, comprises two conductors that are parallel to each other or are on the same axis (see Figure 8.6). 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. 8.6 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.

(iii) 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** (see Figure 8.7).

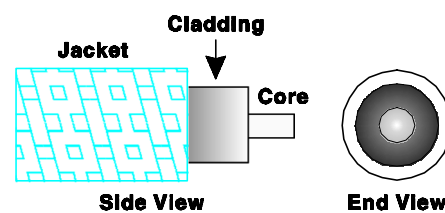


Fig. 8.7 Optical Fibre

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 (LED) or Laser Diode (LD).
- **Detector:** A photo diode that generates electric pulses when light falls on it (see Figure 8.8).

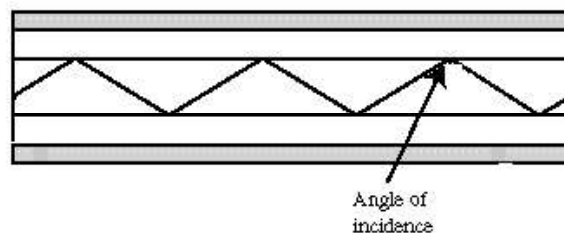


Fig. 8.8 Signals carried over an Optical Fibre

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.

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- It provides better noise immunity.
- The bandwidth is up to 10 Gbps.
- It is lighter than other guided media.

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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.

(i) 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 MHz 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.

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(ii) 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 (see Figure 8.9). 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.

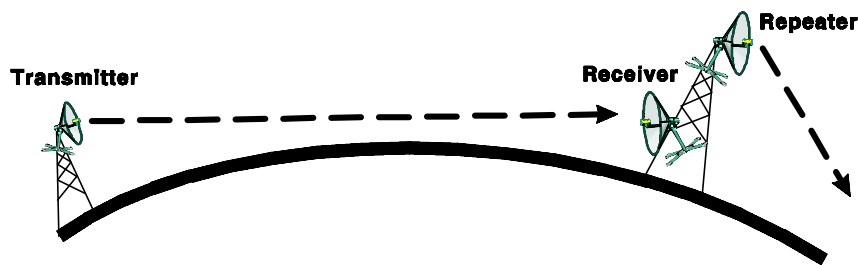


Fig. 8.9 Microwave Transmission

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 (see Figure 8.10).

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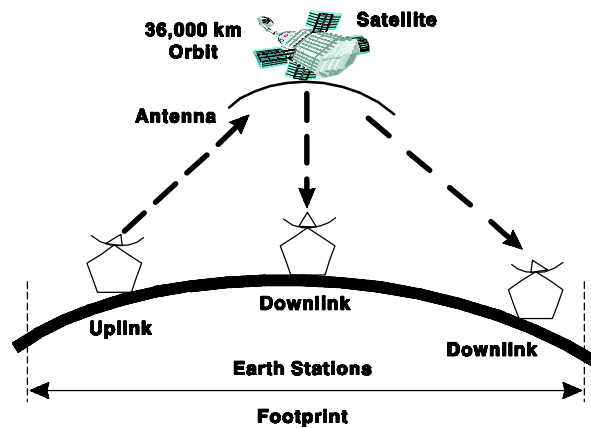


Fig. 8.10 Satellite Transmission

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

Disadvantages of Satellite Transmission

- 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.

Check Your Progress

1. Name the basic components of a telecommunications system.
2. What is a protocol?
3. What are some characteristics of twisted pair cable?
4. What do you use coaxial cable for?
5. What is optical fibre and how does it works?
6. What is unguided media and its types?
7. How fast is microwave transmission?

8.3 COMMUNICATION NETWORKS

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 LAN and WAN.

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.

(a) 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 (see Figure 8.11).

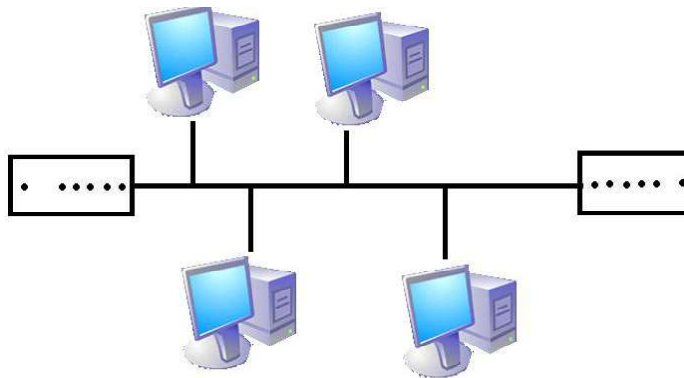


Fig. 8.11 Bus Topology

Advantages

- It is easy to connect and install.
- It involves a low cost of installation.
- It can be easily extended.

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Disadvantages

- 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.

NOTES**(b) 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 (see Figure 8.12).

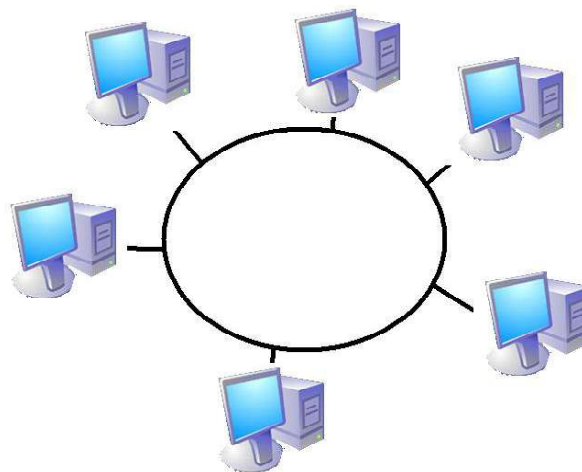


Fig. 8.12 Ring Topology

Advantages

- It is easy to install.
- It uses lesser cable length for installation.
- Every computer is given equal access to the ring.

Disadvantages

- 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.

(c) 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 (see Figure 8.13).

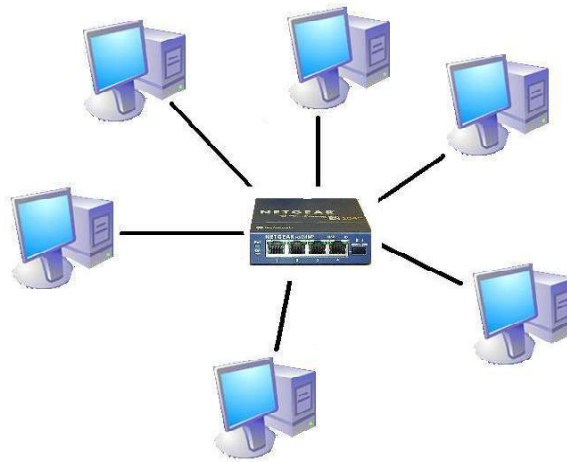


Fig. 8.13 Star Topology

Advantages

- 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.

Disadvantages

- 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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NOTES**(d) 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 (see Figure 8.14).

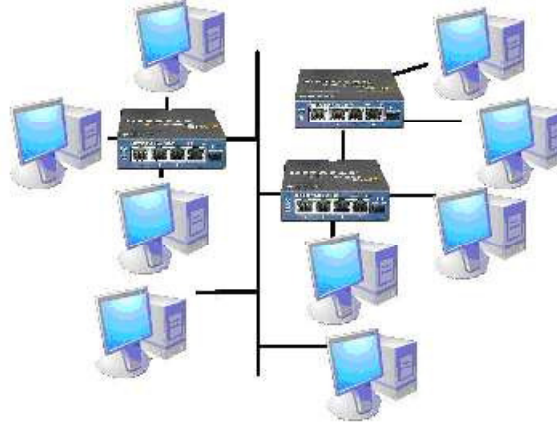


Fig. 8.14 Tree Topology

Advantages

- It eliminates network congestion.
- The network can be easily extended.
- The faulty nodes can easily be isolated from the rest of the network.

Disadvantages

- 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.

(e) Mesh Topology

In the mesh topology, each workstation is linked to every workstation in the network (see Figure 8.15). 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 the large Internet working environment because it provides extensive backup and routing capabilities. This topology is ideal for distributed computers.

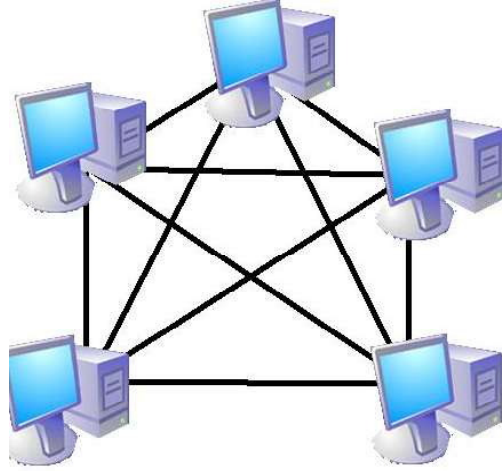


Fig. 8.15 Mesh Topology

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Advantages

- The availability of large number of routes eliminates congestion.
- It is fault tolerant, that is, failure of any route or node does not result in network failure.

Disadvantages

- It is expensive as more cabling is required.
- It is difficult to install.

(f) 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.

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 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.

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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.

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 (LAN)* and *Wide Area Network (WAN)* on the basis of the size of the network.

8.3.1 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 (see Figure 8.16). 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 Mbps to 100 Mbps. LANs are distinguished from other networks by three main characteristics, including their size, topology and transmission technology.

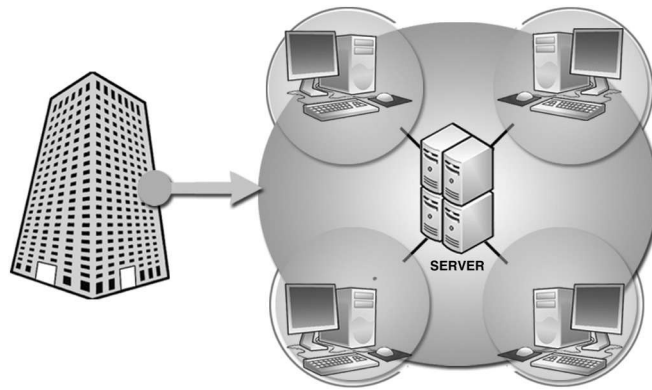


Fig. 8.16 Local Area Network

8.3.2 Wide Area Network (WAN)

A **Wide Area Network (WAN)** spreads over a large geographical area like a country or a continent (see Figure 8.17). 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. 8.17 Wide Area Network

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 fulfil this demand. Some of these are as follows:

- **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

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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.

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.

8.3.3 Video Conferencing

As discussed in the previous unit, video conferencing refers to conducting a video conference two or more sets of hardware and software interact simultaneously while transmitting and receiving audio and video data from two or more geographic locations.

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8.3.4 Relevance to MIS and Usage in Business Process

The Internet is a network of computer networks. It is a public network where a series of servers are interconnected to enable users across the world to access information and communicate with each other. The Internet runs on Transmission Control Protocol/Internet Protocol wherein each server resource is given a unique number called IP Address. Each IP Address has got 12 digits. Most popular service that is accessed on the Internet is called the World Wide Web (WWW), which is a service that allows access to a set of resources located in a collection of Web servers. Over the TCP/IP runs the HyperText Transfer Protocol (HTTP), which enables users to access the Internet resources by giving an alphanumeric address called Universal Resource Locator or URL instead of the cumbersome 12-digit numeric IP address. Each URL has five components; the first part consists of the protocol, the second part is the domain name, the third part is the port number through which that resource is the part of the file that will be accessed. For example, in the URL, <http://www.hotmail.com:80/index.html#A>, the first part denotes the protocol through which the resource has to be accessed (in this case the HTTP protocol); the second part denotes the domain name (in this case www.hotmail.com); the third part, i.e., 80, denotes the default port number through which the resource is to be accessed; the fourth part, i.e. index.html, is the name of the file to be accessed and the last part, i.e., #A, indicates that part of index.html that is to be accessed. Normally, we do not need to denote the port number as the default port numbers are used.

Most documents on the Internet are in a particular format called the HyperText Markup Language (HTML). These documents are created in a format where each document has a 'head' part and a 'body' part. These documents can be viewed in the software called browser. The browser software displays only the body of the html document. Recently, a new markup language called XML is in vogue.

The Internet is now used to create management information systems, particularly for those companies, which have very great geographical spread. In these systems, the user accesses the systems by logging on to the Internet and accessing the relevant Website resource through the browser. The browser acts as a client for the user and through this browser the user is able to access the system on the Internet. These systems have several tiers on which the business logic of the application resides (mostly the business logic lies on the middle tier at

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the Web server). The data is stored on a different server. The benefit of using this type of management information system is that the users present in any geographical location can access the system. Also making changes in the system is easier. If one needs to change business logic, one changes it in one place, i.e., the middle tier and it reflects across the entire system.

Check Your Progress

8. What are the different network topologies?
9. What is ISDN?
10. Define Video Conferencing?

8.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The basic components of a telecommunications system are: terminals, computers, telecommunications processors, telecommunications channels, and telecommunications control software.
2. Protocol refers to some common set of rules which should be followed to make the basic components of telecommunications network work together. It is also required to communicate with each other. Each component of the network must be able to interpret the protocol of other components in the network.
3. Twisted pair cable is the oldest and the most common cable used for data communication. The twisted pair cables are twisted in order to avoid the interference that results in cross connections and data loss. It is reliable, flexible and cost effective. The twisted pair cables are usually used for telephone networks. They are used in a network for short and medium length connection.
4. Coaxial cable, commonly known as coax, used in the transmission of television signals, long distance telephone lines, closed circuit TV, etc. It 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 which is used to shield the cable from Electromagnetic Interference (EMI), and prevents noise and crosstalk.
5. 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. The data is transmitted through an optical fibre using the optical transmission system. The light rays incident at a certain angle are

trapped inside the fibre and propagated for many kilometres with virtually no loss of signal.

6. The unguided media or wireless transmission 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.
7. Microwave signals travel at a higher frequency than radio waves and are popularly used for transmitting data over long distances.
8. Network topology is basically the arrangement of the elements of a communication network. 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.
9. ISDN 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.
10. Video Conferencing refers to conducting a video conference wherein two video or more sets of hardware and software interact simultaneously while transmitting and receiving audio and video data.

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8.5 SUMMARY

- 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.
- 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.
- 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. Hence, the AT&T Company broke up into seven independent Regional Bell Operating Companies (RBOCs).
- Information superhighway is the term used to refer to all these high-speed digital networks, since they provide vast volumes of data and information virtually to everyone in the world.

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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.
- A telecommunications system consists of hardware and software components that help in transmitting text, voice, or video.
- The basic components of a telecommunications system include terminals, computers, telecommunications processors, telecommunication channels, telecommunications control software.
- 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.
- 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. To deliver the message efficiently at the source, the router performs a major role. It directs the data towards the path through which the message can reach its destination most efficiently.
- Data transmission can be analog transmission or digital transmission. The data transmission that uses analog signals to transmit data is called analog transmission. The data transmission that uses digital signals for transmitting the data is called digital transmission.
- Communications channel (transmission media) refers to the physical media through which communication signals (data and information) are transmitted. Transmission media can be broadly classified as guided and unguided media.
- The guided transmission media use a cabling system that guides the data signals along a specific path. There are three basic types of guided media, namely twisted pair cable, coaxial cable and optical fibre.
- 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. Twisted pair cables are of two types, namely unshielded and shielded twisted pair cable.
- A coaxial cable, commonly known as coax, comprises two conductors that are parallel to each other or are on the same axis. The coaxial cables are used in the transmission of television signals, long distance telephone lines, closed circuit TV, etc.
- 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.
- 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.

- The transmission in which radio waves are used is termed as radio wave transmission or propagation. The radio waves penetrate into objects easily, due to which they are used for long distance communication. There are three types of radio wave transmission, namely ground wave propagation, ionospheric propagation and line of sight propagation.
- 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.
- 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.
- Communication networks refer to an arrangement of telecommunications components that facilitate transmission of information.
- 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.
- 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.
- 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.
- 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 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.
- 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 mesh topology is commonly used in the large Internet working environment because it provides extensive backup and routing capabilities. This topology is ideal for distributed computers.
- In a graph topology, the nodes are connected randomly in an arbitrary fashion.

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- PBX is a private telephone exchange designed to serve a particular organization or office.
- A Local Area Network (LAN) is the network restricted to a small area, such as an office or a factory or a building.
- A Wide Area Network (WAN) spreads over a large geographical area like a country or a continent.
- The telecommunications revolution increased the demand for high-speed transmission as well as access to the Internet.
- 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.
- The Internet is a network of computer networks. It is a public network where a series of servers are interconnected to enable users across the world to access information and communicate with each other. The Internet runs on Transmission Control Protocol/Internet Protocol wherein each server resource is given a unique number called IP Address.

8.6 KEY WORDS

- **Buffer:** It refers to something that prevents something else from being harmed or that prevents two things from harming each other.
- **Electromagnetic signals:** It refers to the waves that are propagated by simultaneous periodic variations of electric and magnetic field intensity and that include radio waves, infrared, visible light, ultraviolet, X-rays, and gamma rays.
- **Omnidirectional:** It refers to receiving signals from or transmitting in all directions.
- **Parabolic antennas:** It refers to antennas that use a parabolic reflector, a curved surface with the cross-sectional shape of a parabola, to direct the radio waves.
- **Geostationary Orbit:** It refers to an orbit in which a satellite always remains over the same place on the earth's surface because it moves at the same speed as the earth turns.

8.7 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short note on the functions of telecommunications system.
2. Briefly explain analog transmission and digital transmission.

3. How unshielded twisted pair cable is different from shielded twisted pair cable?
4. List the advantages and disadvantages of coaxial cables.
5. What are the advantages of optical fibre over copper wire?
6. What are the three types of radio wave transmission?
7. What are the advantages and disadvantages of microwave transmission?
8. What is the difference between LAN and WAN?

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Long-Answer Questions

1. Explain the significance of communication channels in an organization.
2. Discuss the need of optical fibre communication.
3. How are radio waves transmitted and received? Explain.
4. Elaborate how does a satellite transmission work?
5. How does a PBX work?
6. What do you understand by network convergence?

8.8 FURTHER READINGS

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BLOCK III

MIS FUNCTIONS AND FEATURES

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UNIT 9 FUNCTIONAL INFORMATION SYSTEMS

Structure

- 9.0 Introduction
- 9.1 Objectives
- 9.2 MIS for Research/Production
- 9.3 MIS for Marketing
- 9.4 MIS for Personnel
- 9.5 MIS for Finance
- 9.6 MIS for Inventory
- 9.7 MIS for Logistics
- 9.8 MIS for Product Development
- 9.9 MIS for Market Development
- 9.10 Answers to Check Your Progress Questions
- 9.11 Summary
- 9.12 Key Words
- 9.13 Self Assessment Questions and Exercises
- 9.14 Further Readings

9.0 INTRODUCTION

In this unit, you will learn about functional information systems which are considered as the key information system applications in organizations. Management Information System (MIS) is defined as an organized assembly of resources and procedures that are required to collect, process and distribute data. This processed data is used for decision-making. A wide variety of information systems are used in an organization. These information systems serve different organizational levels as well as the major business operations (sales, marketing, manufacturing, finance, accounting, etc.) of an organization. Each major business operation is supported by various business processes that refer to a collection of interrelated activities to achieve a specific business result. The coordination and integration of the business processes from various business functions help to improve resource management and customer service and thus, make the organizations more flexible and efficient. The systems that focus on supporting the integrated groups of business processes so that the organizations can operate more efficiently are referred to as enterprise applications.

The unit introduces the functional information system, which further consists of other systems, such as financial information system, research and production information system, personnel information system, logistics information system, market development information system, etc. In addition, you will be taught the classification of systems from a functional perspective and the integration of functions and business processes.

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9.1 OBJECTIVES

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

- Understand the role of MIS for Research/Production
- Discuss the significance of MIS for Marketing
- Explain what MIS is for Personnel
- Discuss MIS for Finance
- Examine MIS for Inventory
- Understand the significance of MIS for Logistics
- Define MIS for Product Development
- Explain MIS for Market Development

9.2 MIS FOR RESEARCH/PRODUCTION

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 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 is also provided so that the operation managers can use this information for better decision-making.

Maintenance Management Subsystem 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.

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Quality Management Subsystem 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 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 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.

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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 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.

9.3 MIS FOR MARKETING

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Marketing is concerned with interacting with customers, educating them about the product or service and related benefits, ensuring the fulfillment of their needs and expanding the customer base.

The marketing department uses the marketing information system (MIS) to help them take decisions in the marketing domain. The information in this type of a system is mostly transaction level information.

Marketing information system helps to effectively manage the marketing department in an organization. The primary role of the marketing information system is to provide relevant information to the marketing department managers, 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 appropriate measures may be taken. 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 present ground realities as well as the future scenario. The subsystems that make up a marketing MIS are as follows:

Marketing Intelligence Subsystem is the subsystem responsible for gathering the necessary information from transaction level data, to help in the marketing process. A marketing intelligence subsystem is an input subsystem of the marketing MIS. It filters data and helps store critical information. Sometimes the input coming into this subsystem is from the competitor. The competitor's transaction data and market-related intelligence data are collected and filtered in this subsystem. This subsystem works as a key information provider for other subsystems in the marketing MIS.

- **Market Research Subsystem** is involved with the input of the marketing MIS. The role of this subsystem is to gather data related to consumers, markets, competitors by conducting surveys. The clandestine nature of marketing intelligence is not exhibited in this subsystem. It collects and analyses key data about the marketing process of the organization as well as the market scenario.
- **Sales Subsystem** provides information, which helps the management in selling the products or services of a firm. It is one of the most important activities of the marketing MIS. Normally, sales function deals with the management of the channels of sales, i.e., managing wholesalers, retailers, stockists, etc., to ensure that the product or service reaches the consumer. The marketing MIS, therefore, provides information about all such entities. The sales department lies at the interface between the customer and the organization and hence it generates a lot of data. This data is used as input for the MIS. We can conceptualize the sales department as lying at the

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boundary between the organization system and the environment of the customers. The sales subsystem in addition provides a forecast of the sales department indicating future sales both in terms of volume and revenue. It also provides information regarding the product lifecycle indicating the stage of the product or service which helps the department to organize and develop product strategies.

- **Promotion, Advertising and Publicity 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 on the return of 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 Subsystem** provides information about the product and the reception accorded to the product in the market. Exception reports are generated if the product is not in keeping with the expectations.
- **Customer Relationship Management Subsystem** fosters customer loyalty towards a brand or a product or a company. It encompasses activities, which result in a greater understanding and knowledge of the customer. The activity of CRM (Custom Relationship Management) subsystem is based on the understanding of the customer as a person who has a long term relationship with the organization rather than at the time of sale only. The CRM subsystem provides key information about the customers' likes and dislikes. The CRM subsystem also helps the department to organize customer-specific strategies.
- **Pricing Subsystem** uses advanced analytics to help marketing department take pricing decisions.
- **Packaging Subsystem** provides 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 (Stock Keeping Unit), etc., are taken using such information.

A Marketing Information System (MIS) is a set of procedures and methods designed to generate, analyze, disseminate and store anticipated marketing decision information on a regular, continuous basis. An information system can be used operationally, managerially and strategically for several aspects of marketing. A marketing information system can be used operationally, managerially and strategically for several aspects of marketing.

Any marketing activity can not be carried out in isolation, i.e., there are various forces external or internal, controllable or uncontrollable may be working on it. Thus to know which forces are acting on it and its impact the marketer needs to gather data through its own resources which in terms of marketing we can say he is trying to gather the market information or form a marketing information system.

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This collection of information is a continuous process that gathers data from a variety of sources synthesizes it and sends it to those responsible for meeting the market places needs. The effectiveness of marketing decision is proved if it has a strong information system offering the firm a competitive advantage. Marketing information should not be approached in an infrequent manner. If research is done this way, a firm could face the following risks:

1. Opportunities may be missed.
2. There may be a lack of awareness of environmental changes and competitors' actions.
3. Data collection may be difficult to analyse over several time periods.
4. Marketing plans and decisions may not be properly reviewed.
5. Data collection may be disjointed.
6. Previous studies may not be stored in an easy-to-use format.
7. Time lags may result if a new study is required.
8. Actions may be reactionary rather than anticipatory.

The total information needs of the marketing department can be specified and satisfied via a marketing intelligence network, which contains following three components.

1. Continuous monitoring is the procedure by which the changing environment is regularly viewed.
2. Marketing research is used to obtain information on particular marketing issues.
3. Data warehousing involves the retention of all types of relevant company records, as well as the information collected through continuous monitoring and marketing research that is kept by the organization.

Depending on a firm's resources and the complexity of its needs, a marketing intelligence network can be computerized. The ingredients for a good MIS are consistency, completeness and orderliness. Marketing plans should be implemented on the basis of information obtained from the intelligence network. An marketing information system has the following advantages:

1. Organized data collection.
2. A broad perspective.
3. The storage of important data.
4. An avoidance of crisis.
5. Coordinated marketing plans.
6. Speed in obtaining sufficient information to make decisions.
7. Data amassed and kept over several time periods.
8. The ability to do a cost-benefit analysis.

The information required by marketing managers can be obtained from the following three main sources:

1. **Internal Company Information:** This type of information can be obtained from resources, such as sales, orders, customer profiles, stocks, customer service reports, etc.
2. **Marketing Intelligence:** It depends on information gathered from many sources, including suppliers, customers and distributors. Marketing intelligence includes all the everyday information about developments in the market that helps a business prepare and adjust its marketing plans.
3. **Market Research:** Management cannot always wait for information to arrive in bits and pieces from internal sources. Besides, sources of market intelligence cannot always be relied upon to provide relevant or up-to-date information specifically for smaller or niche market segments. In such circumstances, businesses often need to undertake specific studies to support their marketing strategy – this is market research.

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9.4 MIS FOR PERSONNEL

Owing to the changes in the work environment, motivating MIS personnel has become more challenging to both MIS managers and CIOs. Although the employees well perform their work, MIS managers still need to improve elements of their staffs' jobs (e.g., salary and opportunity for advancement) to maintain the quality of their staffs' work. The task of motivating MIS personnel is very important as the most precious asset of any organization is its people. Managing them well leads to growth and prosperity and mismanagement results in losses. In fact, most of management literature is about managing this precious resource. Human resource management consists of the following:

- **Recruitment:** It is the activity of selecting the right people for the right job. A selection process is used to select the right kind of people from a multitude of interested people, for a job in the organization. The recruitment activity is a regular activity in an organization, as the organization being a growing entity requires more and more people to run its business and also because people leave an organization for various reasons. This loss of personnel is collectively called attrition. Recruitment is the process to neutralize the attrition effect and ensure that there are enough people to manage the growth activities of the organization. It is an important activity and employs different techniques for attracting the right people, for the job in the organization. The techniques employed are advertisement of jobs with enticing job description, salary details, searching for the right people with the help of online search engines, targeting potential employees through contacts and networks, employing consultants and agencies who have a database of the right kind of people for the job, etc.

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- **Training and Development:** It is the activity, which involves the development of employees in terms of skills, personality, behaviour, etc. This activity is an ongoing activity within an organization, as most organizations believe in continuous improvement and in order to improve constantly, training is essential. Some organizations consider this activity as not very important. However, most good companies' take this activity very seriously as it holds the key to developing the human capital of an organization, which in turn results in improved performance of the organization.
- **Compensation and Benefits Management:** This activity is required to fix the compensation and benefits of employees, so that the employee is satisfied in terms of salary and benefits. This is a very crucial activity, as many things have to be taken into consideration in order to do justice to this kind of work. Issues like seniority, fairness, performance, etc. are very important in conducting this activity properly.
- **Performance Management:** This is primarily a controlling activity. It is required to understand the level of performance of the employees in an organization. The lesser performing employees are normally put through a training process and the high performance employees are rewarded so that they feel good and continue to serve the organization in future with the same performance.

Human Resource Information Systems

Human resource MIS helps managers to administer the HR of the organizations in an improved manner. HR MIS, sometimes called HRIS, is an integrated system and has the following modules:

- **Recruitment Subsystem:** It has already been explained earlier that recruitment is a regular activity in an organization and involves the selection of suitable people for suitable jobs. Recruitment activity tends to increase with the expansion of the organization. It is an ongoing process because people leave an organization for various reasons. Therefore, as mentioned earlier, recruitment of new employees neutralizes the effect of attrition and ensures that sufficient staff is always present to handle the growth activities of the organization.

HRIS is connected to online job portals and through these job portals, HRIS downloads and shortlists suitable candidates for likely positions in the organization. The module also helps in manpower planning and in managing bench. The HRIS gives detailed information about likely candidates and this helps in taking decision on recruiting the right candidate.

- **Training and Development Subsystem:** HRIS helps the ongoing training and development activities in an organization by giving a detailed information about the training needs of employees, trainer details, training modules and content, etc., to help the HR department take improved training and development-related decision.

- **Compensation and Benefits Management Subsystem:** Compensation management involves fixing of compensation and benefits of employees to ensure that the employees are satisfied in terms of the remuneration they receive and the facilities and benefits they are provided. Compensation-related decisions depend on issues such as performance, seniority, fairness, etc.

HRIS provides information on current market rates for the type of skill and competence that an individual possesses to help managers take a decision on compensation. Other related information like pay parity information of similar ranking people in the organization, the historical compensation structure of the organization are also available in the HRIS to help the HR department in deciding compensation packages.

- **Performance Management Subsystem:** As discussed earlier, performance management is a controlling activity wherein the weak performers are recommended for training and the strong performers are appropriately rewarded.

HRIS maintains important measures of performance for each employee, so that the performance of the employee can be rated. The high rated performers can then be rewarded and the poor performers can be relieved. This type of information is very important for taking decisions on the career planning of the employees.

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9.5 MIS FOR FINANCE

Managing finances is the most crucial function of an organization. It involves managing costs, budgets, accounts, receivables, payables and capital expenses. The value of the business can be gauged using various accounting tools.

A 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 financial MIS has the following subsystems:

Working Capital Management subsystem manages the working capital finances of an organization. Working capital as you know, is the capital required for an organization to operate. It is used to pay for salaries and materials. Normally, it is in the form of a short-term debt. The working capital subsystem provides information about the requirement for working capital and the ideal method of financing it.

Receivables and Payables Management is that module of the financial MIS in which the receivables and payables of a company are managed. This module manages debtors and creditors by maintaining key information about them and their commercial terms and reference with the organization.

Budgeting is a strategic function of finance. The financial MIS offers tools that help the finance department prepare a budget. The budgeting module also has

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tools for making projections of the future needs of resources, so that the 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 module of the financial MIS helps the department to take better capital expenditure decisions by providing the relevant information. The module helps decision-makers in the finance department by giving them information about fund utilization, cost of funds, the most suitable fund management options, etc.

Interactive Financial Planning Subsystem 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 financial matters.

Financial Control Subsystem helps the finance department to exercise a control over finances by giving control-related information to the department.

9.6 MIS FOR INVENTORY

Inventory is a very crucial issue for any manufacturing unit, warehouse, clearing and forwarding agents or a distributor. Stacked inventory means blocked money that reduces liquidity and indirectly profits. Cash discounts are available from almost all manufactures because liquidity means more rotation of goods and more profits. On the other hand, lower inventory leads to losses. So, optimum stock levels optimize operational efficiency.

Most large manufacturing units usually need a variety of raw material for production. And manually managing such a large number of raw material and then keeping track of the finished products is not an easy task. IT plays a useful role here; a computerized inventory management system provides the facility of specifying the right amount of inventory in hand and determines the time and the amount of inventory required.

The computerized inventory control system maintains a date-wise list of all items along with the maximum, minimum, reorder and inventory in hand. It keeps on automatically updating the same list as and when material is despatched or received making things much easier and simpler for the production unit. The computerized inventory control system is also capable of preparing many other useful MIS reports, such as aging analysis, goods movement analysis, slow and fast moving stock report, valuation report and it assists the storekeeper and accountants.

ERP software like ORACLE Financials, BAAN, SAP are some examples of sophisticated inventory control packages which can also generate purchase orders automatically whenever the minimum level of stocks is reached, provide automatic posting of accounting entries as soon as any purchase or sale is carried

out and generate analytical reports which (itemize) show the previous and future trends in inventory consumption.

Many organizations nowadays have inventory control systems connected through the Internet or the intranet whereby the request for purchase or the purchase order is instantly delivered to the department or the vendor through e-mail, the moment they receive an order or request for an item which is out of or low in stock. Some inventory control software packages have a feature of automatically generating a purchase or a supply order electronically and mailing it to the preferred supplier, without any human intervention.

Some interesting IT-based innovations used to simplify and improve inventory management are as follows:

- **Barcode Readers: Barcodes** are a series of black and white parallel and adjacent bars with spaces which represent a string of character. Barcode printers are used to encode and print the barcodes and then a barcode reader, which is actually a barcode scanner, is used to decode the barcodes. Barcoding is a quick and easy method for automatically reading barcodes from the products identifying their batch numbers, manufacturing and expiry dates, etc., without having to manually read and type it in the computer to generate bills and track inventory.
- **Hand-Held Terminals (HHTs):** HHTs are microprocessor-based simple devices used to communicate with any type of microprocessor-based device. HHTs' standard input device is basically a calculator-like device with a small LCD display output. It is a compact, easy to use and a rugged device designed for collecting data from large warehouses. A Management Information System or MIS organizes all company data in a computerized inventory database. You can retrieve data from all sections of your company including sales, manufacturing and inventory to see how efficiently each department is operating. This informs you how well the inventory system works with manufacturing and sales.
- **Reports on Inventory Costs:** The management information system can tie the inventory costs to sales. In other words, each unit that sells can have a price assigned to it that is based on what is paid for it. This informs if the purchase prices for inventory are leaving enough room for profit.
- **Reports on Inventory Levels:** You can monitor your inventory levels with a management information system by requesting the database for reports from manufacturing or purchasing, inventory and sales. This will explain how quickly products move through the company. If the products remain in the warehouse for extended periods, you can find ways to move them, either through putting them on sale or advertising them to your customers.
- **Value of Inventory:** A management information system can calculate the sales value of the existing inventory. This counts as an asset for the company and this figure can be useful for various purposes.

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- **Increasing the Inventory Levels:** An inventory in management information system illustrates an increase in sales because it monitors sales on a daily basis. If there is an upward trend, you can stock up on items that sell faster than other items.

For any manufacturing firm, managing inventory is crucial. High inventory results in money being locked up unnecessarily, thereby reducing liquidity and indirectly profitability (if you offer immediate payment, most suppliers would be willing to offer you better rates). On the other hand, lower inventory of finished goods may lead to lost sales or lower inventory of raw material may lead to disruption in production line. Optimum stock levels optimize operational efficiency.

Most large manufacturing units typically need hundreds (if not thousands) of raw material components and produce many products. Managing optimal inventory of such a large number of items is a difficult task. It is here that information technology again plays a very useful role. Inventory management software provides facility for specifying (and determining) the maximum, minimum and reorder levels for each item, so that appropriate levels of inventory can be maintained keeping in mind lead times and Just-In-Time (JIT) systems (if any) for component suppliers.

Basically this is how a typical computerized inventory system works. A list of all the inventory items is prepared along with the maximum, minimum, reorder and current levels (quantity in hand as on a fixed date) for each item. This list is fed into the inventory software. Thereafter, all incomings (materials purchased or produced) and outgoings (sales or issues to production floor) are recorded through the inventory package. Since the computer knows all the ins and outs for each item, it can track the exact quantity in hand for each. The package also generates reports for all the fresh stocks that need to be procured (based upon the levels specified). A variety of other useful MIS reports like aging analysis, goods movement analysis, slow and fast moving stock report, valuation report etc. can also be generated which assists the store keeper and accountants.

Some of the more sophisticated inventory packages (or inventory modules of ERP packages like ORACLE financials, BAAN, SAP, etc.) automatically generate purchase orders (as soon as the minimum level of any item is reached), provide automatic posting of accounting entries (as soon as any purchase or sale is carried out) and generate analytical reports which show the previous and future trends in inventory consumption.

Some interesting innovations in usage of IT for better inventory management are:



Fig. 9.1 Bar Coding System

- **Bar Coding System:** Bar coding is a technique which allows data to be encoded in the form of a series of parallel and adjacent bars and spaces which represent a string of characters (see Figure 9.1). A bar code printer encodes any data into these spaces and bars and then a bar code reader is used to decode the bar codes by scanning a source of light across the bar code and measuring the light's intensity that is reflected back by the white spaces. Bar coding provides an excellent and fast method for identifying items, their batch numbers, expiry dates etc. without having to manually type or read the data.
- **Hand-Held Terminals (HHTs):** HHTs are simple devices used to communicate with any type of microprocessor-based device. The standard input device is the keyboard (typically more akin to the calculator, rather than the computer keyboard) and a small LCD display for the output. HHTs are compact, simple and rugged devices designed for outdoor applications like collecting the information about inventory from large warehouses, recording movement of goods in and out etc.
- **Internet and Intranets:** Many organizations (specially those following 'Just-In-Time or JIT' techniques) now have a system whereby the moment they receive an order or a request for an item (which is not in stock or whose stock is low), the inventory package automatically generates a purchase or supply order electronically and mails it to the preferred supplier—all this without any human intervention.

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9.7 MIS FOR LOGISTICS

Improvements in technology have significantly changed how information can be processed and communicated. The impact of IT is now transforming logistics into a catalyst for renewal. The two major reasons for the use of information technology in logistics are the spatial spread of manufacturing and service activities, and the time element in planning, both of which require data intensive decision-making. To make such decision making possible, there has to be efficient, reliable and timely data capture, data availability at various locations and ease of manipulating it for the purpose of decision-making.

Role of IT

The evolution of Logistics Information Systems (LIS) started with manual processing of information and from there moved on to stand alone computer systems. The next step was information systems at the firm level and inter-firm integrated systems. Simultaneously, the speed of information transfer evolved in such a way that integrated systems could provide computational speeds that matched operational decision-making. These options use a combination of hardware and software, offering specifically designed systems to manage, control and measure logistics activities.

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Hardware includes the processor, input/output devices and storage media which can be configured in a number of ways. A continuous range of possibilities is available, starting from stand-alone personal computers, to micro computers, mini-computers, networks and mainframes. The use of Local Area Networks (LANs), Wide Area Networks (WANs) and client-server architecture offers the benefits of decentralization, responsiveness, flexibility and redundancy while providing data integration throughout the enterprise. What ever the choice of IT architecture might be, the decision should reflect the desired managerial structure and also have the ability to be extended for changes expected to take place in the foreseeable future.

The hardware aspect of communication and networking includes cables, fibres, satellite technology and VSAT (Very Small Aperture Terminal) technology to access satellites. This is a rapidly expanding field, where the infrastructure is becoming available and affordable for many players, through services offered by independent providers and by public sector companies in the field of communications.

Software includes system and application programs used for processing transactions, management control, decision analysis and strategic planning. Logistics information is generated at each stage of the customer order performance cycle. The objective of LIS is to apply itself to the effective flow of related information from the point of origin until the point of their consumption in order to assist the firm in satisfying customer demands in the best way possible.

Based on the managerial scope of the particular application, IT applications can be classified from the point of view of functionality as follows:

- **Data Capture, Display and Organization:** This is the basic function of IT which includes recording inventory, production and resource availability (for example, machine availability status) using a variety of automated techniques. Barcoding as an good example of this. Data display is ideally in graphical form or in formats that are close to what managers find convenient, such as tables. Data organization is achieved through a database management system.
- **Communication:** Data needs to be made available across spatially dispersed decision-making units. Communication of data across distances is now possible through a variety of technologies. Communicating dispatch advices about shipments from warehouses to distributors, tracking dispatches, reporting stock availability at distribution nodes and recording customer orders from multiple distributors are some transactions that require efficient communication networks that support effective data transfer.
- **Processing:** The processing of data for control and strategic decision-making is becoming an increasingly important requirement of LIS. For example, deciding shipment content and use of transport mode (trucks or railway rakes) requires analysis of data, such as demand for different

products, quantity to be shipped and network destinations. IT plays a very important part in providing such information.

Considering the multiple roles required for IT, distributed systems and client-server architecture are preferable options for logistics operations. Communication and networking technologies can be integrated to allow centralized recording of transactions and data, and also a mix of decentralized decisions, such as individual branches placing orders at warehouses, and centralized decisions, such as allocation decisions by plants to multiple warehouses.

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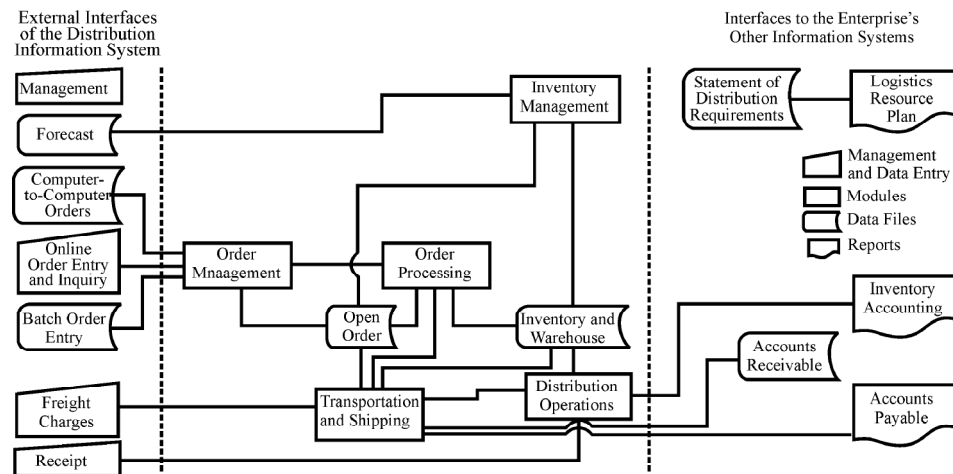


Fig. 9.2 Operational Logistics Information System

Figure 9.2 is a schematic diagram of a operational LIS system. It conceptualizes the major system elements and their structure. It shows (a) modules, that is, the actual routines that process data or information; (b) data files or the information structures that store task specific data such as orders or inventory records; (c) management and data entry activities, which represent the interfaces where the LIS must obtain input from an external environment, such as a decision maker or another firm; (d) reports, which provide information regarding logistics activity and performance links; and (e) communication links or the internal and external interfaces between LIS components and the outside environment.

The **logistics information system** flow has five modules: order entry, order processing, transportation and shipping, distribution operations and inventory management. The files contain the data and information base to support the communication activities. The major database structures are: (1) order file, (2) inventory and warehouse files, (3) accounts receivable file and (4) distribution requirements file.

The reports consist of numerous summary, detail and exception listings to provide hard copy information documenting system activities and performance. The links identify the information flow between the subsystems, files, entry activities and reports.

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The design and implementation of advanced logistics solutions is unthinkable without IT. This added the advantage of a computerized system, by which reports and statistics, which allow for the monitoring of supply chain performance, can be generated. System-wide metrics of supply chain performance can be measured through an integrated information system.

In addition, other impacts of IT on logistics are as follows:

- It has enabled the move from centralized to decentralized management without any loss of information at any level.
- It has improved speed/timely delivery, reliability, cost saving and security.
- It has resulted in the empowerment of individuals and teams, with the work environment progressively moving from the functional organizational arrangement to a team arrangement.
- It has enabled high level connectivity, information sharing and integration not only within a company and/or among companies or within a nation and/or among nations, but globally.

IT is increasing in both speed and capacity, while there is a decline in the cost of transactions. Some specific technologies have demonstrated widespread logistics applications. Some of these technologies are:

- Electronic Data Interchange (EDI)
- Barcodes and Scanning
- RFID
- Satellite Communication
- Expert Systems

9.8 MIS FOR PRODUCT DEVELOPMENT

The manufacturing and production function refers to planning and controlling all activities involved in the process of producing goods and services from the raw materials. The main purpose of manufacturing and production function is related with planning, developing, and controlling the production schedule, setting up the production goals and controlling inventories. In addition, it is also responsible for allocating resources like raw materials, machines, facilities and labour that are required to produce finished goods. The information systems that are designed to support all these activities are known as **manufacturing and production information systems**.

The manufacturing and production information systems use information technologies to integrate and automate production and support processes. These systems help organizations to simplify, automate and integrate many of the activities required to produce goods in order to efficiently produce high quality products and services. These systems are used for processing customer orders, preparing production schedule and shipping documents, performing quality assurance, etc.

The following are examples of manufacturing and production information systems used at different organizational levels.

- **Machine Control System:** It helps the operational managers in controlling the actions of machines and equipments being used to manufacture the products.
- **Production Planning System:** It assists the middle managers in estimating the product quantity to be produced and the time when it is to be produced.
- **Facilities Location System:** It enables top executives to decide the location of new manufacturing plants and production facilities.

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9.9 MIS FOR MARKET DEVELOPMENT

The sales and marketing is a vital business function of an enterprise, which includes planning, promoting and selling organization's existing products and services as well as establishing new products and services in order to provide better service to the existing and potential customers. The sales function is responsible for reaching customers, selling desired products and services to them, getting orders from them and following up the sales orders. The marketing function is responsible for advertising and promoting the company's products and services, determining the prospective customers for those products and services, analysing customers' needs and preferences, and developing products and services as per the customers' choices. The information systems that are designed to support the sales and marketing business function are called sales and marketing information systems.

The sales and marketing information systems use information technologies to automate many information processing activities for sales support and marketing management. These systems analyse demands for several products in different regions. This information enables managers to identify the target customers in a more accurate manner and deliver the right products to them. These systems are capable of identifying the new trends in markets, assessing the customers' changing needs so that the organizations could develop innovative products that best meet the customers' demands. Besides, these systems can help marketing managers in product planning, sales promotion, deciding targeted market strategies, advertising, product pricing and other product management activities.

The following are examples of sales and marketing information systems used at different levels of an organization.

- **Order Processing System:** It supports the operational managers for various activities like entering, processing and tracking the orders.
- **Pricing Analysis System:** It helps the middle managers in deciding the prices for the organization's products and services by analysing similar types of products available in the market.

- **Sales Trend Forecasting System:** It provides top managers the information on trends in demands for company's products and services which enables them to forecast sales for the next five years.

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Check Your Progress

1. How operations (production) management MIS helps in taking operations related decisions?
2. What is the primary role of the marketing information system?
3. What information does HRIS provide?
4. How financial MIS helps the finance department?
5. What is budgeting module in finance?
6. What does computerized inventory control system maintain?
7. Name the modules available in logistics information system flow.
8. Name the specific technologies used in logistics applications.
9. Why manufacturing and production systems use information technology?
10. What is the responsibility of the sales function?

9.10 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. 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.
2. Marketing information system helps to effectively manage the marketing department in an organization. The primary role of the marketing information system is to provide relevant information to the marketing department managers, so that the department can function efficiently and effectively.
3. HRIS provides information on current market rates for the type of skill and competence that an individual possesses to help managers take a decision on compensation. Other related information like pay parity information of similar ranking people in the organization, the historical compensation structure of the organization are also available in the HRIS to help the HR department in deciding compensation packages.
4. A 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.

5. Budgeting is a strategic function of finance. The budgeting module has tools for making projections of the future needs of resources, so that the 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.
6. The computerized inventory control system maintains a date-wise list of all items along with the maximum, minimum, reorder and inventory in hand. It keeps on automatically updating the same list as and when material is despatched or received making things much easier and simpler for the production unit. The computerized inventory control system is also capable of preparing many other useful MIS reports, such as aging analysis, goods movement analysis, slow and fast moving stock report, valuation report and it assists the storekeeper and accountants.
7. The logistics information system flow has five modules: order entry, order processing, transportation and shipping, distribution operations and inventory management.
8. Some specific technologies used in logistics applications include:
 - Electronic Data Interchange (EDI)
 - Barcodes and Scanning
 - RFID
 - Satellite Communication
 - Expert Systems.
9. The manufacturing and production information systems use information technologies to integrate and automate production, and support processes. These systems help organizations to simplify, automate and integrate many of the activities required to produce goods in order to efficiently produce high-quality products and services. These systems are used for processing customer orders, preparing production schedule and shipping documents, performing quality assurance, etc.
10. The sales function is responsible for reaching customers, selling desired products and services to them, getting orders from them and following up the sales orders.

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9.11 SUMMARY

- 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

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financial MIS and the marketing MIS so that some basic data can be interchanged between the departments.

- Production management subsystem 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.
- Marketing is concerned with interacting with customers, educating them about the product or service and related benefits, ensuring the fulfillment of their needs and expanding the customer base.
- The marketing department uses the marketing information system to help them take decisions in the marketing domain. The information in this type of a system is mostly transaction level information.
- Marketing intelligence subsystem is the subsystem responsible for gathering the necessary information from transaction level data, to help in the marketing process. A marketing intelligence subsystem is an input subsystem of the marketing MIS.
- The task of motivating MIS personnel is very important as the most precious asset of any organization is its people. Managing them well leads to growth and prosperity and mismanagement results in losses. In fact, most of management literature is about managing this precious resource.
- Managing finances is the most crucial function of an organization. It involves managing costs, budgets, accounts, receivables, payables and capital expenses. The value of the business can be gauged using various accounting tools.
- A 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.
- Inventory is a very crucial issue for any manufacturing unit, warehouse, clearing and forwarding agents or a distributor. Stacked inventory means blocked money that reduces liquidity and indirectly profits. Cash discounts are available from almost all manufactures because liquidity means more rotation of goods and more profits.
- A Management Information System or MIS organizes all company data in a computerized database. You can retrieve data from all sections of your company including sales, manufacturing and inventory to see how efficiently each department is operating.
- The two major reasons for the use of information technology in logistics are the spatial spread of manufacturing and service activities, and the time element in planning, both of which require data intensive decision-making.
- The logistics information system flow has five modules: order entry, order processing, transportation and shipping, distribution operations and inventory

management. The files contain the data and information base to support the communication activities.

- Bar coding is a technique which allows data to be encoded in the form of a series of parallel and adjacent bars and spaces which represent a string of characters. A bar code printer encodes any data into these spaces and bars and then a bar code reader is used to decode the bar codes by scanning a source of light across the bar code.
- The manufacturing and production function refers to planning and controlling all activities involved in the process of producing goods and services from the raw materials. The main purpose of manufacturing and production function is related with planning, developing, and controlling the production schedule, setting up the production goals and controlling inventories.
- The sales and marketing is a vital business function of an enterprise, which includes planning, promoting and selling organization's existing products and services as well as establishing new products and services in order to provide better service to the existing and potential customers.
- The sales function is responsible for reaching customers, selling desired products and services to them, getting orders from them and following up the sales orders. The marketing function is responsible for advertising and promoting the company's products and services, determining the prospective customers for those products and services, analysing customers' needs and preferences, and developing products and services as per the customers' choices.

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9.12 KEY WORDS

- **Empirical Data:** It refers to the information received by means of the senses, particularly by observation and documentation of patterns and behaviour through experimentation.
- **Clandestine:** It refers to something that is planned or done secretly.
- **Customer Relationship Management (CRM):** It refers to the combination of practices, strategies and technologies that companies use to manage and analyse customer interactions and data throughout the customer lifecycle, with the goal of improving customer service relationships and assisting in customer retention and driving sales.
- **Stock Keeping Unit (SKU):** It refers to a number assigned to a product by a retail store to identify the price, product options and manufacturer of the merchandise.
- **Cost benefit Analysis:** It refers to a systematic approach to estimating the strengths and weaknesses of alternatives.

- **Attrition:** It refers to a gradual process of wearing down, weakening, or destroying something.

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9.13 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short Answer Questions

1. What is maintenance management subsystem?
2. Differentiate between pricing subsystem and packaging subsystem.
3. What is recruitment?
4. What is working capital management?
5. Define the value of inventory.
6. What are the three main sources using which marketing managers can obtain information?
7. Give some examples of manufacturing and production information system.
8. Why are sales and marketing information systems designed?

Long Answer Questions

1. Discuss the functioning of research production with reference to MIS.
2. Explain the significance of MIS in marketing.
3. Discuss the key points of personnel MIS.
4. Explain the financial function of MIS with the help of an example.
5. Elaborate on the role of inventory in MIS.
6. Discuss the significant functions of logistics with reference to MIS.
7. How MIS helps in product development? Explain with the help of an example.
8. Explain the assistance provided by the market development function in MIS.

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UNIT 10 CLIENT/SERVER COMPUTING

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Structure

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10.0 INTRODUCTION

In this unit, you will learn about client-server computing. The client-server model is a computing model that acts as distributed application which partitions tasks or workloads between the providers of a resource or service termed as servers and service requesters termed as clients. Often clients and servers communicate over a computer network on separate hardware, but both client and server may reside in the same system. A server machine is a host that is running one or more server programs which share their resources with clients. The server component provides a function or service to one or many clients, which initiate requests for such services. Hence, the client-server model has become one of the central ideas of network computing. Many business applications being written today use the client-server model. You will learn about communication servers, such as file server, groupware server, mail server, workflow server and database server.

Integrated Services Digital Network (ISDN) is a set of communications standards for simultaneous digital transmission of voice, video, data and other network services over the traditional circuits of the public switched telephone network. The key feature of ISDN is that it integrates speech and data on the same lines, adding features that were not available in the classic telephone system.

There are several kinds of access interfaces to ISDN defined as Basic Rate Interface (BRI), Primary Rate Interface (PRI) and Broadband ISDN (B-ISDN). Electronic Data Interchange (EDI) is the structured transmission of data between organizations by electronic means. It is used to transfer electronic documents or business data from one computer system to another computer system, i.e., from one trading partner to another trading partner without human intervention. You will also be acquainted with Enterprise Resource Planning (ERP) systems which integrate internal and external management information across an entire organization, embracing finance/accounting, manufacturing, sales and service, customer relationship management, etc. ERP systems automate this activity with an integrated software application.

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10.1 OBJECTIVES

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

- Understand the basics and functioning of client-server networking
- Define the various types of communication servers
- Discuss the significance of digital networks
- Explain electronic data interchange and its applications
- Explain enterprise resource planning systems
- Analyse inter-organizational information systems
- Define value-added networks

10.2 CLIENT SERVER NETWORKING: AN INTRODUCTION

A computer network can be either of the following two major types: peer-to-peer network or client-server network.

Peer-to-Peer Network

In a **peer-to-peer network**, all computers in a network are equal. It means no computer in the network has any higher or lower priority. There is no specific computer configured as client or server. There is no centralized control over the network resources. Any computer can share resources with any other machine in the network. Each computer can be a client, requesting services from other computers as well as providing services to other computers in the network. In this type of network, since there is no centralized control over the network, each user is an administrator of his own machine. A local administrator (individual user) has the right to seek permission or deny permission for sharing information or accessing specific resources concerned with that machine.

Security in a peer-to-peer network is at the share level (i.e., it is not assigned to a single user but to all users who want to access resources). The group of users

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called workgroup can be formed by providing password to users who require access to specific resources. It is the responsibility of each user to maintain security.

Also, centralized backup and restore is required by each individual machine to protect information. One of the most important issues that arise in a peer-to-peer network is data organization. To search a particular file or resource in the network becomes difficult with large number of nodes. It is difficult to keep track of which information is available on which machine and sometimes, you may get lost in finding documents.

Suppose User1's machine is attached to a shared network printer. If the other users who shares this printer access it for taking printouts simultaneously, User1 will suffer from reduction in performance of machine because the machine is always busy in handling requests of other network users (see Figure 10.1).

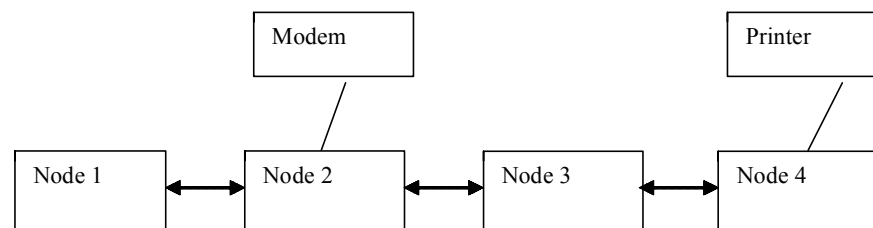


Fig. 10.1 Diagrammatic Representation of Peer-to-Peer Networking

Advantages

A peer-to-peer network gives some benefits. It is easy to install besides being cheap and suitable for small organizations. There is no requirement of a network administrator. Individual users have the right to control access to their own resources. To configure the network, special hardware and software are not required. Once the network is set up, users can easily share information and resources.

Disadvantages

Peer-to-peer networking has some disadvantages as well. This type of network is not suitable for large organizations. This is because as the number of nodes increases, it is difficult to manage data and resources. It offers very poor security as security applies to individual node at a time. To protect data, individual machines must be provided backup. The user of a network machine, which shares resources, may suffer degrading performance by that machine.

Client-server Network

A **client-server network** is also known as a server-based network. The client-server model of computing is an emerging technology put in use by modern business organizations. In contrast to the peer-to-peer network, a client-server network is centralized and computers are configured with specific functionality. Also, computers can be configured with high priority or low priority.

Server: It is a system (central program) which provides services or communicates with other computers (different programs) in the network. A server is defined by RFC (Request For Comments) 2616 (HTTP/1.1) as, ‘An application program that accepts connections in order to service requests by sending back responses.’

Client: It is a computer program which accesses services from a common server.

RFC 2616 (HTTP/1.1) defines a client as, ‘A program that establishes connections for the purpose of sending requests.’

A server accepts requests of client computers and provides services to clients in a network (see Figure 10.2). It provides single administration and central sharing of resources in the network. Network security can be set up and maintained through a central server in the network. Each user can be authenticated by providing user name and password. Using a single logon, a user can access resources in the network. Therefore, there is no need to remember multiple passwords. Access rights of each user can be set up through the central server. The operating systems, such as Windows NT and Windows 2000 provide domain model which manages users, groups and access rights of users.

Locating resources is also easy as these are available on specific machines, which reduce the time taken for locating resources in the network. Also, backup and restore is easy since it is centrally managed.

Though the client-server model is more advantageous than the peer-to-peer set-up, the client-server set-up is expensive when compared to the peer-to-peer network. It requires one machine to be set up as server which will handle the clients’ multiple requests. This server must be high powered and able to run special server software, which becomes costly. It requires skilled persons to set up a network and administrate it. The centralized management of a network makes works easier but also adds single point of failure. If the central server fails, then the entire network fails. In such a situation, users cannot access data and resources.

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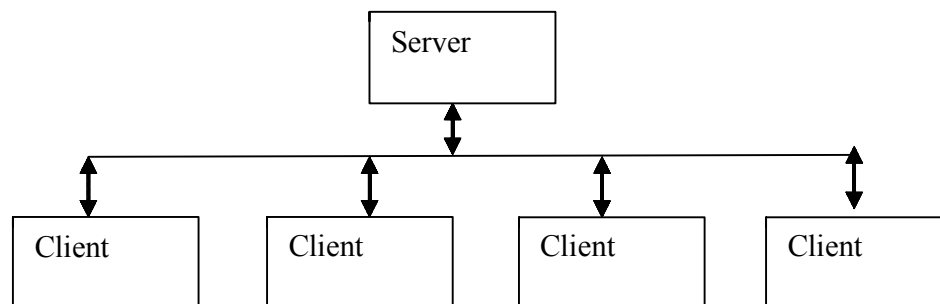


Fig. 10.2 Diagrammatic Representation of the Client-server Network

Server Hardware**NOTES**

A normal desktop computer can act as a server if it meets the following conditions:

- It has higher processing power.
- It has higher configuration of RAM.
- It can support multiple processors.
- It supports swappable disk drive, which can also add speed and storage capacity.
- It has a high speed network card.

For installing Windows 2000 server, the following hardware requirements are required:

Windows 2000 Server

- Processor: 133 MHz or higher with Pentium compatible CPU.
- Minimum 256 MB of RAM recommended. 128 MB minimum supported; 4 GB maximum.
- 2 GB hard disk with a minimum of 1 GB of free space. Additional free hard disk space is required if you are installing over a network.
- Windows 2000 Server supports up to four CPUs on one machine.

Windows 2000 Advanced Server

- Processor: 133 MHz or higher Pentium compatible CPU.
- Minimum 256 MB of RAM recommended. 128 MB minimum supported; 8 GB maximum.
- Minimum of 1 GB of free space on 2 GB hard disk. Additional free hard disk space is required if you are installing over a network.
- Windows 2000 Advanced Server supports up to eight CPUs on one machine.

For any machine to be configured as client machine, the minimum requirements for Windows 2000 are as follows:

Windows 2000 Professional

- Processor: 133 MHz or higher Pentium compatible CPU.
- Minimum 64 MegaBytes (MB) of RAM recommended. More memory generally improves responsiveness 4 GigaBytes (GB) RAM maximum.
- Minimum of 650 MB of free space on 2 GB hard disk. Additional free hard disk space is required if you are installing over a network.
- Windows 2000 Professional supports single and dual CPU systems.

Server Software

Server software is available in two categories: Network Operating System and Server Application Software.

Network Operating System: It comes with multiple features for security, backup and restore, print or file service.

The following are some server operating systems:

- Novell NetWare
- OS/2
- Windows NT
- Windows 2000 Server
- Windows 2003 Server
- Windows 2008 Server
- UNIX, Linux
- IBM LAN Server

Server Application Software: This is used for specific purposes. This can be installed with the server operating system for running a particular application; for example, fax, mail, remote access server, etc.

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10.2.1 Client-server Model

Butler Pyramid Model of Client-server Computing

The Butler Group of Client-server Forum, London, has designed a new framework to advance the client-server approach. This is a five-layer model, also called the VAL (Value Added Layers) model.

The basic structure of this model resembles a pyramid having the infrastructure layer at the bottom, followed by middleware, applications, repository and business model layers (see Figure 10.3).

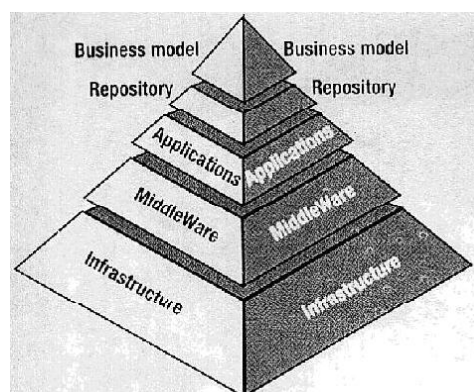


Fig. 10.3 Layers in the Butler Pyramid Model

The characteristics of each layer are summarized as follows:

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- **Layer 1—Infrastructure Layer**

The infrastructure layer collects inactive components; it does not perform any business function. For example, network set-up, network devices, user interface, computer operating systems and database management systems are the passive components.

- **Layer 2—Middleware Layer**

It is one step above the infrastructure layer and adds value through specialization. The middleware layer acts as glue between the client and the server. Middleware provides environment for applications to openly communicate with other programs or processes independent of location. Middleware integrates diverse hardware and various software environments to communicate with each other. For example, the way the program develops in one database also allows access rights to other databases, thereby doubling its usefulness. Another example is ODBC (Open Database Connectors) or JDBC (Java's Database Connectivity), API (Application Programming Interface). Typical middleware deals with remote procedures, database connections, interaction between database and application programs and network connections.

- **Layer 3—Applications Layer**

This layer contains density and creates further specializations. One point to note here is that as we move up, the layer keeps minimizing and its specialization keeps increasing.

Applications are those components which actively participate in carrying out work for the organization. In true sense, data is manipulated and business requirements (functions) are converted into software applications.

- **Layer 4—Repository Layer**

The role of the **repository layer** is to separate a business model from the tools and technologies, which are used to implement it. It is the central space within an organization's infrastructure (location) which stores and maintains several databases over a network.

- **Layer 5—Business Model**

It is the top of the pyramid. A business model is not dependent on technologies that are used to implement it. Basically, it is concerned with providing application specific functionality and is portable to the most suitable hardware and software environment. It is the proper business design in cost-revenue-profit terms and a strategy to accomplish the objectives and goals of the company.

Client-server Layers

The client-server model works on logical processes. The following are the logical layers of the client-server architecture (see Figure 10.4).

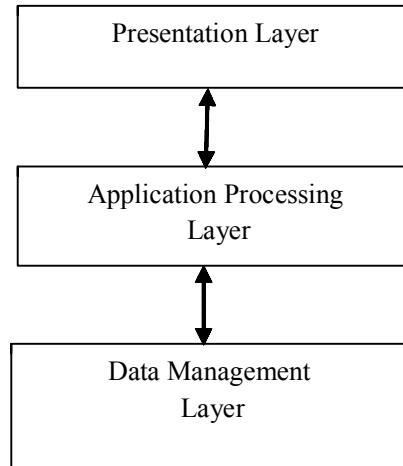


Fig. 10.4 Logical Layers in the Client-Server Model

Presentation Layer: This layer deals with collecting user inputs and presenting the output (results) of computation to the users of the system. This layer represents GUI (Graphical User Interface).

Application Processing Layer (Business Logic): This layer deals with providing application specific functionality; for example, in a banking system, operations such as opening or closing an account. This layer is the core or heart, which shapes business knowledge and logic.

Data Management Layer: This layer is most critical to any business and deals with database management of the system. Data is available across multiple sessions of the application. Data represents the knowledge repository, which is reusable.

10.2.2 Golden Rules of Client-server Implementation

Client-server is beneficial if implemented correctly. Benefits include easy application development, flexibility and better response to customers. The following are the golden rules of client-server implementation:

- (i) **Fix the Business Process:** Many organizations prefer the client-server model to fix their business problems. Their assumption is that implementation of the client-server technology will help them solve their business problems. First, make sure that the whole company understands and is committed to the client-server model and how it is beneficial to the company.
- (ii) **Define the Scope for Implementing the Client-Server Model First Time:** Instead of implementing it on the entire system, start on a small scale, non-critical departmental level and scale up, i.e., instead of implementing

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for 500 systems directly, first start with fifty system set-ups and then scale it up. Using this way, companies can scale up easily, which also helps maintain the functionality of the organization. Also, it is easy to implement it on all systems as the organization already has a working set.

- (iii) **Managing Project:** Find the requirements of the system. Information can be gathered by questionnaires. Prepare questionnaires in such a way that even non-IT persons are able to answer them.

For example, ABC Company decided to develop computerized applications for its business process. For collecting requirements, they invited people from each department and gave presentation on what can be the new system. As the invited people did not know the business processes, they could only state what they wanted from the new system, but were not able to provide the information required by the IT team. So prepare questionnaires in such a way that even non-IT persons are able to provide their requirements.

Based on gathered inputs, make test plans. Prepare specifications of the software and hardware to be purchased against these specifications.

- (iv) **System Model:** The design of the client-server model must encompass the whole business and not just one application.
- (v) **System Configuration:** In the client-server system, find out which software versions are required and which are available. Also find out hardware specifications for the system.
- (vi) **Operating Platform:** In client-server computing, system management can be tricky. Find emerging standards for software and hardware from hardware and networking vendors.
- (vii) **Analyse the Complexity of Client-Server Development:** The client-server model is beneficial if implemented properly. Before switching to the client-server model, it is necessary to understand the complexity of model. Preparation of business process plans for computing is also required. For first time implementation, it is not economically advantageous as it includes cost of development, support, maintenance and training.

Check Your Progress

1. What is client-server network?
2. Define the function of data management layer in client-server model.

10.3 COMMUNICATION SERVERS

There are several services which can be implemented by using the client-server model of computing. A server can be configured to provide different services such as central storage of files, i.e., as a file server.

10.3.1 File Server

- A **file server** is used to store files in a centralized location in the network. It is also responsible for management of data. Users in the network can centrally access files from a file server. For each user in the network, some storage space is allocated by the administrator to store files on a file server.
- To set up a file server, a computer must have high speed processor, a large amount of disk space and high configured RAM memory.
- In the network, a file server may be a network-attached storage device, which facilitates users to store files centrally as they store files on their hard disk drive.
- A network administrator can configure a dedicated file server, which will only handle storage and management of a file. The administrator can also configure a non-dedicated file server, which can be used for file storage as well as for workstation operations.
- A file server handles shared data; backup of data can be scheduled and recovery of data can be made possible from the central place. Security of data can be maintained by implementing proper access rights.
- In Windows platform, Windows file server is the dominant file server. Windows server version provides in-built facility to manage files with improved security. Red Hat Linux file server and Mac OS X server are examples of file server.
- **Setting up a File Server for Windows Server 2003**
 - (i) Click on Start → Configure your server wizard → select File Server from the list → Next → then it will ask whether you want to enable the indexing service; this option can be enabled or disabled depending on how users are using File Server → Next → Share a folder wizard; select a folder name, which is to be shared in the network → Next → Share name, description and offline settings of the folder → then specify Permissions to folder. Permission to folder can be assigned based on which users will use it for read, which users will modify it, etc. Windows provide four options to select permission: a) All users have read-only permission; b) Administrators have full access, whereas other users have read only access; c) Administrators have full access; other users have read and write access; and d) Use custom share and folder permissions.
 - (ii) After setting permission, click on finish button and close the wizard.
- **File Server Management**

For managing the shared folders, file server management console acts as a central administrator. It provides the following features:

Shares: It displays the list of available share files to the network users. It also gives the option to backup contents of the file server. Select the option 'Backup file server', which displays choice for backup and restore. Specify

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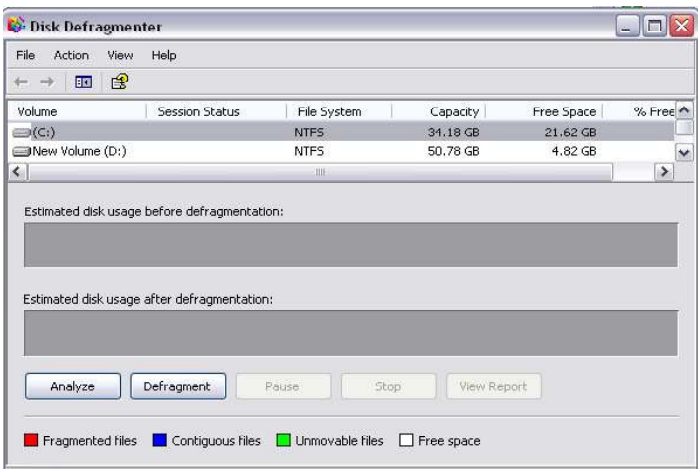
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the data to be backed up and also specify the location where the backup data is to be stored.

Sessions: It displays which user is connected to the network session and from what time. The administrator can also disconnect any user from the session if required. To disconnect any user from the session, select user name, right click and select ‘Close session’. To close all sessions, select option ‘Disconnect all sessions’ in the main window.

Open Files: This will display a list of all files accessed by a user in the network. This also shows you which file is connected to which user. Windows also provides the option to disconnect all open files.

Disk Defragmenter: This option arranges files on the disk drive and increases the speed of accessing data from the disk drive. To find whether the disk is defragmented or not, Defragmented analyse option is provided.



Disk Management: This helps manage disk partition and displays information in the graphical format. It also allows creating partition, format partition and changing letter of hard disks. It sets space and security permission from properties of each drive.

10.3.2 Groupware Servers

Using a network, a user can not only share information and resources, but can also carry out day-to-day activities, such as sending and receiving messages. Users can make a group or a team working on a common project or a task called workgroup.

Groupware server provides environment to all users to share documents, communicate and coordinate in groups to complete tasks more effectively. Users can prepare schedules; they can view schedule of other users in the group and share their knowledge and plan accordingly.

Examples of groupware servers are as follows:

Workflow Servers, Mail Servers, Newsgroup Servers, Calendar Servers

The following are the main features of groupware servers:

- Groupware server allows grouping of multiple users to work on the same data.
- It handles concurrency related issues when multiple users access the same data.
- It provides tools to complete the job of workgroups more efficiently.

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Workflow Servers

The flow of work in an organization is called workflow. An organization has to follow specific procedures for smooth execution of business applications. It may define some sets of rules for specific applications. Workflow can be a group of interdependent tasks that are carried out in business. It has a start and an end point. Though responsibilities are divided among individuals, the completion of a task depends on each other. In workflow, any task or information or document is passed from one level to another level in hierarchical way. Some activities in workflow can be manual or automated or partially manual and partially automated.

In case of automatic workflow, an organization can define the entire sequence of information flow and its path. Application programming interface is used to write procedures for workflow server. A workflow server does the following:

It defines workflow and different tasks, identifies which tasks are manual and which are automated and describes the set of rules for each task. It also defines what actions are to be carried out at each stage.

For example, consider an online leave application system in a company. If an employee applies for leave, it is received by the assistant manager. The assistant manager forwards it to the manager. The system sets the status of application based on the availability and nature of leaves of employees. The manager can either accept or reject the application. If an application is accepted by the manager, the system makes deduction from the available leaves and sets the status as accepted. In case of rejection, the system puts the status as rejected. It informs the applicant about the status of leave.

Sometimes, after receiving an application, the manager may not take any decision. The system will keep track of it and send reminder to the manager about the application. If a standard rule is set by the business to be followed for accepting or rejecting the leave application, the business strategy workflow server will perform that set of actions.

Mail Servers

These are workgroup servers. It provides e-mail-related services on a network. It can configure to store and forward services. It stores the incoming messages and waits for the user to read it. Similarly, it stores messages in the outbox, and

when connection to the appropriate external mail server is established, it forwards them to the recipients. Mail server is also used by corporates to send auto response to incoming mail.

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Mail servers also sort incoming mails and redirect them to the respective user's inbox. They send outgoing mails via intranet or the Internet to their respective destination. They also manage the address book of all contacts.

Users use e-mail clients, such as Microsoft Outlook and Open source software, such as Mozilla Thunderbird to connect to mail servers. Mail servers can also be used by both single users and group users with mail clients. Mail clients use IMAP (Internet Message Access Protocol) or POP (Post Office Protocol) to download received mails from mail servers. To send and receive mails, SMTP (Simple Mail Transfer Protocol) is used.

Examples include MS Exchange and Lotus Domino Mail Server.

The Lotus Domino server supports Microsoft Windows (R) 95, Windows 98, Windows NT(R) 4, Windows 2000, Windows XP Professional and Macintosh PowerPC Systems.

Features of domino server include messaging, networking and security.

Messaging: It is the primary function of domino. Each user has an independent mail box. It gives browser-based access to notes, mail, calendar, scheduling features to notes user. The user can send, receive mail, view their calendars, invite people to meetings, create 'To Do' lists, keep a notebook, and work offline. It filters messages based on specific criteria. Specific action can be carried out on selected mails. It allows setting quota for each user for using mail box. It also warns user if mail exceeds specific quota.

Networking: It speeds up the communication between lotus notes client and domino server. It enables the server to connect the Internet automatically for transferring mail initiated by another server.

Security: It provides each user notes id and password. It checks the authentication certificate before trusting it. It gives different administrative rights to multiple administrators of a single server. It contains replication facility across the network.

Newsgroup Servers

An organization can form bulletin boards by configuring the news group server. Users can send messages, display news, notices to all users by using newsgroup servers. These servers are configured for advertising and marketing.

Calendar Server

This server provides scheduling and calendar management services. To schedule any event or meeting, users can prepare schedules. They can view the schedule of other users in the group, share their knowledge and plan accordingly.

10.3.3 Database Server

Database servers are special servers used in an organization to store data centrally. Data stored in a database can be accessed by any user from any location in the network. It provides services to other applications in the network. Database servers allow multiple users to share the same data at the same time.

Database servers control storage of data, set access permission to each user, insert, remove and update database according to the request of a user as well as process queries of the user and return the result to them.

The Database Servers include Microsoft SQL Server 2008, IBM DB2, Sybase and Oracle. For Oracle, SQL Plus acts as client to oracle database server.

- **Transaction Server/TP Monitor**

A transaction server is also known as Transaction Processing Monitor. A transaction is a predefined set of actions. It provides services which have database transaction management capabilities. A transaction must possess the following ACID properties:

- o **Atomicity:** It means that a transaction is either successfully completed or aborted. It should not be partially completed.
- o **Consistency:** A transaction can take a state from one consistent state to another.
- o **Isolation:** A transaction must be isolated, that is, it should not be visible to other transactions.
- o **Durability:** Any modification made to a transaction is permanent and tolerates system failure.

Online transaction processing is known as transaction processing monitor. A transaction processing monitor deals with execution and management of transactions. It ensures integrity of data. The TP monitor handles load balancing in the network by forwarding any transaction to other servers in the network. It provides scalability to application message delivery. It provides database recovery and restart. It monitors performance and throughput. It reduces complexity, executes remote data, and provides security, manageability and recoverability.

10.4 DIGITAL NETWORKS

Networks may be classified by geographic scope into local networks and wide area networks. Wide area networks encompass a relatively wider geographic area, from several miles to thousands of miles, whereas local networks link local resources, such as computers and terminals in the same department or building of a firm. Local networks consist of private branch exchanges and local area networks.

A **Private Branch Exchange (PBX)** is a special-purpose computer designed for handling and switching office telephone calls at a company site. It can belong to a company or to a provider. Today's PBXs can carry voice and data to create local networks. PBXs can store, transfer, hold and redial telephone calls

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and also switch digital information among computers and office devices. Using a PBX, you can write a letter on a PC in your office, send it to the printer, then dial up the local copying machine and have multiple copies of your letter created.

The advantage of digital PBXs over other local networking options is that they do not require special wiring. A PC connected to a network by telephone can be plugged or unplugged anywhere in a building using the existing telephone lines. Many commercial vendors provide/maintain PBX services, so an organization does not need special expertise to manage them.

The geographic scope of PBXs is limited, usually to several hundred feet, although a PBX can be connected to other PBX networks or to packet-switched networks to encompass a larger geographic area. The primary disadvantages of PBXs are that they are limited to telephone lines and cannot easily handle very large volumes of data.

Network Services and Broadband Technologies

In addition to topology and geographic scope, networks can be classified by the types of service they provide.

The digital network can be defined using Integrated Services Digital Network as follows:

Integrated Services Digital Network (ISDN)

It is an international standard for dial-up network access that integrates voice, data, image and video services in a single link. Organizations and individuals requiring the ability to provide simultaneous voice or data transmission over one physical line might choose this service. Primary Rate ISDN offers transmission capacities in the megabit range and is designed for large users of telecommunications services.

Like ISDN, Digital Subscriber Line (DSL) technologies also operate over existing copper telephone lines to carry voice, data and video, but they have higher transmission capacities than ISDN.

High speed transmission technologies are sometimes referred to as broadband. The term broadband is also used to designate transmission media that can carry multiple channels simultaneously over a single communications medium. Broadband media is available in most big cities in India.

Narrow Band and Broadband ISDN

ISDN is a group of CCITT/ITU (The International Telegraph and Telephone Consultative Committee/International Telecommunication Union) standards relating to digital transmission across conventional copper wire telephone lines, as also other media. This technology uses ISDN adapters in place of modems and provides very fast speed up. ISDN necessitates adapters at either end of the transmission circuit. However, in actual fact, multimedia delivery needs an extensive network that is capable of delivering data at high delivery speeds. Currently, ISDN implementation in the narrow band affords the best access and is the most appropriate delivery medium.

ISDN is seen by many in the industry as having the high potential of gaining universal acceptance. The installed base of ISDN is growing rapidly throughout the world to provide connections among different countries. The governments of various countries are coming out with plans and policies to implement ISDN as soon as possible. Conceptually, ISDN represents the integration of both voice data or analog signals and digital data transmission over a single network. ISDN effects this transmission over a medium that is, strictly speaking, designed for analog transmission, with BISDN (Broadband ISDN) holding out promise of extending the integration of both these services right across the entire spectrum of media of end-to-end paths including fibre optic and radio media. Broadband ISDN will cover frame relay service for high speed data that can be transmitted in sustained bursts, especially over FDDI (Fiber Distributed Data Interface) and SONET (Synchronous Optical NETwork). BISDN would support transmission from 2 Mbps to much higher.

Definition of ISDN

ISDN is a network architecture in which digital technology is used to convey information from multiple networks to the end user. This information is digital from end to end.

Features

- Offers point-to-point delivery.
- Network access and network interconnection for multimedia.
- Different data rates from 64 Kbps up to 2 Mbps are commercially available which can meet many needs for transporting multimedia and is four to many times more better than today's analog modems.
- Call set-up times are under one second. ISDN can dramatically speed up transfer of information over the Internet or over a remote LAN connection, especially rich media like graphics, audio or video applications that normally run at LAN speeds.
- ISDN would be feeder network in respect of broadband ISDN based on ATM (Asynchronous Transfer Mode) standards.

ISDN can be less expensive, particularly in the case of prolonged usage, cheaper than even ATM connections and is likely to be more widely available for a longer length of time. This is the main reason why it is such a crucial tool for bringing multimedia applications to a wide spectrum of users. There are two forms of ISDN service: Narrow band and Broadband.

Narrow Band ISDN

Narrow Band ISDN is a digital service where the transport speeds are 1.544 Mbps (T1) or less. Narrow band ISDN provides for the following services:

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- **Circuit Switched Voice:** Circuit switched voice service is a digital voice service that offers many of the capabilities of a business. It is centered over a 4-wire ISDN Digital Subscriber Line (DSL).
- **Circuit Switched Data:** Circuit switched data service provides end-to-end digital service to pass data or video information over the public network. ISDN uses out-of-band signalling to establish and maintain data connections, which require special processing.
- **Low Speed Packet:** ISDN lines are equipped with a packet connection that is used to manage ISDN connections. This monitoring capability is provided by using the D channel on a DSL. The D channel is a 16Kbps X.25 connection that is also capable of passing low speed packet while also relaying call processing information.
- **High Speed Packet:** ISDN lines are also equipped with two B channels. Each B channel is a 64Kbps channel that can be used for circuit switched voice, circuit switched data, or high speed packet service. To provision high speed packet service one or two of the 64Kbps B channels are connected (permanent virtual circuit) to the packet network thus providing a 64Kbps X.25 connection.

Broadband ISDN Service

Broadband ISDN Service is a digital service in excess of 1.544Mbps. This digital service can be in the form of Frame Relay, SMDS, or ATM. Broadband ISDN is the service of the future. The higher speeds offered are required to support the many applications of the Information Super Highway. The range of speeds for the broadband ISDN services usually range from 25Mbps up to the Gigabit range. The two speeds that are most often discussed are OC 1 that is 155Mbps and OC 3 that is 622Mbps. The speeds in the broadband are made possible by the high quality of the digital facilities in place on the network. The early data protocols, such as X.25 required extensive overhead to insure the delivery of data. Error correction and flow control were performed at a number of intermittent points along the way of a data connection. The new digital facilities and the introduction of fibre optics have eliminated this need up to a maximum extent. High speed broadband services rely for the most part on the upper layer protocols to perform these functions on an end-to-end basis.

ISDN is accessed via any one of two alternative services, viz., CCITT as BRA (Basic Rate Access) and PRA (Primary Rate Access). Both these rates include a number of B channels which carry data, voice and other services. The D channel carries control and signalling information.

- **Basic Rate Access (BRA)** affords an ISDN user with simultaneous access to two 64 Kbps data channels utilizing the conventional/existing twisted pair copper telephone cable, as illustrated in Figure 10.5. Each channel referred to as a 'B' channel is capable of carrying both voice or data.

Another channel, known as the 'D' channel, functions at 16 Kbps and is used for sending and receiving signals between user devices and the ISDN. The total transmission rate of BRA works out to a combined total of 144 Kbps. The use of the two discrete 'B' channels and the lone signalling channel has resulted in the term '2B+D'. BRA is also sometimes called 'I.420', as per CCITT recommended terminology. Basic rate ISDN is meant for low capacity usage, as per the normal needs of small business organizations.

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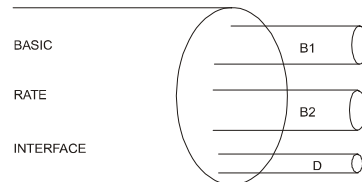


Fig. 10.5 Basic Rate Interface

- Primary Rate Access (PRA)** service provides up to 30 independent 64 Kbps B channels and a separate 64 Kbps D channel to carry the signalling. This basically provides digital access via a T1 line as shown in Figure 10.6. A T1 line provides a 1.544 bandwidth. This bandwidth is divided into 24 numbers of 64 Kb channels. The ISDN PRI (Primary Rate Interface) service uses 23 of the T1 channels to provide B channel access and uses the 24th channel for signaling purposes. ISDN call control procedures use packet messages to initiate, monitor and release connections. In a BRI (Basic Rate Interface) connection these messages are routed via the D channel. On the PRI service the /connection/call control messages are routed over the 24th channel which is the D channel in this instance. Total data rate of PRA is 1.544 Mbps. Primary Rate Access or PRA is frequently referred to as 23 B+D due to the number of 'B' and 'D' channels or 1.421 because of the CCITT recommendation from which it is derived. This type of access is basically intended to be used in situations that call for large transmission capacity, e.g., when organizations make voice and data calls via an integrated services PBX.

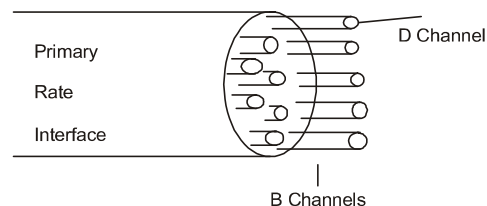


Fig. 10.6 Primary Rate Interface

ISDN and Standards

Products for ISDN technology from different vendors, even with similar features and options, may create some compatibility issues. CCITT after good deliberations over the years published the first significant ISDN standards in a number of red

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binders in 1984 and they were simply known as the Red Book standards. The group subsequently met four years later which culminated in the publication of the 1988 Blue Book standards. These international publications were the foundation for the evolving ISDN national standards. The CCITT eventually was reformed into the group, which is now called the ITU-T. The standards used to define ISDN make use of the OSI reference model with the first three layers of this OSI reference model.

The two standard ISDN connectors are (i) RJ-45 type plug and socket (very much like a telephone plug) uses unshielded twisted pair cable (it is meant for accessing basic rate ISDN) and (ii) one for accessing primary rate ISDN through a coaxial cable. The ISDN passive bus can run to maximum length of 1 kilometer; it is a cable in user premises and enables up to eight user devices attached to the ISDN interface. However, since there are but two 'B' channels, only two of the eight devices can be operative at any given time, while they all have to compete for access to the passive bus. Equipment for ISDN includes bridges or terminals, terminal adapter cards, video conferencing, PC cards, ISDN internal computer terminal adapter cards and LAN access gateways or bridges, a few of which are derived from PC cards or standalone boxes. All the problems of API standards can be side stepped for internal computer adapters by the use of external ISDN Terminal Adapters. Given that, until recently, the speed of internal computer adapters was limited to 19.2 Kbps, this solution has not proved to be viable. Recently, internal PC cards, which can work asynchronously up to 115 Kbps have come in the market, which are adaptable to multimedia operations in tandem with the appropriate external terminal Adapter. ISDN can be accessed by using any of the two services which are, as per CCITT nomenclature: BRI (Basic Rate Interface) and PRI (Primary Rate Interface). BRI gives 144 Kbps using the existing twisted copper cable phone wiring.

BRI includes two B channels and one D channel. This may be written as 2B+D. Providing 64 Kbps data transmission speed, 'B' channel (Bearer) can carry voice or data, while 'D' channel (Delta) functions at 16 Kbps and is used for control, i.e., signalling functions between ISDN and the user devices. This pushes up the total data rate of BRI to 144 Kbps. Audio is digitized using Pulse Code Modulation (PCM).

PRI can carry up to 30 independent, 64 Kbps lines of data or voice channels. The architecture includes a 64 Kbps D channel for signalling between devices and the network, and another 64 Kbps channel meant for synchronising and monitoring. This brings the total data rate to 2.048 Mbps. PRI is popularly referred to as '30+D' due to the number of channels, and because of the CCITT nomenclature from which it is derived. This type of access is basically meant for use in situations calling for generous transmission capacity, for example in the case of organizations with moderate to heavy voice and data traffic via an Integrated Services PBX.

ISDN Internetworking Equipment

The following are different internetworking devices that can make use of ISDN:

- **Terminal Adapters (TAs):** These are external devices that connect a conventional data interface, such as X.21, to an ISDN circuit, allowing non-ISDN equipment to use the ISDN. Manufacturers of inter-networking equipment who do not have any approved native ISDN interface, make wide use of terminal adapters. The disadvantage is that there is only partial transfer of information from the D channel to the TA, so the said non-ISDN equipment cannot avail of the full facilities offered by ISDN, like CLI (Calling Line Identification).
- **ISDN Bridges:** Thanks to the simplicity of ISDN bridges, bridging is an extremely popular way of interlinking LANs. One problem associated with ISDN bridging lies in controlling the bridge's use of the ISDN network. However, bridges are simple to install and have the advantage that will forward data including broadcasts, by default. Over ISDN, this translates into calls that will be made to transmit mostly unnecessary data which, over time, can turn out to be an expensive proposition. To obviate this, bridges can be architected to jam broadcasts from particular protocols, but the bridge ends up losing its prime benefit—simplicity. Nevertheless, bridges are perfect for ISDN back-up.
- **ISDN Routers:** A far more effective way of utilising ISDN for LAN inter-networking is installing a router. Internetworking vendors on the whole tend to go this route. Data is only transmitted over the ISDN network when it is essential to do so, hence there is a curb on the number of broadcast messages to be send, which in turn means that there is more efficient use of bandwidth than in the case of bridges, and the architecture can actually be simpler, to boot. Filters may be used to block all the unnecessary traffic.

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Advantages

- **Quality:** ISDN connections may be seen as very low rate-of-error digital conduits. Moreover, there is the advantage of flexibility: ISDN can be viewed as a readily adaptable leased line. Connections can be established any time between two locations having access to ISDN with minimum fuss and bother.
- **Economy:** ISDN is available for rent just like a telephone call, and usage costs are the same as conventional telephone services. Overall, ISDN is most cost effective as far as intermittent ISDN use and LAN to LAN connectivity is concerned. It offers very fast, near-transparent call establishment, so the dial-up facility is adaptable to most ISDN users.
- **Availability:** ISDN is now becoming widely available because of the initiatives taken by the governments of various countries.

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Check Your Progress

3. Why is a file server used?
4. What is ISDN?

10.5 ELECTRONIC DATA INTERCHANGE AND ITS APPLICATIONS

Earlier, companies used paper for conducting business. They used to enter data into a business application, print the form containing data and mail this form to a trading partner. The exchange of information between companies relied heavily on the postal system. The trading partner, after receiving the form, used to re-key the data into another business application. Inherent in this process are poor response times and excessive paperwork and the potential for errors as information is transcribed. The use of the postal system can add days to the exchange process. The advent of business computers has enabled companies to process data electronically, that is, exchanging information via electronic means. **Electronic Data Interchange (EDI)** is defined as, 'The computer-to-computer transfer of information in a structured and predetermined format'.

How does EDI Work?

EDI software has four layers, namely *business application*, *internal format conversion*, *EDI translator* and *EDI envelope for document messaging* (see Figure 10.7). At the sender's side, these four layers make a package of the information and then this package is sent over the value added network to the target side where the four layers follow the reverse process to obtain the original information.

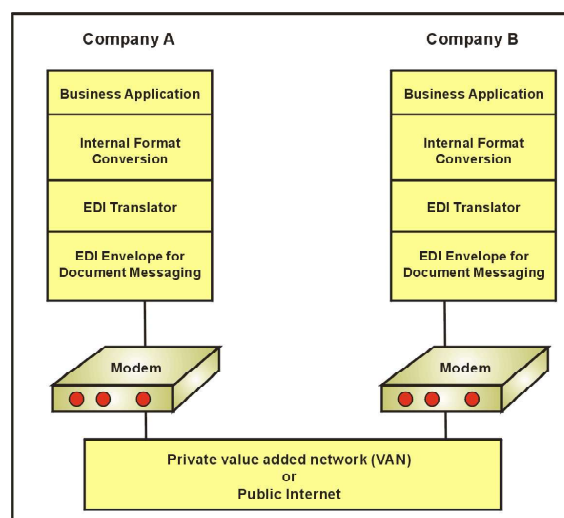


Fig. 10.7 EDI Transmission of Information

The first layer (business application) in the EDI process creates a document, i.e., an invoice, in a software application. This software application uses the internal format conversion to convert the document into the form an EDI translator can understand, and sends the document to an EDI translator. An EDI translator automatically reformats the invoice into the agreed EDI standard by both the business entities. Then this business information is passed on to the EDI envelope for document messaging, where business information is wrapped in the electronic envelope of the 'EDI package' and it is mailed to the trading partner over VANs. The receiving trading partner receives this 'EDI package' and the process is reversed to obtain the original invoice in the format the receiving trading partner can understand, and it is sent to the application to process the invoice.

To understand the process of EDI, consider an example of an organization that has to send purchase orders to different manufacturers. To accomplish this, the steps below are followed.

1. **Preparation of Electronic Documents:** The first step is to collect and organize the data by the organization's internal application systems. Rather than printing out purchase orders, the system builds an electronic file of purchase orders.
2. **Outbound Translation:** The next step is to translate this electronic file into a standard format. The resulting data file will contain a series of structured transactions related to the purchase orders. Note that the EDI translation software will produce a separate file for each manufacturer.
3. **Communication:** The organization's computer automatically makes a connection with its value added network, and transmits all the files that have been prepared. The VAN or Value Added Network will process each file, routing it to the appropriate electronic mailbox for each manufacturer. In case of manufacturers not subscribed to the organization's VAN, the files are automatically routed to the appropriate network service.
4. **Inbound Translation:** The manufacturers retrieve the files from their electronic mailboxes as per their convenience, and reverse the process that the organization went through, translating the file from the standard purchase order format to the specific format required by the manufacturer's application software.
5. **Processing Electronic Documents:** Each manufacturer processes the purchase orders received in their internal application systems.

Benefits of EDI

EDI offers a number of benefits, some of which are as follows:

- **Speed:** Information between computers moves more rapidly and with little or no human intervention. Sending an electronic message across the country takes minutes or less.

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- **Accuracy:** The alternate means of document transfer suffer from the major drawback of requiring re-entry into the recipient's application system, with the possibility of keying errors. But information that passes directly between computers without having to be re-entered eliminates the chances of transcription errors. There is almost no chance that the receiving computer will invert digits, or add an extra digit.
- **Economy:** The cost of sending an electronic document is not more than the regular first class postage. In addition, the cost has also reduced due to the elimination of re-keying of data, human handling, routing and delivery. The net result is a substantial reduction in the cost of transaction.

10.6 ENTERPRISE RESOURCE PLANNING SYSTEMS (ERP SYSTEMS)

ERP or **Enterprise Resource Planning** is an information system that integrates departments and functions across a company using one database system. It runs off a single database, enabling various departments to share information and communicate with each other. It is a business management system that integrates all facets of the business, including planning, manufacturing, sales and marketing. It automates the finance and human resources departments and helps manufacturers in handling jobs, such as order processing and production scheduling. ERP began as a term used to describe a sophisticated and integrated software system used for manufacturing. In their simplest sense, ERP systems create interactive environments designed to help companies manage and analyse the business processes associated with manufacturing, such as inventory control, order taking, accounting and much more. Although this basic definition still holds true for ERP systems, their definition is expanding. In today's dynamic and turbulent business environment, there is a strong need for organizations to become globally competitive. The survival guide to competitiveness is to be closer to the customer and deliver value-added products and services in the shortest possible time. This, in turn, demands integration of the business processes of an enterprise, which is the stronghold of ERP. The economy has shifted from being based on manufacturing to service and information has become an asset that provides the competitive advantage. ERP helps an organization in obtaining accurate and timely information. However, it is necessary for an organization to align IT spending with business strategy and needs. ERP from an IT perspective is a comprehensive software package that stores, retrieves, modifies and processes the transactions of all the functions of an enterprise in an integrated fashion. ERP is a semi-finished product with tables and parameters that user organizations and their implementation partners configure according to their business needs. An organization opts for an ERP implementation with a certain objective. The objective translates into benefits and sub-benefits. The objectives of ERP implementation should be aligned with the firm's competitive strategy. ERP can bring in many benefits that can be broadly classified as strategic, operational and managerial.

An example will make the role an ERP system plays in an organization clearer. Let us say, a customer places an order and it is entered into the ERP system. The production unit will see the demand immediately and they can plan their production accordingly. They will also have access to inventory data, inventory in the pipeline, production in progress, etc. The shipment division can check the availability of goods and plan to ship the goods. Once goods are shipped and data is entered into the ERP system, the accounting unit will know the amount receivable. When a customer inquires about the possible delivery date, the customer support staff can access the inventory details, required shipping time and answer the query with reasonable accuracy. Without an ERP system, the marketing and sales unit would have to find out the answer from the production unit.

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Check Your Progress

5. Define the layers of electronic data interchange software.
6. What is enterprise resource planning system? How is it related to business management system?

10.7 INTER-ORGANIZATIONAL INFORMATION SYSTEMS

Today, business firms need information to flow throughout the organization in order to improve customer service and bring about more efficient execution. This requires new systems that can coordinate and integrate the information from different functional systems and present an enterprise wide view of information.

Business Processes and Information System

Business processes refer to the manner in which work, information and knowledge are coordinated and focused to produce specific business results. The business processes help managers to assess how well an organization can perform. The ways the organizations carry out their business processes may make them perform better than their competitors or become barriers to organizational efficiency. Thus, it can be concluded that the business processes can prove a major source of strategic success or failure for an organization.

Each functional area of an organization has its own set of business processes. The business processes of sales and marketing, for example, include order processing, product pricing, etc. Similarly, the business processes of human resources include personnel administration, performance management, etc. In addition, many business processes in the organization are cross-functional; that is, the scope of the processes goes beyond the boundaries between functional areas. The cross-functional business processes involve activities performed by different business functions in order to produce meaningful results. The scope of the 'bill payment' business process, for example, is not only up to the finance and accounting

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for paying the bill amount, but it also encompasses other activities like ordering materials to the vendors, receiving and accepting goods, etc.

The information systems are designed to support the separate business processes of each functional area as well as the cross-functional business processes of the organizations. They automate the parts or sometimes the whole business processes, which in turn help the organizations to achieve greater efficiencies.

Enterprise Applications

Enterprise applications are the cross-functional enterprise information systems that support the organization-wide coordination and integration of business processes. The main objectives of enterprise applications are to improve the efficiency and effectiveness of critical business processes all across the organization and coordinate the firm's activities with those of suppliers and customers. To achieve these objectives, a number of enterprise applications are used, which include customer relationship management, supply chain management and enterprise systems.

Customer Relationship Management

Customers have always been valuable for businesses, but today their importance is very much appreciated for the profitability of the enterprise. This is largely because of rapid globalization and growing competition. Customers now have a variety of options available with them for purchasing a particular product. They can easily make comparisons, shop or even switch companies in case they are not satisfied with the service. As a result, today, the topmost strategy of a business is to become a customer-focused business in order to provide maximum satisfaction to the customers thereby establishing a long-term relationship with them. That is why many companies are turning to Customer Relationship Management (CRM) that focuses on the ways of identifying and retaining the profitable customers.

CRM is defined as a business and technology discipline that manages the ways an organization deals with its customers, in order to enhance the revenue, profitability, customer satisfaction and retention. It analyses the different aspects of customer relationships, including customer services, sales and marketing, to improve their customer focus. It uses information technology to create a cross-functional information system called CRM information system that integrates and automates a firm's many customer-related business processes in sales, marketing and customer services to provide quick, convenient, and consistent service to its customers.

Earlier, the business processes of different business functions were isolated from one another and, thus, various customer information were fragmented in different systems. There was no provision for consolidating all the customer-related information in order to provide a unified view of a customer to the organization and its employees who need to interact with the customers. However, this problem was resolved with the help of CRM systems. The CRM systems comprise a set of

tools that capture customer information from all customer **touch points** (methods of interacting with customers) like e-mail, telephone, fax, retail stores, company's Website, etc. This consolidated information is stored in a common customer database and made available across the organization via the Internet, intranet or other network links. Figure 10.8 shows a typical CRM information system.

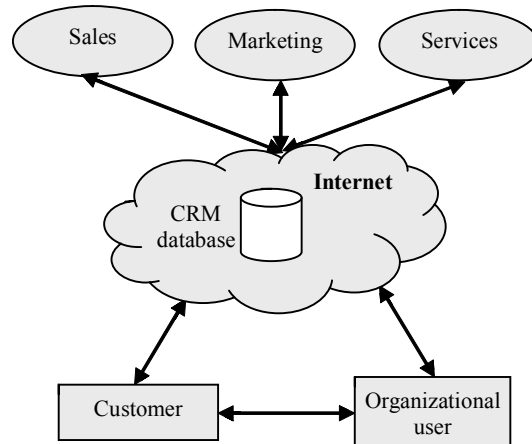


Fig. 10.8 A Typical CRM System

Types of CRM Systems: Nowadays, three major types of CRM systems, namely *Operational CRM*, *Analytical CRM* and *Collaborative CRM* are being used in many organizations.

- **Operational CRM:** It provides support to front-office business processes that involve direct interaction with customers through any communication channel, such as phone, fax, e-mail, etc. The details of every interaction with customers, including their requirements, preferences, topics of discussion, etc., are stored in the customers' contact history and can be retrieved by the organization's staff whenever required. Thus, it presents a unified view of customers across the organization and across all communication channels. Examples of operational CRM applications are Sales Force Automation (SFA), Customer Service and Support (CSS), Enterprise Marketing Automation (EMA), etc.
- **Analytical CRM:** It enables to analyse customer data generated by operational CRM applications, understand the customers' behaviour and derive their true value to the organization. This helps to approach the customers with pertinent information and proposals that satisfy their needs. The analytical CRM applications use analytical marketing tools like data mining to extract meaningful information like the buying patterns of the customers, target market, profitable and unprofitable customers, etc., that help to improve performance of the business.
- **Collaborative CRM:** It allows easier collaboration with customers, suppliers and business partners and, thus, enhances sales and customer services across all the marketing channels. The major goal of collaborative

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CRM applications is to improve the quality of services provided to the customers, thereby increasing the customers' loyalty. Examples of collaborative CRM applications are Partner Relationship Management (PRM), customer self service and feedback, etc.

Benefits of CRM: Effective CRM systems can realize the following benefits to an organization.

- Help organizations to determine their most profitable customers and establish a long term relationship with them. This can increase the firm's sales revenue.
- Result in reduced churn rate (the number of customers who stop buying or using products of a company) by enabling the firms to customize and personalize the products according to user needs, preferences, buying habits, etc.
- Enables provision of better customer service and support across all the touch points, whichever the customer uses.

Supply Chain Management

The concept of supply chain management is not new but it has become increasingly important for the last few years. With the shifting of business focus from manufacturing to customer value, companies are not much concerned about manufacturing costs or producing high-quality products; rather the major challenge is to deliver the correct product, at the correct location, at the time the customers need, in the appropriate quantity and at the lowest possible cost. Meeting this challenge entails the need of Supply Chain Management (SCM).

SCM is a business and technology discipline that refers to the ways of coordinating the activities involved in purchasing, designing, building and selling a product. It uses information technology to create a cross-functional inter-enterprise (involving more than one organization) system called **SCM information systems**. These systems integrate the business processes of suppliers, purchasing firms, distributors and custom logistics in order to improve the efficiency and effectiveness of manufacturing and distribution. They automate the flow of information between a company and its supply chain partners to optimize the sourcing and procurement, manufacturing and delivery of products or services.

The Supply Chain: In simplest terms, SCM is all about managing the supply chain—a network of organizations and the business processes for acquiring the raw materials, transforming them into finished goods and distributing the products to the customers. The supply chain links many business entities, such as supplier, manufacturer, transporter, distributor, retailer and the customers themselves. Note that the supply chains of different organizations may differ in the number of entities and it is not always required for a supply chain to have all the entities. Each entity in the supply chain contributes to the goal of reaching the customers. The supply chain is driven by three main inputs, namely *information*, *materials* and *funds* which flow among the supply chain members.

Figure 10.9 shows a simplified example of a supply chain in a typical organization. The raw material sources from suppliers are transformed to

intermediate products and finished goods through manufacturing facilities. The finished products are shipped to distribution centres and from there to retailers and ultimately to customers. Note that in this figure, only the primary supplier of the company has been shown. However, the supply chains, especially of large manufacturers can have primary, secondary and tertiary suppliers also.

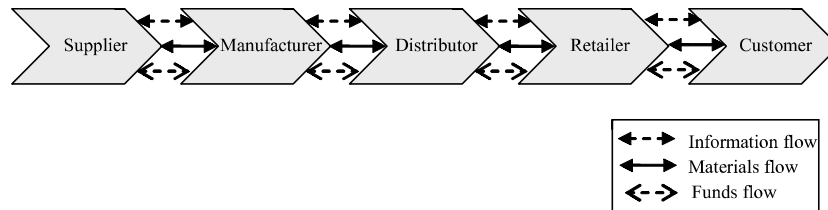


Fig. 10.9 An Example of a Supply Chain

The ultimate goal of SCM systems is to efficiently manage the flow of information, materials and funds across the entire supply chain, thereby reducing the cost of supply chain while bringing a firm's products from concept to market.

Types of SCM Systems: Depending on the functions the SCM systems perform, they are classified into two categories, namely *Supply Chain Planning Systems* and *Supply Chain Execution Systems*.

- **Supply Chain Planning Systems:** These systems provide information that help businesses in the planning of their supply chain. Some of the important supply chain planning functions are as follows:
 - o Forecasting demand for specific products, and preparing sourcing and manufacturing plan for those products.
 - o Estimating the quantity of the product to be manufactured in a given time period.
 - o Deciding the location where the finished goods are to be stored.
 - o Identifying the transportation mode to be used for delivering the products.
 - o Setting the inventory levels for raw materials, intermediate products and finished goods.
 - o Determining the product quantity a business should make in order to meet all its customers' demands.
- **Supply Chain Execution Systems:** These systems provide information that help businesses in the execution of their supply chain steps. Some of the major supply chain execution functions are as follows:
 - o Managing the flow of products from the manufacturers to distributors to retailers and finally to customers in order to ensure the accurate delivery of products.
 - o Providing information about the status of orders being processed so that the vendors could provide the exact delivery dates to customers.

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- o Tracking the shipment and accounting for the products that have been returned or are to be repaired and serviced.

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Benefits of SCM: Effective SCM systems provide the following benefits to optimize the organization's performance.

- Improve the customer service by delivering them the right product at the right time and at the right location, which in turn increases the organization's sales.
- Enable the companies to bring the products to the market at a quicker rate. Thus, the companies get their payment sooner than those who lack an efficient supply chain.
- Lower the total supply chain cost, including procuring materials cost, transportation cost, inventory carrying cost, etc. The reduction in supply chain cost helps to increase the firm's profitability.

10.8 VALUE-ADDED NETWORKS AND NETWORKINGS

A Value-Added Network (VAN) is a private, third-party-managed network that offers data transmission and network services to subscribing firms. Let us say, a business firm wants to communicate purchase orders to its vendor. One possibility is that both parties join hands and set up a communication system. Another possibility is to subscribe to a VAN service provider who will set up the system and the buyer and the vendor will be connected to each other through the VAN service provider. The VAN service provider will facilitate communications between both parties. The parties pay only for the amount of data they transmit along with a subscription fee. VANs are cost effective because of economies of scale.

The term VANs stands for Value Added Network Services. Traditionally it transmits data formatted as Electronic Data Interchange (EDI) but now they also transmit data formatted as XML or in more specific binary formats. Value-added network services provide data transformation between specific formats, such as EDI-to-XML, EDI-to-EDI, etc. At one extreme, a VAN hosts only horizontal Business-to-Business application integration services, hosting general-purpose integration services for any process or industry. At the other extreme a VAN also hosts process specific or industry specific integration, for example supply chain ordering or data synchronization services. A VAN not only transports (receives, stores and forwards) messages but also adds audit information to them and modifies the data in the process of automatic error detection and correction or conversion between communications protocols.

Check Your Progress

7. What are enterprise applications?
8. What is value-added network?

10.9 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. A client-server network is also known as a server-based network. The client-server network model is centralized and computers are configured with specific functionality. Also, computers can be configured with high priority or low priority.
2. The data management layer in client-server model is most critical to any business and deals with database management of the system. Data is available across multiple sessions of the application. Data represents the knowledge repository, which is reusable.
3. A file server is used to store files in a centralized location in the network. It is also responsible for management of data. Users in the network can centrally access files from a file server. For each user in the network, some storage space is allocated by the administrator to store files on a file server.
4. ISDN is a network architecture in which digital technology is used to convey information from multiple networks to end user. This information is digital from end to end.
5. Electronic Data Interchange (EDI) software has four layers, namely business application, internal format conversion, EDI translator and EDI envelope for document messaging. At the sender's side, these four layers make a package of the information and then this package is sent over the value added network to the target side where the four layers follow the reverse process to obtain the original information.
6. Enterprise Resource Planning (ERP) system is an information system that integrates departments and functions across a company using one database system. It runs off a single database, enabling various departments to share information and communicate with each other. It is a business management system that integrates all facets of the business, including planning, manufacturing, sales and marketing. It automates the finance and human resources departments and helps manufacturers in handling jobs such as order processing and production scheduling.
7. Enterprise applications are the cross-functional enterprise information systems that support the organization-wide coordination and integration of business processes. It improves the efficiency and effectiveness of critical business processes all across the organization and coordinate the firm's activities with those of suppliers and customers using customer relationship management, supply chain management and enterprise systems.
8. A value added network is a private, third-party managed network that offers data transmission and network services to subscribing firms.

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10.10 SUMMARY

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- A computer network can be either of the following two major types: peer-to-peer network or client-server network.
- In a peer-to-peer network, all computers in a network are equal. It means no computer in the network has any higher or lower priority. There is no specific computer configured as client or server.
- A client-server network is also known as a server-based network. A client-server network is centralized and computers are configured with specific functionality. Also, computers can be configured with high priority or low priority.
- The Butler Group of Client-Server Forum, London, has designed a new framework to advance the client-server approach which is a five-layer model, also called the VAL (Value Added Layers) model. The basic structure of this model resembles a pyramid having the infrastructure layer at the bottom, followed by middleware, applications, repository and business model layers.
- A file server is used to store files in a centralized location in the network. It is also responsible for management of data. Users in the network can centrally access files from a file server. For each user in the network, some storage space is allocated by the administrator to store files on a file server.
- Groupware server provides environment to all users to share documents, communicate and coordinate in groups to complete tasks more effectively. Users can prepare schedules; they can view schedule of other users in the group and share their knowledge and plan accordingly.
- The flow of work in an organization is called workflow. Workflow can be a group of interdependent tasks that are carried out in business. It has a start and an end point. In workflow, any task or information or document is passed from one level to another level in hierarchical way.
- Mail servers are workgroup servers. It provides e-mail-related services on a network and stores the incoming messages and waits for the user to read it. Mail server is also used by corporate to send auto response to incoming mail.
- Database servers are special servers used in an organization to store data centrally. Data stored in a database can be accessed by any user from any location in the network. It allows multiple users to share the same data at the same time.
- A Private Branch Exchange (PBX) is a special-purpose computer designed for handling and switching office telephone calls at a company site. It can belong to a company or to a provider.
- Integrated Services Digital Network (ISDN) is an international standard for dial-up network access that integrates voice, data, image and video services in a single link.

- Electronic Data Interchange (EDI) is defined as ‘the computer-to-computer transfer of information in a structured and predetermined format’. EDI software has four layers, namely business application, internal format conversion, EDI translator and EDI envelope for document messaging.
- Enterprise Resource Planning (ERP) is an information system that integrates departments and functions across a company using one database system. It runs off a single database, enabling various departments to share information and communicate with each other. It is a business management system that integrates all facets of the business, including planning, manufacturing, sales and marketing.
- Enterprise applications are the cross-functional enterprise information systems that support the organization-wide coordination and integration of business processes.
- The main objectives of enterprise applications are to improve the efficiency and effectiveness of critical business processes all across the organization and coordinate the firm’s activities with those of suppliers and customers. To achieve these objectives, a number of enterprise applications are used, which include customer relationship management, supply chain management and enterprise systems.
- A Value Added Network (VAN) is a private, third-party-managed network that offers data transmission and network services to subscribing firms.

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10.11 KEY WORDS

- **Repository:** It refers to a place where or receptacle in which things are or may be stored.
- **Questionnaire:** It refers to a set of printed or written questions with a choice of answers, devised for the purposes of a survey or statistical study.
- **Groupware:** It refers to programs that help people work together collectively while located remotely from each other.
- **Domino server:** It refers to the name of the applications and messaging server program for the Lotus Corporation's Lotus Notes product.
- **Digital Conduits:** It refers to the tubes or troughs for protecting electric wiring.
- **Cross-functional Business Processes:** It refers to the different functional areas of an organisation working to complete the same piece of work, goal or aim.
- **Churn Rate:** It refers to the annual percentage rate at which customers stop subscribing to a service or employees leave a job.

10.12 SELF ASSESSMENT QUESTIONS AND EXERCISES

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Short Answer Questions

1. Differentiate between peer-to-peer and client-server networks.
2. What are the various layers in client-server model?
3. What does file server handles?
4. What is the significance of integrated services digital network?
5. Define the term electronic data interchange.
6. Why is enterprise resource planning system used?
7. What is CRM?

Long Answer Questions

1. Discuss peer-to-peer and client-server network models with the help of examples and illustrations.
2. Describe Butler pyramid model of client-server computing with the help of an example.
3. Explain the golden rules of client-server implementation.
4. Discuss the significance of communication servers. Explain its various types.
5. Discuss the role of integrated services digital networks in an organization and explain its various types.
6. Analyse the significance of electronic data interchange and its applications.
7. Discuss the significance of enterprise resource planning system in an organization and also management of resources.
8. Discuss the various roles and standards of inter-organizational information systems in business processes.
9. Explain the significance of value added network services in business processes.

10.13 FURTHER READINGS

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UNIT 11 ELECTRONIC COMMERCE AND INTERNET

*Electronic Commerce
and Internet*

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Structure

- 11.0 Introduction
- 11.1 Objectives
- 11.2 E-Commerce Bases
- 11.3 E-Commerce and the Internet
 - 11.3.1 E-Commerce Practices
 - 11.3.2 Administration, Business and Consumer Models of E-Commerce
 - 11.3.3 Applications in B2C
 - 11.3.4 Business-to-Business (B2B) Models
 - 11.3.5 Consumer-to-Consumer Model
 - 11.3.6 Peer-to-Peer Model
- 11.4 M-Commerce
- 11.5 Electronic Data Interchange
- 11.6 Applications of Internet and Website Management
- 11.7 Types of Social Media
 - 11.7.1 Uses of Social Media in Business Organization
- 11.8 Answers to Check Your Progress Questions
- 11.9 Summary
- 11.10 Key Words
- 11.11 Self Assessment Questions and Exercises
- 11.12 Further Readings

11.0 INTRODUCTION

In this unit, you will learn about Electronic commerce, commonly known as e-commerce. E-commerce refers to the buying and selling of products or services over electronic systems, such as the Internet and other computer networks. Electronic commerce describes such technologies as electronic funds transfer, supply chain management, Internet marketing, online transaction processing, Electronic Data Interchange (EDI), inventory management systems and automated data collection systems. Modern electronic commerce typically uses the World Wide Web in the transaction's life cycle. E-commerce is the application of communication and information sharing technologies among trading partners to the pursuit of business objectives. E-commerce is generally considered to be the sales aspect of e-business. It also consists of the exchange of data to facilitate the financing and payment aspects of business transactions. You will also learn about Mobile Commerce or M-Commerce, which is any transaction involving the transfer of ownership or rights to use goods and service using mobile access to computer mediated networks with the help of an electronic device. The Internet applications can be categorized into online media, online information search, online

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communications, online communities, online entertainment, e-business, online finance and other applications. E-business is an application that is closely related to our lives. Search engines are used as basic applications that allow users to acquire the information they demand online.

11.1 OBJECTIVES

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

- Analyze the scope of e-commerce bases
- Discuss the significance of e-commerce and the Internet
- Define the concept of M-commerce
- Explain the process of electronic data interchange
- Describe the various applications of the Internet and Website management
- State the type of social media and their usage in business

11.2 E-COMMERCE BASES

E-commerce is the application of communication and information sharing technologies among trading partners to the pursuit of business objectives. E-commerce can be defined as a modern business methodology that addresses the needs of organizations, merchants and consumers to cut costs while improving the quality of goods and services and increasing the speed of service delivery. E-commerce is associated with the buying and selling of information, products and services via computer networks. Key element of e-commerce is information processing. It facilitates new types of information based business processes for reaching and interacting with customers – online advertising and marketing, online order taking and online customer service, etc. Virtual enterprises are business arrangements in which trading partners separated by geography and expertise are able to engage in complex joint business activities, as if they were a single enterprise. E-commerce allow the customer to do ‘one stop shopping’ with the assurance that a single phone call will bring the right materials to the right location at the right time.

Hence, e-commerce has become a very popular form of transaction in today’s world. Now buyers purchase goods and services online rather than visiting the shops and making selections. The prime benefit of e-commerce is its 24 × 7 connectivity which is not present in normal transactional selling. The following are best Indian Website which deal with e-commerce:

khaj.com

khaj.com is a very popular Indian Web directory as the e-commerce section of this site provides important information regarding the e-commerce rules defined by the Ministry of Commerce of India. This Website also provides a list of other

e-commerce portals, such as walletwatch.com, paygateindia.com, seekandsource.com, dotlinedesigns.com and many more.

Sifycorp.com

Sify is referred as one of the most renowned end to end e-solutions providing company in India. They endeavor persistently to provide you with a network connectivity solution that connects your critical business systems and offers a smooth data network directly with customers, vendors and staff.

eBay. in

Formerly known as bazee.com, today ebay.in is one of the largest e-commerce Website of India. This Website has a vast list of products and services on offer to all its prospective customers. Its product line can be divided into several categories like apparels, accessories, electronic gizmos, cars and bikes, fitness and sports, home appliances and many more. Another advantage of using this site is that you can sell your products online.

shopping.rediff.com

It is the e-commerce portal of rediff.com which is known for its unique offerings and cheapest of prices. This e-commerce portal also has a separate section called “best discounts” where only those items are displayed upon which more than normal discount have been allotted.

futurebazaar.com

futurebazaar.com is one of the largest Indian e-commerce Website partnered by Big Bazaar, a leading departmental stores of India. It offers a wide variety of shopping items like apparel, books, cameras, consumer durables, kitchen appliances, laptops, mobile phones, and many more. On some selected products, this e-commerce portal provides up to 50% discount.

Synapse.com

Synapse is a renowned Website. It compiles communications, data management and security to offer clients e-commerce solutions to businesses worldwide. Synapse also provides its customer’s competitive, effective B2B and B2C e-solutions involving reduced transaction fees, real time tracking of transactions; e-tailing of products; secure electronic transactions and the remote management of logistics, including the tracking of users, processes and information.

Check Your Progress

1. What is e-commerce associated with?
2. What is the key element of e-commerce? What does it facilitate?
3. What is futurebazaar.com?

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11.3 E-COMMERCE AND THE INTERNET

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.

11.3.1 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 basics 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

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/Javasoftware 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

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to be able to shop for, buy and make payments for products and services offered on dissimilar frameworks. This is not possible at present.

(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

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 supports 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.

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 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:

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- 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.

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).

C. Online E-Telephony 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.

11.3.2 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.

(i) Business-to-Consumer (B2C), through the Internet

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. Table 11.1 shows the main elements of the Internet, extranet and intranet

Table 11.1 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

11.3.3 Applications in B2C

The followings are the applications in business to consumers:

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:

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.

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.

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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.

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.

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.

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.

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.

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.

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.

11.3.4 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' 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.

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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.

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11.3.5 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.

11.3.6 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 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.

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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 11.2 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

- 4. What is e-commerce?
- 5. What does does e-transaction mean?
- 6. What does an e-commerce framework presume?
- 7. What is e-banking?

11.4 M-COMMERCE

Mobile Commerce, also known as M-Commerce or mCommerce, is the ability to conduct commerce using a mobile device, such as a mobile phone, a Personal Digital Assistant (PDA) or a smartphone. Mobile Commerce has been defined as, ‘Mobile Commerce is any transaction involving the transfer of ownership or rights to use goods and services, which is initiated and/or completed by using mobile access to computer mediated networks with the help of an electronic device’.

Mobile commerce was originated in 1997 when the first two mobile phone enabled Coca Cola vending machines were installed in the Helsinki area in Finland. The machines accepted payment via SMS (Short Message Service) text

messages. The first mobile phone based banking service was launched in 1997 by Merita Bank of Finland, also using SMS. In 1998, the first sales of digital content as downloads to mobile phones were made possible when the first commercial downloadable ringtones were launched in Finland. Two major national commercial platforms for mobile commerce were launched in 1999: Smart Money (<http://smart.com.ph/money/>) in the Philippines and NTT DoCoMo's i-Mode Internet service in Japan. Mobile-commerce-related services spread rapidly in early 2000. In April 2002, building on the work of the Global Mobile Commerce Forum (GCMF), the European Telecommunications Standards Institute (ETSI) appointed Joachim Hoffmann of Motorola to develop official standards for mobile commerce.

PDAs and cellular phones have become so popular that many businesses are beginning to use mobile commerce as a more efficient way to communicate with their customers. In order to exploit the potential mobile commerce market, mobile phone manufacturers, such as Nokia, Ericsson, Motorola and Qualcomm are working with carriers such as AT&T Wireless and Sprint to develop WAP-enabled smartphones. Smartphones offer fax, e-mail and phone capabilities.

Since the launch of the iPhone, mobile commerce has moved away from SMS systems and into actual applications. SMS has significant security vulnerabilities and congestion problems, even though it is widely available and accessible. In addition, improvements in the capabilities of modern mobile devices make it prudent to place more of the resource burden on the mobile device.

More recently, brick and mortar business owners, and big-box retailers in particular, have made an effort to take advantage of mobile commerce by utilizing a number of mobile capabilities, such as location based services, barcode scanning and push notifications to improve the customer experience of shopping in physical stores. By creating a 'bricks & clicks' environment, physical retailers can allow customers to access the common benefits of shopping online, such as product reviews, information and coupons. This is referred as a bridge between the gap created by e-commerce and in-store shopping, and is being utilized by physical retailers as a way to compete with the lower prices typically seen through online retailers.

M-Commerce Applications

Mobile Ticketing: Tickets can be sent to mobile phones using a variety of technologies. Users then use their tickets immediately, by presenting their phones at the venue. Tickets can be booked and cancelled on the mobile device with the help of simple application downloads or by accessing the WAP portals of various travel agents or direct service providers.

Mobile Vouchers, Coupons and Loyalty Cards: Mobile ticketing technology can also be used for the distribution of vouchers, coupons and loyalty cards. These items are represented by a virtual token that is sent to the mobile phone. A

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customer presenting a mobile phone with one of these tokens at the point of sale receives the same benefits as if they had the traditional token. Stores may send coupons to customers using location based services to determine when the customer is nearby.

Content Purchase and Delivery: Currently, mobile content purchase and delivery mainly consists of the sale of ringtones, wallpapers and games for mobile phones. The convergence of mobile phones, portable audio players and video players into a single device is increasing the purchase and delivery of full length music tracks and video. The download speeds available with 4G networks make it possible to buy a movie on a mobile device in a couple of seconds.

Location-Based Services: The location of the mobile phone user is an important piece of information used during mobile commerce or m-commerce transactions. Knowing the location of the user allows for location based services, such as:

- Local discount offers.
- Local weather.
- Tracking and monitoring of people.

Information Services: A wide variety of information services can be delivered to mobile phone users in the same way as it is delivered to PCs. These services include:

- News
- Stock quotes
- Sports scores
- Financial records
- Traffic reporting

Customized traffic information, based on a user's actual travel patterns, can be sent to a mobile device. This customized data is more useful than a generic traffic report broadcast, but was impractical before the invention of modern mobile devices due to the bandwidth requirements.

Mobile Banking: Banks and other financial institutions use mobile commerce to allow their customers to access account information and make transactions, such as purchasing stocks, remitting money. This service is often referred to as Mobile Banking or M-Banking.

Mobile Brokerage: Stock market services offered via mobile devices are becoming more popular and are known as Mobile Brokerage. They allow the subscriber to react to market developments in a timely mode irrespective of their physical location.

Auctions: Over the past three years, mobile reverse auction have developed in popularity. Unlike traditional auctions, the reverse auction (or low-bid auction) bills the consumer's phone each time they place a bid. Many mobile SMS

commerce solutions rely on a one time purchase or one time subscription; however, reverse auctions offer a high return for the mobile vendor as they require the consumer to make multiple transactions over a long period of time.

Mobile Browsing: Using a mobile browser—a World Wide Web browser on a mobile device—customers can shop online without having to be at their personal computer.

Mobile Purchase: Catalogue traders can accept orders from customers electronically via the customer's mobile device. In some cases, the trader may even deliver the catalogue electronically, rather than mailing a paper catalogue to the customer. Some traders provide mobile Website that are specifically customized for the smaller screen and limited user interface of a mobile device.

Mobile Marketing and Advertising: In the context of mobile commerce, mobile marketing refers to marketing sent to mobile devices. Mobile campaigns must be based on the global Content Generation also called Generation C and four other C's: Creativity, Casual Collapse, Control and Celebrity. A successful mobile commerce requires the development of marketing campaigns targeted to particular market segment.

Payment Methods

Consumers can use many forms of payment in mobile commerce, including:

- Premium rate telephone numbers', which apply charges to the consumer's long distance bill.
- Charges added to the consumer's mobile telephone bill, including deductions to prepaid calling plans.
- Credit cards support. Some providers allow credit cards to be linked to a phone's SIM card.
- Micropayment services.
- Stored value cards, often used with mobile device application stores or music stores.

11.5 ELECTRONIC DATA INTERCHANGE

Electronic Data Interchange (EDI) Exchange integrates business processes across companies by exchanging business documents, such as purchase orders, invoices, shipment notices, etc., in electronic form using a standard format over a communication network. The benefits of EDI include reduction in data entry errors, cycle time, cost and paperwork. Once the data is in electronic form, it stays that way; it does not get converted to paper form that will require re-entry at the receiver's site. If the parties communicating are customer and supplier, both can benefit by following the same standards and plan in a better manner, which results in reduced inventory and competitive advantage.

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There are many protocols for EDI, such as ANSI X.12 and EDIFACT. Applications, such as ATMs, airlines reservations systems and stock exchange transactions use this technology. EDI differs from e-mail in that it transmits an actual structured transaction (with distinct fields such as the transaction date, transaction amount, sender's name and recipient's name) as opposed to an unstructured text message such as a letter.

11.6 APPLICATIONS OF INTERNET AND WEBSITE MANAGEMENT

The **Internet** is a global system of interconnected computer networks that use the standard Internet protocol suite (often called TCP/IP, although not all protocols use TCP) to serve billions of users worldwide. It is a network of networks that consists of millions of private, public, academic, business and government networks of local to global scope that are linked by a broad array of electronic, wireless and optical networking technologies. The Internet carries an extensive range of information resources and services, such as the interlinked hypertext documents of the World Wide Web (WWW) and the infrastructure to support e-mail.

The Internet applications can be categorized into online media, online information search, online communications, online communities, online entertainment, e-business, online finance and other applications. Search engines are basic applications that allow users to acquire the information they demand online. Online communications include e-mail and instant messaging. Due to the rising popularity of the Internet in offices, more and more employees are using e-mail. Instant messaging is referred as a linking point for the socialized Internet. Additionally, instant messaging platforms are gradually becoming an important entry point for e-mail, blogs, online gaming, search and other types of the Internet applications.

Interactivity is one of the most important characteristics of online news. Online news has allowed traditional one-way broadcasting to give way to two-way or multi-way communication. Online news has resulted in the combination of several types of media. This means it is even more expressive and infective.

The online communities include friend-finding Website and blogs. E-business is an application that is closely related to our lives. Over the past year, the number of online marketplaces has evidently grown. Except for online shopping, online sales and travel bookings have already established a beginning user base. Online payment systems, which are closely related to online shopping, have also been developing extremely fast. Online trading is directly related to the changes in the stock market.

The Internet allows greater flexibility in working hours and location, especially with the spread of high speed connections. The Internet can be accessed almost

anywhere by numerous means, including mobile Internet devices. Mobile phones, data cards, handheld game consoles and cellular routers allow users to connect to the Internet wirelessly. Educational material at all levels from pre-school to post-doctoral is available from specific Website. Examples range from virtual universities to access to top-end scholarly literature through the likes of Google Scholar. Hence, the Internet in general and the World Wide Web in particular are important enablers of both formal and informal education.

The low cost and almost on the spot sharing of ideas, knowledge and skills has made collaborative work dramatically easier, with the help of collaborative software. Internet chat, whether in the form of an IRC chat room or channel, via an instant messaging system or a social networking Website, allows colleagues to be in touch in an extremely convenient method while working at their computers. Messages can be exchanged even more quickly and conveniently than via e-mail. These systems may allow files to be exchanged, drawings and images to be shared or voice and video contact between team members. Content management systems allow collaborating teams to work on shared sets of documents simultaneously without accidentally destroying each other's work. Business and project teams can share calendars as well as documents and other information.

Website Maintenance

Technically, the Website maintenance process comprises of following:

- Content addition and modifications as per the client needs.
- Website designing and redesigning.
- Search engine submissions and other promotional activities.
- Website restructuring according to the changing client needs.
- New technology deployment.

Creating a Website is easy compared to maintaining it because maintaining a site can require more money than developing it. The following are the four areas of Website maintenance and management:

- **Content:** The content needs to be alive, current and accurate. With fresh information people will return to the Website time and again. Also old articles, comments and other information should be archived.
- **Technology:** Technology changes so fast that a 'Web year' is sometimes referred as one month. A site looks and acts old without updating. In addition, components of the site can malfunction, requiring maintenance.
- **Community Development and Marketing:** The number of visitors depends on the increased activities of the Website. This building of the community requires promotion and regular creative improvement.

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- **Response and Customer Service:** Site visitors, customers and members often need a response. They may have questions, comments, complaints and suggestions. The customer support, forum moderating and any kind of database management must be carefully handled.

11.7 TYPES OF SOCIAL MEDIA

Some of the most popular current forms of social media are social networking Websites, such as Facebook, which surpassed over one billion active monthly users. There are several types of online platforms classified under the vast umbrella of social media. These categories include:

- **Social Networks:** Social networking websites allow users to build web pages featuring personal portfolios and interests. These pages are used to connect with friends, colleagues and other users in order to share media, content and communications. Examples of social networks include Facebook, LinkedIn, MySpace and Bebo.
- **Web Blogs:** Some of the oldest and most popular forms of social media are blogs. Blogs are often viewed as online journals that order content chronologically, or by date, month, year and category. Blogging Websites include Word Press, Blogger and Tumblr.
- **Microblogs:** Microblogging is particularly common for posting quick updates and distributing content via mobile devices. Notable microblogging sites include Twitter and Tumblr. However, social networks, such as Facebook, Google+, LinkedIn and Myspace also have their own microblogging features.
- **Content Communities:** Users on content communities organize, share and comment on different types of content, including images and videos. YouTube, Flickr and Scribd are examples of content communities.
- **Wikis:** Wiki Websites allow a community of people to add and edit content in a community-based database. One of the best-known wikis is Wikipedia.
- **Podcasts:** Podcasts are audio and video files available through subscription services, such as Apple iTunes. The term 'podcast' is a neologism derived from 'broadcast' and 'pod' (as in 'iPod'), since Podcasts are often listened to on portable media players.

Other types of social media include the following:

- Rating and review sites (e.g. Yelp).
- Social bookmarking or social tagging features (e.g. Digg; StumbleUpon).
- Forums and discussion boards (e.g. Yahoo!; Answers).

- Virtual social worlds (e.g. Second Life; World of Warcraft).
- Music and audio sharing (e.g. Spotify; Pandora Radio).

11.7.1 Uses of Social Media in Business Organization

Social media is not only a whole new way for users to communicate and express themselves; it is also a whole new way for organizations to conduct business. Every day new applications can be seen for social media in market research, marketing communications, brand management, innovation and even supply chain management.

For Brand Managers

Social media gives you a quick and accurate way to find out a specific image for your brand among consumers. You can perform a brand audit by analysing posts (also referred to as 'sound bites' or 'verbatim') from consumers about a brand.

Brand managers and customer service managers can track a metric, such as sentiment (positive or negative), which can be thought of as a measure of brand equity. Brand equity metrics obtained through social media analysis are available without waiting for survey data.

For Customer Service

This is really the same technique as brand equity tracking (i.e., tracking sentiment), but it is used for customer service evaluation instead. Net Promoter Score (NPS), which is survey based, is sometimes used; sentiment is simply another way to measure the same parameter with social media.

For Market Researchers

You can compare brands in a category on various attributes, including share of buzz, overall sentiment, and key positive and negative themes using social media. An innovation technique that social media supports is incremental innovation, where you improve your existing product by fixing the complaints or by finding out what people like about your competitor and adding those benefits to your product. You can search social media for 'lead users,' who are users of a product or service that currently experience needs still unknown to the public and who would benefit greatly if they could find a solution to these needs. If they do, their solution can be commercialized, and the Lead User Method suggests it will be more successful than other methods.

In addition to the above mentioned uses, one can use social media to fulfil other business purposes such as for public relations, for business intelligence, for research and development (R&D), for lead generations, mergers and acquisitions, community participation, brand rationalization, marketing, customer satisfaction measurement and to name a few.

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Check Your Progress

8. What is mobile commerce?
9. What does electronic data exchange integrate?
10. List the categories of Internet applications.
11. Name the several types of online platforms.

11.8 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. E-commerce is associated with the buying and selling of information, products and services via computer networks.
2. Key element of e-commerce is information processing. It facilitates new types of information based business processes for reaching and interacting with customers – online advertising and marketing, online order taking and online customer service, etc.
3. futurebazaar.com is one of the largest Indian e-commerce Website partnered by Big Bazaar, a leading departmental stores of India. It offers a wide variety of shopping items like apparel, books, cameras, consumer durables, kitchen appliances, laptops, mobile phones, and many more.
4. 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.
5. 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.
6. 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.
7. E-banking is a way through which users can do their transactions electronically or online over the Internet. Through Internet banking, users can check their transactions at anytime and number of times they want.
8. Mobile Commerce, also known as M-Commerce or mCommerce, is the ability to conduct commerce using a mobile device, such as a mobile phone, a Personal Digital Assistant (PDA) or a smartphone.

9. Electronic Data Exchange (EDI) integrates business processes across companies by exchanging business documents, such as purchase orders, invoices, shipment notices, etc., in electronic form using a standard format over a communication network.
10. The Internet application can be categorized into online media, online information search, online communications, online entertainment, e-business, online finance and other applications.
11. The several types of online platforms are social networks, web blogs, microblogs, content communities, wikis, podcasts, rating and review sites, forums and discussion boards, virtual social worlds, music and audio sharing.

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11.9 SUMMARY

- E-commerce is the application of communication and information sharing technologies among trading partners to the pursuit of business objectives.
- E-commerce can be defined as a modern business methodology that addresses the needs of organizations, merchants and consumers to cut costs while improving the quality of goods and services and increasing the speed of service delivery.
- 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 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.
- E-commerce can be Business-to-Business (B2B) selling and purchasing, the security of business transactions and e-retailing with online catalogues, etc.
- 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-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.
- An e-commerce framework assumes 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.

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- 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.
- 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.
- 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.
- Electronically trading in stocks, securities and funds is called e-trading. It needs an extensive communication network and infrastructure to clear transactions.
- Mobile Commerce, also known as M-Commerce or mCommerce, is the ability to conduct commerce using a mobile device, such as a mobile phone, a Personal Digital Assistant (PDA) or a smartphone.
- Electronic Data Interchange/Exchange (EDI) integrates business processes across companies by exchanging business documents, such as purchase orders, invoices, shipment notices, etc., in electronic form using a standard format over a communication network.
- The Internet applications can be categorized into online media, online information search, online communications, online communities, online entertainment, e-business, online finance, and other applications.
- Technically, the Website maintenance process comprises of Content addition and modifications as per the client needs, Website designing and redesigning, Search engine submissions and other promotional activities, Website restructuring according to the changing client needs and New technology deployment.

11.10 KEY WORDS

- **Web directory:** It refers to a database of selected websites, ordered in such a way as to facilitate browsing.
- **Demographic data:** It refers to the statistical data about the characteristics of a population, such as the age, gender and income of the people within the population.
- **Extranet:** It refers a system of computers that makes it possible for particular organizations to communicate with each other and share information.
- **Intranet:** It refers to a local or restricted communications network, especially a private network created using World Wide Web software.

- **Loyalty Card:** It refers to a card issued by a supermarket or chain store to a customer and used to record credit points awarded for money spent in the store.
- **Mobile Brokerage:** It refers to a brokerage house that allows you to buy and sell stocks and obtain investment information from its website.
- **Global Positioning System (GPS):** It refers to a satellite navigation system used to determine the ground position of an object.

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11.11 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short Answer Questions

1. List the famous Indian Websites which deal with e-commerce.
2. Differentiate between e-commerce, e-business and e-transaction.
3. What is an e-commerce communication mechanism?
4. What are the advantages of e-tailing?
5. What are credit cards?
6. What are the payment methods in m-commerce?
7. What are the protocols and applications of electronic data interchange?

Long Answer Questions

1. Explain the significance and functioning of the e-commerce bases.
2. Discuss the significant features of the e-commerce.
3. 'E-commerce facilitates commercial transactions electronically using the Internet technology.' Discuss.
4. Discuss the administration, business and consumer models of the e-commerce.
5. Explain the applications of B2C, B2B and C2C models of the e-commerce.
6. Explain m-commerce technology with the help of examples.
7. Critically evaluate the uses of social media in business organization.

11.12 FURTHER READINGS

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BLOCK IV
COMPUTER SYSTEMS AND ETHICAL
CHALLENGES OF MIS

*Computer Systems and
Resources*

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UNIT 12 COMPUTER SYSTEMS AND
RESOURCES

Structure

- 12.0 Introduction
- 12.1 Objectives
- 12.2 Types of Computer System Processing
 - 12.2.1 Batch Processing System
 - 12.2.2 Online Processing System
 - 12.2.3 Online Real-time Processing System
 - 12.2.4 Distributed Data Processing Mode
 - 12.2.5 Other Data Processing Modes
- 12.3 Computers systems: Types
 - 12.3.1 Input Devices; 12.3.2 Output devices; 12.3.3 Secondary storage
- 12.4 Hardware standards and Other Acquisition Issues
- 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

When it comes to define a computer system. You can simply define it as a set of integrated devices that input, output, process and store data and information. It is basically a basic, complete and functional system which incorporates all the hardware and software required to make it functional for a user. A complete computer system allows users to input, manipulate and store data.

The unit is all about types of computer systems and the types of computer system processing. It also discusses about the different methods of data processing, primary and secondary storage. In addition to this, you will also learn about hardware and software standards and other acquisition issues.

12.1 OBJECTIVES

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

- Discuss the types of computer systems
- Assess different methods of data processing

- Describe primary and secondary storage devices
- Understand input and output devices
- Explain hardware standards and other acquisition issues

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12.2 TYPES OF COMPUTER SYSTEM PROCESSING

Computers are used for processing data, analysing it and getting the necessary information for facilitating decision-making. It is, therefore, imperative that the data be processed in keeping with the specific needs, demands and requirements of the organization. Broadly, there are four different methods used for data processing and updating as illustrated in the figure 12.1.

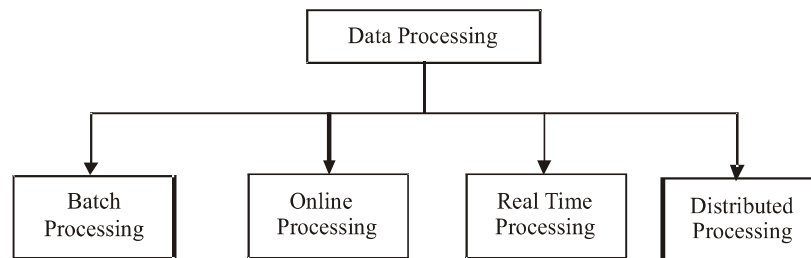


Fig. 12.1 Different Methods of Data Processing

Data processing transforms raw data into information. Such processing is automatic and runs on a computer. Just a collection of data alone does not mean anything unless it is presented systematically to convey some meaningful information. An information system has data-processing structures to highlight their practicality. Information systems accept raw data as input and generate information as output. Information is either a meaningful response to a question or may lead to further questions to get a meaningful response.

The computer does not think, and has no power of reasoning. So it can produce output of the quality that matches that of the input. If input is inconsistent, so will be the output.

While the computer keyboard is a common method of data input, there are various other ways for data capture. They are as given below:

- OCR (Optical Character Reader) that reads characters by optical scanning.
- Voice recognition software that takes input in form of speech
- OMR (Optical Mark Reader) that reads marks
- Hand-held devices that extract input from a document
- Bar Code Readers that are used to capture information in the form of bar codes.

The advantages and disadvantages of these systems are:

Method	Advantage	Disadvantage
OCR	Can scan old documents	May not recognize every character
Voice recognition software	Takes speech input and produces output.	Not fit for regional dialects
OMR	High speed recognition	Recognizes markings only
Hand-held devices	Portable devices for capturing data	Has to be connected to a working station
Barcode	Highly reliable	Difficult to interpret

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Data processing is done both offline and online. When high volumes of data is to be handled, and results are not required immediately, then offline or batch processing is most suitable. Advantages of such processing are:

- Done at a quiet time without disturbing other important jobs.
- Verification and validation can be done.

A bank uses offline processing for daily transactions on its customers' accounts. Here, the results are not needed immediately but on the next working day.

In online data processing, an immediate response is needed, as in an air traffic control system, where data is to be updated all the time and there is continuous change in input and subsequent output.

12.2.1 Batch Processing System

Till the early 1960s, batch processing was the only method of data processing, as technical limitations required that periodic data preparation and periodic batch processing be utilized. This system, however, continues to be used till date in older systems or in those systems where massive volumes of periodic transactions are involved.

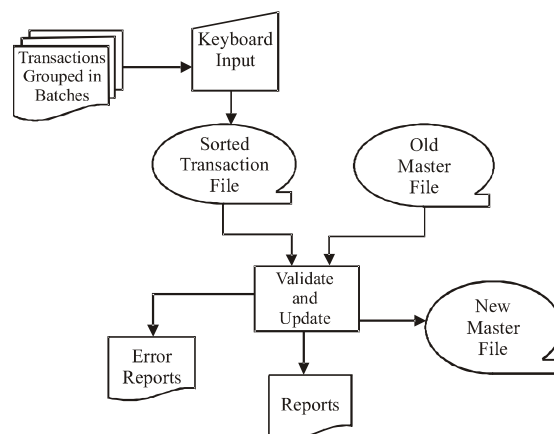


Fig. 12.2 Batch Processing

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Batch processing involves the accumulation/storage of information in a group or **batch** until it becomes efficient or necessary for processing them. Batch processing of transactions can be very efficient in terms of data preparation and processing of transactions, especially when they are processed against a sequential file.

In batch systems, transactions are collected in a transaction file, which holds all the transactions for a particular period. This file is periodically used for updating the master file, which holds permanent information on entries. Adding the transaction data to the existing/current master file, generates a new master file, as illustrated in figure 12.2.

While batch processing may be useful in enhancing the control of transaction processing, it must be remembered that one major disadvantage of periodic batch processing is the delay in detecting and correcting errors.

12.2.2 Online Processing System

The online processing system of transactions has now become a way of life. In this system, the user has access to a terminal for input of transactions and output of results. Transactions are entered by the user into a device which is directly connected to the computer system. The transaction is taken for processing directly and validated immediately before being taken up for further processing. After validation, the data is accepted but processing itself may be performed either immediately or later, as illustrated in figure 12.3.

For online processing, the files must be available on direct access storage devices for immediate access to the data, so that records could be added to or deleted from the file. Thus, in online processing, the processing of data—from input to computation and updation of status on various files—is carried out immediately.

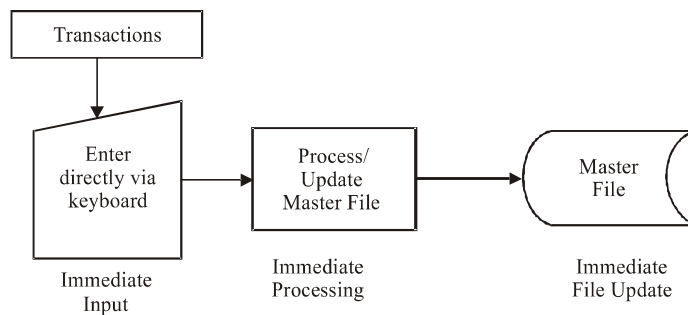


Fig 12.3 Online Processing

However, a user responsible for processing data in an online system must ensure proper security protocol—he must sign on properly, enter transactions in the proper, laid down format, respond to error messages with corrected input, review control information and sign off after the transaction processing is completed to prevent unauthorized use/access.

12.2.3 Online Real-time Processing System

The online real-time processing system is similar to the online processing system as in both the systems, a transaction is entered directly into the computer and validated immediately. However, while under the online processing system, the transaction may be processed later, under the online real-time processing system, once a transaction is found to be valid, it is processed immediately and the results are also made available immediately, as the master data is always kept up to date.

Needless to add, the online real-time processing system is used where stored data needs to be updated simultaneously as the transaction takes place.

The points to be considered are the higher costs of online processing, requiring greater computing power and often data communication, as also the extra procedures required to produce adequate control information and safeguard files against accidental or deliberate destruction during online updating.

A schematic representation of two alternatives for an online direct entry is illustrated in figure 12.4.

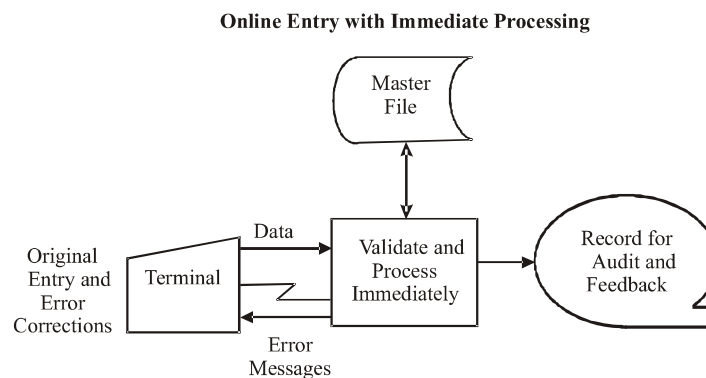


Fig. 12.4 Online Entry with Immediate Processing

12.2.4 Distributed Data Processing Mode

The distributed data processing mode became popular during the 1970s as this period witnessed the growth of powerful telecommunications networks and developments in computer technologies, leading to significant decline in computer hardware prices/costs.

The distributed data processing method refers to the distribution of computer processing among geographically and functionally multiple locations linked by the communications network. The distributed data processing mode enables the serving of multiple real-time applications as well as multiple classes of users. Instead of relying on a single centralized/mainframe computer system to provide service to remote sites, the distributed processors directly serve regional/local units/establishments. These processors, in turn, are linked to each other by networks.

The distributed data processing system provides the advantages of increased system availability and quicker system response time. System availability is increased

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because when the CPU malfunctions or undergoes preventive maintenance, its work may be transferred to another CPU in the system. The response time is improved because the workload can be distributed evenly among the CPUs to ensure optimum utilization.

12.2.5 Other Data Processing Modes

In addition to the batch processing, online processing, real-time processing and distributed data processing modes, there are some other modes which can be used for data processing. These modes are based on the capability of the operating system. Such data processing modes are as follows:

- Time-sharing
- Multi-programming
- Multiprocessing

Let us briefly discuss these three data processing modes.

Time-sharing

The time-sharing mode of data processing allows several users to simultaneously share the processing capability of the computer system. Under this mode, each user is allotted a certain time slot or time slice during which that particular user has access to the processor. The processor spends this allotted time on one program before moving over to another. This activity is repeated until the user's task is finally completed. The users of the system generally avail the facility of time-sharing of a computer system through remote terminals.

Multiprocessing

Multiprocessing is a capability of the operating system. It allows combining two or more CPUs to operate in parallel in one computer system. The tasks envisaged to be carried out are divided between the CPUs, leading to simultaneous execution of two or more processing units, which are part of the same system. This is possible as each processor shares access to its main memory with the other processors.

Multi-programming

Multi-programming is one of the most important capability of an operating system used for sharing computer resources and facilitating data processing. Multi-programming allows numerous programs to use a computer system's resources at any particular time through concurrent use of CPU, thereby enabling higher CPU utilization. Multi-programming enables a group of programs to take turns in using the CPU. For example, in the multi-programming mode, a number of programs are present in the memory and a number of jobs will be in queue waiting to be processed. When one of the jobs in the memory is finished, another job is taken from the queue and put into the main memory for execution.

It has, however, to be remembered that multi-programming and multiprocessing are different in as much as while multi-programming uses concurrent

processing with the single CPU, multiprocessing uses simultaneous processing with multiple CPUs.

Check Your Progress

1. Name the four different methods used for data processing and updating.
2. What are the different ways for data capture?
3. What things a user should ensure while processing data in an online system?

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12.3 COMPUTERS SYSTEMS: TYPES

According to the Information Technology Act, 2002, 'Computer means any electronic, magnetic, optical or other high-speed data processing device or system, which performs logical, arithmetical and memory functions by manipulating electronic, magnetic or optical impulses, and includes all inputs, output, processing, storage, computer software or communication facilities, which are connected or related to the computer in a computer system or computer network.'

However, a computer is basically an electromagnetic device and when we refer to a computer we normally have in mind the basic hardware equipment in a computer system. Computer hardware is the physical equipment used for input, processing and output activities in an information system, which supports the following functions:

- Entry or input to the computer
- Output from the computer
- Secondary storage
- Central processing unit (CPU), consisting of Arithmetical and Logical Unit (ALU) for computation, control and primary storage. Sometimes, the following two additional functions may also be present:
 - Data communication
 - Data preparation

The basic functions in a computer system can be illustrated in figure 12.5.

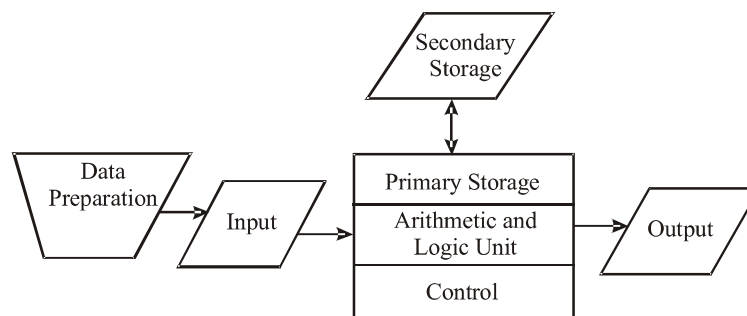


Fig. 12.5 Central Processing Unit

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The computer hardware consists of the following:

- Central processing unit (CPU)
 - Input devices
 - Output devices
 - Storage devices—primary and secondary
 - Physical media to link the aforesaid devices (communication devices).
- The various components can be illustrated in figure 12.6.

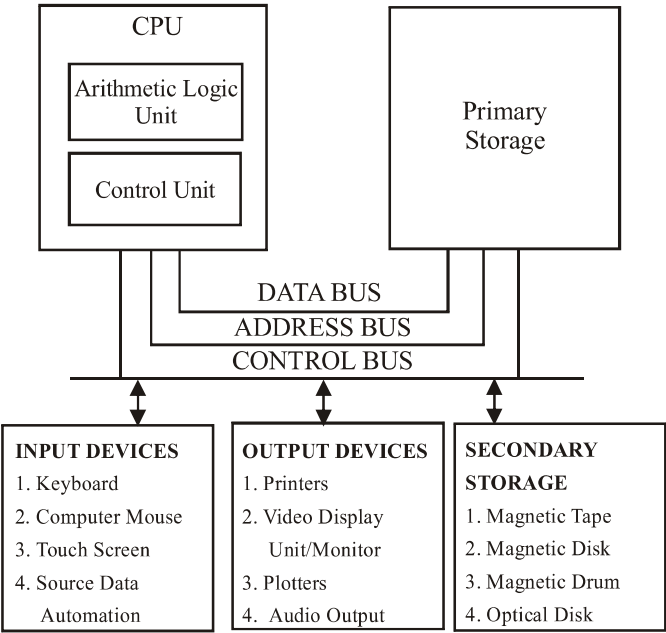


Fig. 12.6 Various Components of Computer Hardware

Before proceeding further, let us briefly define and describe the various components:

Central processing unit (CPU)

The CPU consists of the arithmetic and logic unit and the control unit. It is at the CPU that the manipulation of symbols, numbers and letters takes place. The CPU also controls the other parts of the computer system. Its functions are similar to the human brain.

Arithmetic and logic unit (ALU): The ALU in the CPU performs both arithmetic and logical operations. The arithmetic operations include addition, subtraction, multiplication and division and also determine whether a given number is positive or negative. On the logical side, it distinguishes between letters as well as numbers logically, and also determines whether a given quantity is greater than or lesser than or equal to another quantity.

Control unit: It controls and coordinates the other components of a computer system.

Primary storage

Also referred to as the main/core memory, primary storage is the component where data and storage instructions are stored for a temporary period till the processing is completed. There are three different types of primary storage, namely the register (in ALU or CU), the cache and the RAM. The linkage between CPU, primary storage and the other devices is provided by three buses, viz. data bus, address bus and control bus. The data bus moves data to and from primary storage. The address bus transmits signals for locating a given address in primary storage. The control bus transmits signals specifying whether to read or write data to/from a given primary storage address, input device or output device.

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12.3.1 Input Devices

Input devices are used for entering data into the computer system. Using a keyboard has been the traditional method of inputting data. A keyboard consists of the usual keys as well as special keys. The computer mouse is now a more popular input device particularly in the aftermath of the Graphical User Interface. A computer mouse is a hand-held device that is usually attached to the computer by a cable. It is known as a 'point and click' device, though it can also be used to draw images on the screen.

Touch screens permit entering or selecting commands and data by touching the surface of a sensitized video display unit/monitor with a finger or a pointer.

Source data automation is an input device—rather a technology—that captures data in computer readable form at the time and place the data is created. Magnetic ink character recognition (MICR), optical character recognition (OCR), bar code, pen-based inputs, digital scanners, voice input devices and sensors are examples of this technology.

12.3.2 Output devices

Some common output devices are cathode ray tube (CRT), terminals (video display units), printers, plotters, etc.

Cathode ray tube is generally the most popular form of output device in contemporary computer systems.

Printers produce a printed copy—known as hard copy—of information output. Printers can be 'impact printers' (e.g., dot matrix) or 'non-impact printers' (e.g., ink jet, laser, etc.). The output can be in the form of text, graphics or otherwise, as the case may be.

Plotters are used for obtaining high-quality graphic documents and are useful for computing large size charts, maps or drawings. An audio output device is one which converts digital output data into spoken word/intelligible speech.

12.3.3 Secondary storage

Secondary storage is the relatively long-term, non-volatile storage of data outside the CPU and primary storage. Hard disk, high density diskette, magnetic tape, optical disk, etc., are some of the secondary storage devices used.

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Check Your Progress

4. Define 'computer' as per the Information Technology Act, 2002.
5. What component is called the brain of the computer and why?
6. Name some secondary storage devices.

12.4 HARDWARE STANDARDS AND OTHER ACQUISITION ISSUES

A system consists of both, hardware as well as software. Hardware is the physical part whereas software is an abstract part of the system. Software needs a machine on which it can run and hardware needs instructions in form of program(s), contained in the software, for its working. Thus, to acquire a system, one has to acquire both, hardware as well as software.

The IT strategy should identify the basic type of hardware that the business requires, and prepare a systematic schedule for its acquisition. The pricing and ongoing costs are affected by the upgrade costs, warranties, level of support required, and the maintenance contract with the supplier.

An individual can acquire hardware in a several ways, such as by buying, leasing or renting it. Many small businesses buy their desktop and server hardware from the original manufacturer directly and completely via their website or over the telephone, or through a retail channel. The direct route is much more cost-effective for a small number of PCs at a time.

To gain the best from this route, it is essential that the specifications are clearly defined. One has to choose a standard offering that is not only meets the minimum requirements, but also compatible to changes in the future. For instance, memory can be upgraded later, if need be.

Another option is to hire a consultant to refine the requirements, prepare the list, analyse the various deals that are offered by different suppliers then finally buy the hardware.

You can also buy printers directly from the manufacturer. Ink-jet printers are priced cheaply. However, their ink cartridges are expensive and need frequent replacement. Therefore, it is better to purchase a more expensive laser-based printer and share it between the staff by using the network. The lower running costs will quickly cover the additional capital cost in case a great deal of colour is used. The running costs must be considered before choosing a particular type.

Network infrastructure components such as, network switches, wiring required to connect servers, printers as well as PCs. This type of hardware is available at most of the major catalogue based IT vendors who have a wide range of network equipments.

It is essential to strike a balance on the expenditure done on the infrastructure and PCs. The IT strategy and planning must include the expenses so that in case any network upgrades are required, they are implemented at the right time, not in a piecemeal fashion.

Software Acquisition - Types of Software

There are many types of software available in the market today. This requires lot of analysis before acquiring one that suits your requirement.

System software does not deliver business functionality directly. **System software** supports functionality by providing the framework application in which one can use a computer. Operating systems such as Windows or Linux are used to handle large amounts of data and these are not made for specific use. These are made for system oriented use.

Application software supports a particular application handled by user and interacts with hardware component of computer. Application software is designed by keeping in mind the requirement of users of different types. Normally, it is designed to a particular type of business requirements that covers a greater segment of customers. Developers try to create more useful add-ons to attract customers. An application package that has large user base may be marketed at a lower price because development cost is distributed over the entire customer base. On the other hand application packages, built to suit a smaller group, will be very expensive.

Application software fall under three categories:

- **Off-the-shelf package:** Such packages are built to suit a very large number of customers. These are sold through retail outlets. Developer has no contact with customers. Such packages are made with added features that attract different types of users.
- **Bespoke software applications:** Such application packages are created to meet the needs of a single customer as per specification provided by user. Such a package will be very costly since entire cost of development is booked on the single customer. Such applications are normally not used much. There are certain software that are to be kept secret such those used in forensic science. Such packages are not used in normal business operations.
- **Tailored application software:** These packages are developed on some standard. Some changes to suit the requirement of users can be made. Such changes are usually made by original software developer. Alternatively such changes can be done by employing a third party.

Understanding requirements

While deciding to acquire a software application package, the requirements such as the maintenance of VAT facilitates the selection the best of the lot. The time spent on assembling these requirements depends on the software and individual plans to acquire:

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- **Off-the-shelf ‘office’ package:** A detailed set of requirements is probably not useful in this case. The selection may be restricted to choosing a package that is compatible with the company's partners, suppliers etc.
- **Complex business-oriented package such as a payroll or accounts system:** A collection of requirements is helpful in this case as it assists selecting between different suppliers' packages.
- **A bespoke application:** An entirely structured set of requirements is vital in this case and will probably require professional help to construct them.

It is useful to concentrate initially on **what** is required in the application, not how this will be accomplished. This is particularly important in case of a customized application. This type of **functional requirement** describes things that the application has to do, in business terms.

Non-functional requirements describe things that are important but are not directly related to the business functions that the package performs. Take for instance, the speed and performance of a package that carries out some functions and the operating systems that the package works with.

The staff using the application is the best source of ideas about the functionality of any equipment/application. Their involvement facilitates the implementation. Their input in the form of a request for proposal can be used that contains the entire list of all the things you propose to buy. This list is sent to several suppliers to obtain a like-for-like price comparison.

Other Routes to Software Acquisition

Most software packages are provided under a license that restricts the utilization of the entire package as it does not provide the source code from which the package is generated.

The source code refers to the original program written by the software developer. This code can be modified to update the product or to suit a new activity. As the source code is not provided with the package, only the original developer can make changes in the code.

The popularity of Open-source software is an alternative that has swiftly grown. It is also made available under a license similar to proprietary software; however, this license is less restrictive as it provides the source code of the package.

Open-source software is usually available at minimal or zero cost. What is more, the software can be installed on as many computers as required at no extra cost. Therefore, it serves as a major cost saving approach over proprietary package.

Nevertheless, there are a few drawbacks of this approach:

- Limited number of business-oriented open-source applications
- Obtaining support and training for the application is tough

Another approach is the utilization of an application service provider. In this approach, the software is installed at the service provider's end and used over the internet.

The service provider maintains the data stored on their computers. The service provider also takes care and upgrades the software, which is done quite efficiently as it is situated at a single location.

Check Your Progress

7. What factors affect the pricing and ongoing costs of hardware?
8. What are the three categories of application software?

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12.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The four different methods used for data processing and updating are as follows:
 - (a) Batch Processing
 - (b) Online Processing
 - (c) Online Real-Time Processing
 - (d) Distributed Data Processing
2. Different ways for data capture include: Optical Character Reader (OCR), Voice recognition software, Optical Mark Reader (OMR), Hand-held devices, Barcode readers.
3. A user responsible for processing data in an online system must ensure proper security protocol-he must sign on properly, enter transactions in the proper, laid down format, respond to error messages with corrected input, review control information and sign off after the transaction processing is completed to prevent unauthorized use/access.
4. According to the Information Technology Act, 2002, 'Computer means any electronic, magnetic, optical or other high-speed data processing device or system, which performs logical, arithmetical and memory functions by manipulating electronic, magnetic or optical impulses, and includes all inputs, output, processing, storage, computer software or communication facilities, which are connected or related to the computer in a computer system or computer network.'
5. The central processing unit (CPU) is referred as the brain of computer because it is responsible to make decisions and perform calculations. The CPU consists of the arithmetic and logic unit and the control unit. It is at the CPU that the manipulation of symbols, numbers and letters takes place. The CPU also controls the other parts of the computer system.
6. Some of the secondary storage are hard disk, high density diskette, magnetic tape, optical disk, etc.
7. The pricing and ongoing costs of the hardware are affected by the upgrade costs, warranties, level of support required, and the maintenance contract with the supplier.

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8. The three categories of application software are as follows:

- Off-the-shelf application software
- Bespoke application software
- Tailored application software

12.6 SUMMARY

- Computers are used for processing data, analysing it and getting the necessary information for facilitating decision-making.
- There are four different methods used for data processing and updating, namely Batch Processing, Online Processing, Real Time Processing, and Distributed Processing.
- Batch processing involves the accumulation/storage of information in a group or batch until it becomes efficient or necessary for processing them. Batch processing of transactions can be very efficient in terms of data preparation and processing of transactions, especially when they are processed against a sequential file.
- In Online processing system, the user has access to a terminal for input of transactions and output of results. Transactions are entered by the user into a device which is directly connected to the computer system. The transaction is taken for processing directly and validated immediately before being taken up for further processing.
- For online processing, the files must be available on direct access storage devices for immediate access to the data, so that records could be added to or deleted from the file.
- The online real-time processing system is similar to the online processing system in as much as in both the systems, a transaction is entered directly into the computer and validated immediately.
- The distributed data processing method refers to the distribution of computer processing among geographically and functionally multiple locations linked by the communications network. The distributed data processing mode enables the serving of multiple real-time applications as well as multiple classes of users.
- In addition to above-mentioned processing modes, there are some other modes which can be used for data processing. These modes are based on the capability of the operating system. Such data processing modes are time-sharing, multiprocessing and multi-programming.
- A computer is basically an electromagnetic device and when we refer to a computer we normally have in mind the basic hardware equipment in a computer system.

- Computer hardware is the physical equipment used for input, processing and output activities in an information system, which supports the functions like input, output, secondary storage, data communication, data preparation, and central processing unit.
- The CPU consists of the arithmetic and logic unit and the control unit. It is at the CPU that the manipulation of symbols, numbers and letters takes place. The CPU also controls the other parts of the computer system. Its functions are similar to the human brain.
- Primary storage is the component where data and storage instructions are stored for a temporary period till the processing is completed. There are three different types of primary storage, namely the register (in ALU or CU), the cache and the RAM.
- Input devices are used for entering data into the computer system. Using a keyboard has been the traditional method of inputting data. A keyboard consists of the usual keys as well as special keys.
- Some common output devices are cathode ray tube (CRT), terminals (video display units), printers, plotters, etc.
- Secondary storage is the relatively long-term, non-volatile storage of data outside the CPU and primary storage. Hard disk, high density diskette, magnetic tape, optical disk, etc., are some of the secondary storage devices used.
- Hardware is the physical part whereas software is an abstract part of the system. Software needs a machine on which it can run and hardware needs instructions in form of program(s), contained in the software, for its working. Thus, to acquire a system, one has to acquire both, hardware as well as software.
- System software supports functionality by providing the framework application in which one can use a computer. Operating systems such as Windows or Linux are used to handle large amounts of data and these are not made for specific use. These are made for system oriented use.
- Application software supports a particular application handled by user and interacts with hardware component of computer. Application software is designed keeping in mind the requirement of users of different types. Normally, it is designed to a particular type of business requirements that covers a greater segment of customers.

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12.7 KEY WORDS

- **Non-volatile Storage:** It refers to the type of computer memory that has the capability to hold saved data even if the power is turned off.

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- **Off-the-shelf Package:** It refers to the designated commercial products that are ready for use without modification.
- **Bespoke software:** It refers to a software that is especially developed for some specific organization or other user.
- **Request for proposal:** It refers to a document issued by a business or an organization to request vendor bids for products, solutions and services.

12.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Compare the pros and cons of different data capture systems.
2. How transactions are collected in batch processing system?
3. Write a short note on distributed data processing mode.
4. What are the two main classifications of software?

Long-Answer Questions

1. Discuss the difference between online processing and online real-time processing.
2. Explain three data processing modes.
3. Evaluate the difference between primary and secondary storage.
4. Explore the difference between system software and application software.

12.9 FURTHER READINGS

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UNIT 13 MANAGING INFORMATION TECHNOLOGY

NOTES

Structure

- 13.0 Introduction
- 13.1 Objectives
- 13.2 Managing Information Resources and Technologies
 - 13.2.1 Information Process
 - 13.2.2 Types of Information
 - 13.2.3 Attributes of Information
 - 13.2.4 IS Architecture and Management: Centralized, Decentralized and Distributed
- 13.3 Electronic Data Interchange (EDI)
- 13.4 Supply Chain Management
- 13.5 Global Information Technology Management
- 13.6 Answers to Check Your Progress Questions
- 13.7 Summary
- 13.8 Key Words
- 13.9 Self Assessment Questions and Exercises
- 13.10 Further Readings

13.0 INTRODUCTION

Managing information refers to manage the records, information or data efficiently and professionally. Effective management of information involves identifying it as an asset, cataloguing it and providing various types of active management. In this unit, you will study about the methods of managing information resources and technologies, the architecture and management of information systems. The unit also discusses about technologies used in logistics applications like electronic data interchange (EDI). In addition to this, the process of supply chain management and global information technology management has also been discussed in the unit.

13.1 OBJECTIVES

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

- Discuss the management of information resources and technologies
- Assess the IS architecture and management
- Describe the process of supply chain management
- Analyse the significance of electronic data interchange (EDI)
- Examine the role of MIS in global businesses

13.2 MANAGING INFORMATION RESOURCES AND TECHNOLOGIES

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Initially, in opening our discussion on MIS, we had said that an MIS is a system that provides information to the management. We had also said that we are living in an information age. Information is of critical importance for the setting up, running, survival and prosperity of a business organization as it enables an organization to gain and retain a competitive edge and emerge a winner.

We will now discuss the concepts of information in more detail as MIS is centred around information.

Information is derived from data. Data is nothing but a random, unorganized collection of indications or measurements of certain qualities or attributes relating to an entity, recorded either in alphabetical, numerical, alphanumeric, voice, image, text or any other form.

Data can also be described as unstructured raw facts, observations or unevaluated messages in isolation. Data, per se, does not convey much or is not of much use. It is like a material that is simply available in an unfinished form. Data consists of facts and figures that are not currently being used in the decision process and usually kept as historical records without any immediate intent to retrieve them for decision-making.

Information, on the other hand, is like a finished product. Information, therefore, is defined as data that is collected, collated, processed, logically organized and analysed so as to be used by the decision-maker.

Information, according to Davis and Olson, is 'data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective actions or decisions.' Thus, data, in order to be converted into information, has to undergo processing as illustrated hereunder:

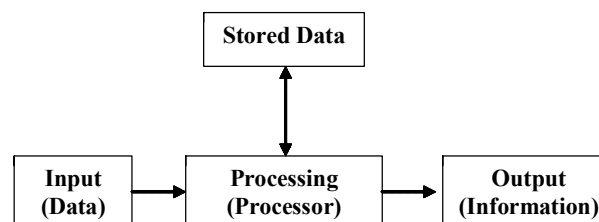


Fig 13.1 Information Processing

13.2.1 Information Process

As stated, data has to be processed before information is made available. Hence, various operations have to be carried out for converting data into meaningful information as follows:

- | | |
|-----------------------------------|--|
| • Capturing | Data from an event/transaction has to be recorded. |
| • Verifying | Data has to be checked/validated for correctness. |
| • Classifying | Data has to be placed in specific categories. |
| • Arranging/sorting | Data has to be placed in a particular order/sequence. |
| • Summarizing | Data elements have to be combined/aggregated. |
| • Calculating | Arithmetical/logical calculations/computations have to be carried out. |
| • Storing | Data has to be placed in some storage media. |
| • Retrieving | Specific data elements have to be searched for and accessed. |
| • Reproducing | Data has to be duplicated from one medium to another. |
| • Dissemination/
communication | Data has to be transmitted from one place (device) to another (user). |

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Information and Decision-Maker

Information is not only relevant but also critical for the decision-maker as the quality of the decision depends on the quality of the information. More specifically, information is useful for the decision-maker as:

- It helps in minimizing, if not eliminating altogether, the elements of risk and uncertainty in decision-making.
- It minimizes the element of 'surprise' and uncertainty in decision-making.
- It improves the quality of decision-making.
- It helps achieve the optimum results within given constraints.
- It affects the decision-making behaviour and makes a difference.

Sources of Information

Data is the foundation of them all information. A few aspects of data, sources of data and methods of collecting data for the purposes of converting into information are described as follows:

Primary and secondary data: Data is the raw material used for obtaining information. It is derived from a number of sources, both internal as well as external. If the data is collected for the first time by the researcher, it is known as *primary data*. If, however, is borrowed by the researcher from other sources, it is referred to as *secondary data*.

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Primary data could be gathered directly from the respondent. Different techniques such as observations, questionnaires and interviews can be used for obtaining primary data, which can then be converted into information.

Secondary sources of data/information include internal records as well as external records. Sources such as newspapers, magazines, trade journals, government publications, government policy documents, research reports and Web sites are considered secondary sources of data.

13.2.2 Types of Information

Information is to be used for decision-making. There are three types of information, which are required for the decision-making process:

- Strategic-level information
- Tactical-level information
- Operational-level information

For strategic decision-making, one needs strategic information, which is holistic, unstructured and draws heavily from the external environment. It also requires futuristic inputs like the emerging technologies, competition, consumer preferences, social-economic-political changes, as these inputs would be used for long-term planning.

Tactical information would be used for medium/short-term planning by the middle management, budgets, forecasts, analysis, cash/funds flow projections, etc., are part of tactical information. Such information is mostly from the internal environment and partly from the external environment such as customer perceptions, competitors strategy, pricing, and so on. It has medium-term impact.

Operational information is mainly concerned with current happenings within the organization and is mainly drawn from internal sources. It also covers a specific product, specific activity and a smaller group/number of people.

Apart from the three types stated above, we can also divide information into *Planning Information* and *Control Information*. The planning and control information could be differentiated as follows:

Table 13.1 Difference between Planning Information and Control Information

Planning Information	Control Information
• It covers the whole organization.	• It is concerned with a small, specific part of an organization.
• It has a longer time span.	• It has a shorter time span.
• It looks for and analyses trends/patterns.	• It looks for specific details for functional activity.
• It is used for working futuristic trends/forecast.	• It is used for assessing actual performance vis-à-vis budgeted.

13.2.3 Attributes of Information

Information, in order to be used by decision makers, must have certain attributes. The various attributes required depends upon the decision process and where it is to be used. In general, information must possess some essential attributes. These are:

Timeliness: The information should be available when it is required. For example, if you are planning a journey, you must get all the information about booking your tickets before you move out of the house.

- **Currency:** It must conform to the current situation and should have relevance to present conditions.
- **Periodicity/Frequency:** Much information is required at a regular interval of time in a continuous business process. This is mostly found in day-to-day processes where rate of information is very important. A computer processes millions of instructions per seconds and input too, pertaining to the system, is required for its fast processing.
- **Pertinent/Relevant:** The information collected should be relevant to the purpose for which it is required.
- **Completeness:** The information must be complete. Incomplete information is more dangerous than no information.
- **Consistency:** Information must be consistent with its requirement. If information is consistent, results based on this will also be consistent. Information may contain a set of facts. All these facts should not have any inner contradiction.
- **Accuracy:** The information should be such that it can be used. It must be collected without errors. Inaccurate information will lead to a wrong action.
- **Reliability:** Reliability is essential in a business environment. Information may be accurate, but if it is not reliable, then there is no surety that in future too information extracted from the source will be accurate.
- **Clarity:** Every piece of information should be clear and convey a clear fact.
- **Comprehensibility:** Information should be such that it can be comprehended. Every piece of information may be individually correct but the complete information may not be comprehensible, making it unworthy of use.
- **Verifiability:** Users of information would like to verify whether information is correct and relevant. If the user has no basis to check it, it may be misleading.
- **Brevity:** Too much information may not be good. Information that is complete and accurate should be brief and precise.
- **Cost-effectiveness:** Information should be made available in a cost effective manner. If information costs are high then it will add to business overheads.

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There are many attributes of information that are dependent on factors such as type of business or establishment. Even in the same organization, different departments or sections need different types of attributes for decision making.

An efficient information system brings great potential to the business process and overall business as well as social environment. Some of these are being given below:

Globalization: Information technology has brought the world closer and has contributed to the world economy. Countries separated by thousands of kilometres are able to exchange information and conduct business, making selection of talent and global trading possible. This has over-ridden geographical boundaries, turning the world into a global village. This has brought remarkable socio-economic changes.

Communication: With the development of information system and technology, communication has also become cheaper and faster. Global communication is no longer a dream. Instant messaging, on-line business transaction, on-line video conferencing, remote surgery, and so on are some of distinct advantages that we are witnessing now.

Bridging the cultural gap: Information technology has helped bring people together and know each other better, leading to a better society of understanding, consideration and freedom from prejudice.

Needless to add, the more attributes the 'information' possesses, the better the quality, leading to higher value of such information for the organization and decision-maker.

13.2.4 IS Architecture and Management: Centralized, Decentralized and Distributed

Centralized computing is a type of computing architecture where all or most of the processing/computing is performed on a central server. **Centralized IS architecture** enables the deployment of all of a central server's computing resources, administration and management. All server components are installed on the same host.

In **decentralized IS architecture**, all system information are constantly replicated to all sites in the network. It means that the system does not have any single point of failure. This way, local call and data traffic will continue without interruption. All features will remain intact, even if one or more local sites lose connection to the rest of the network. The flat decentralized IP architecture and intuitive software also enable effortless, self-configuring site expansion.

In **distributed IS architecture**, any or all of the server components are installed on dedicated hosts. In distributed architecture, components are presented on different platforms and several components can cooperate with one another over a communication network in order to achieve a specific objective or goal. The

basis of a distributed architecture is its transparency, reliability, and availability. Distributed architecture is the most recommended method as all IS components function at their most optimized capacity.

Check Your Progress

1. What is data?
2. What do you mean by information?
3. What are the primary and secondary sources of information?
4. Name the three types of information required for the decision-making process?

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13.3 ELECTRONIC DATA INTERCHANGE (EDI)

IT is increasing in both speed and capacity, while there is a decline in the cost of transactions. Some specific technologies have demonstrated wide-spread logistics applications. Some of these technologies are:

- Electronic Data Interchange (EDI)
- Bar Codes and Scanning
- RFID
- Satellite Communication
- Expert Systems

As we have already discussed about technologies like Barcodes and Scanning, RFID, Satellite Communication, and Expert Systems in previous units. Let us now read about Electronic Data Interchange (EDI) in detail.

Electronic Data Interchange (EDI)

Electronic Data Interchange (EDI) describes both the capability and practice of communicating information between two organizations via computer systems, instead of through traditional forms of communication for managing distribution and procurement systems. It allows two organizations to effectively utilize the information exchanged using business documents in standard formats.

EDI has a highly structured message communication system, with tight, pre-decided formats of documents, which allows effective, speedy and reliable communication between different locations (see Figure 13.2). It uses a service provider, which transfers data and provides translators between different formats. The service provider also handles the EDI traffic between various sources and destinations.

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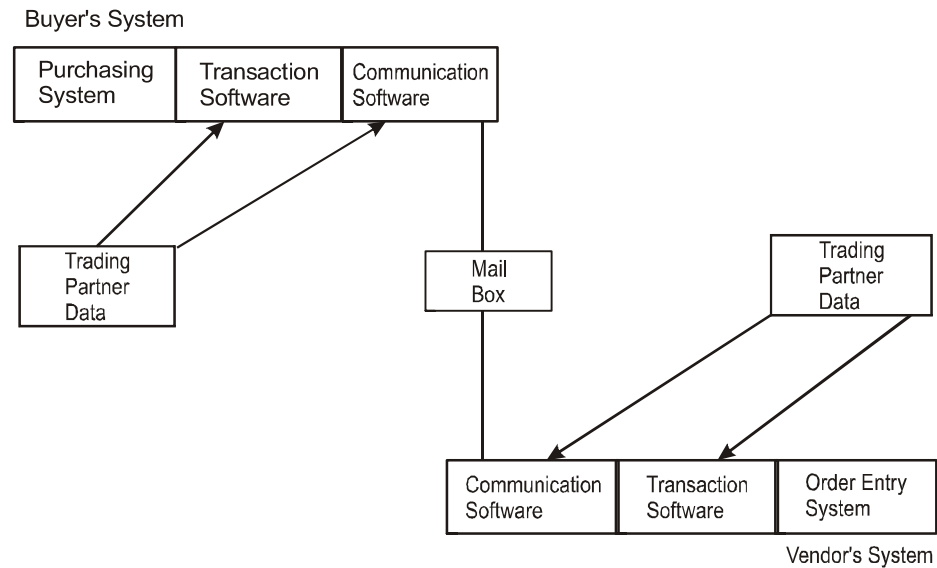


Fig. 13.2 A Typical EDI System

Industry organizations have developed and refined two general standards as well as numerous industry-specific standards in an effort to standardize both communication and information interchange. ASC $\times 12$ is promoted as the United States standard, while UN/EDIFACT is used by the United Nations as a global standard for communications. Information exchange is based on transaction sets that are generally application specific on an industry basis. The use of EDI requires adherence to certain document standards. Standards are emerging in various industries worldwide. In India, the automobile industry, along with some major auto component manufacturers and other players like banks have agreed on common formats of EDI documents.

EDI formats typically have a layered structure, which contain identification of the firm and make the transaction, functional specification of documents, the document structure and the data elements, all in a certain format that has to be strictly followed.

The major advantage of EDI is that it provides fast, error-free and reliable exchange of data between different entities in a supply chain. Documents (especially standard and repetitive format ones), such as purchase orders and despatch advices, are ideally suited for EDI. Other common applications are invoices, payment advices, requests for quotations, advance shipping notices (despatch advices), and order status inquiries and response. Real-time data on company operations – inbound material flows, production status, product inventories, customer shipments and incoming orders, among others – are also suited for EDI.

Benefits: Direct EDI benefits include: (1) increased internal and external productivity through faster information transmission as well as reduced information entry redundancy. Accuracy is improved by reducing the number of times and individuals involved in data entry; (2) reduced labour and material costs associated

with printing, mailing and handling paper-based transactions; (3) reduced telephone, fax and telex communication; (4) reduced clerical costs; (5) decreased operating costs; (6) enhanced supply chain relations; and (7) improved customer responsiveness.

In addition, EDI improves channel relationships and the quality of decision-making, along with the ability to compete internationally.

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13.4 SUPPLY CHAIN MANAGEMENT

An organization procures raw materials, processes them to add value and then sells them to customers. The objective is to meet market demand but at the same time avoid excess inventory of raw material or finished products. An organization needs to anticipate market demand and forecast long, intermediate and short term customer demands. Based on these forecasts, the supplies have to be ordered appropriately and production has to be carried out. These activities together are referred to as supply chain management. There are software available in the market to manage information related to supply chains. These software take into account past sales data and the lead time to acquire supplies to forecast demand and calculate optimum or economic re-order quantity and the time to place the order. SCM systems may also be web enabled to give real-time access to orders and suppliers, and this reduces communication time considerably. SCM also supports e-payments to suppliers. One can track the status of orders and shipments using SCM. At any point, one can know the inventory, the shipments due to arrive and the orders pending. An organization can also plan the distribution of its products in an economical way by using SCM. Take for example the problem of a travelling salesman who has to find out the optimum route (travel minimum distance) to visit a particular client or customer. One cannot solve this problem even by trying all possible combinations and choosing the best one as it is computationally impossible. Heuristics are used to find a near-optimal solution for working out a distribution network. Thus, SCM helps an organization in planning the procurement and distribution of goods.

13.5 GLOBAL INFORMATION TECHNOLOGY MANAGEMENT

MIS plays a crucial role in almost all kinds of organizations irrespective of their size and nature of business. MIS has evolved from traditional electronic data processing (EDP) systems to highly integrated information systems (enterprise information systems like ERP, CRM, SCM). Many advances in IS/IT have led to a fundamental shift in the role of information systems. As already been mentioned, information systems play three vital roles for a business organization today. They support the business processes of an organization, decision-making by managers and the strategies of an organization for gaining competitive advantage.

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MIS has changed the way organizations do business and has increased their efficiencies and responsiveness. Today, Internet-based and web-enabled systems and global e-business and e-commerce systems are becoming quite common in the operation and management of a business organization. The information systems have played a major role in automating business transactions, streamlining routine operations and have also helped organizations to take quick and well informed decisions and thus enable the organizations to have better intimacy of customers and suppliers. Today, organizations are implementing integrated MIS systems and replacing their old or legacy systems.

Let us try to understand the role of MIS in impacting the business globally.

(i) Integration of functional areas

Integrated information systems play a very important role in integrating the various functional areas of a business organization. Because a highly integrated information systems like ERP are designed on the premise of a common database and a common interface for all the functional areas and thus have the ability to automatically update data among related functions or activities. For example, when a customer places an order and the order is entered into the system (either online or offline), it triggers many actions across various departments or functional areas like inventory management; production planning; finance; marketing and so on. The invoices are generated, production schedule is planned, the inventory status is verified; the items, if not available in the stock, are ordered; and the customer is informed about the likely date of the delivery of the ordered item. All these actions are taken automatically and data updation happens instantaneously. This role of ERP in integrating various functional areas leads to improved responsiveness across the organization, and thus enables better decision-making and problem solving in organizations. This, in turn, leads to reduced lead time (the elapsed time between placing an order and receiving it); reduced cycle time (the time between placing an order and delivery of the product); efficient use of resources; on time delivery of products; transparency; and overall customer satisfaction.

(ii) Reengineering of business processes

Highly integrated information systems like ERP Systems are process-oriented and one of the pre-requisites for the implementation of ERP systems is business process re-engineering (BPR). Thus ERP Systems force the organizations to re-engineer or redesign their obsolete function-oriented business processes. To implement ERP System, organizations have to either adopt ERP-based processes or modify ERP System so as to match its existing business processes. Since ERP Systems are designed and developed on the basis of the best practices of industry, it is generally recommended to adopt ERP processes.

(iii) Standardization of systems and procedures

Highly integrated information systems, which are based on an integration approach, enables an organization to follow standardized systems and procedures across

the organizational units. This brings about consistency in the entire organization. This becomes all the more important for the organizations, which have either acquired other company or got merged with some other company. ERP ensures that the new company after the acquisition or merger uses the same information systems throughout and follows the similar procedures.

(iv) Networked Business

The integration of highly integrated information systems nowadays are extended beyond the boundaries of an organization leading to network with the business partners of the organization like Supply Chain Management (SCM) System; Customer Relationship Management (CRM) System, etc. This network with the partners of the organization enables it to exchange electronically various business documents like purchase orders, sales order, invoices, billing, etc.

Check Your Progress

5. What is the meaning of EDI and how is it used?
6. Briefly discuss the significance of supply chain management.

13.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Data is a random, unorganized collection of indications or measurements of certain qualities or attributes relating to an entity, recorded either in alphabetical, numerical, alphanumeric, voice, image, text or any other form.
2. Information is like a finished product. Information, therefore, is defined as data that is collected, collated, processed, logically organized and analysed so as to be used by the decision-maker.
3. Data is the raw material used for obtaining information. It is derived from a number of sources, both internal as well as external. If the data is collected for the first time by the researcher, it is known as *primary data*, which could be gathered directly from the respondent. If, however, it is borrowed by the researcher from other sources, it is referred to as *secondary data*.
4. The three types of information, which are required for the decision-making process include strategic-level information, tactical-level information, and operational-level information.
5. Electronic Data Interchange (EDI) is the practice of communicating information between two organizations via computer systems. It allows two organizations to effectively utilize the information exchanged using business documents in standard formats.
6. Supply chain management is the broad range of activities which involve plan, control and execute a product's flow, from acquiring raw materials

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and production through distribution to the final customer. There are software available in the market to manage information related to supply chain.

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13.7 SUMMARY

- MIS is a system that provides information to the management. Information is of critical importance for the setting up, running, survival and prosperity of a business organization as it enables an organization to gain and retain a competitive edge and emerge a winner.
- Data is nothing but a random, unorganized collection of indications or measurements of certain qualities or attributes relating to an entity, recorded either in alphabetical, numerical, alphanumerical, voice, image, text or any other form.
- Information, on the other hand, is like a finished product. Information, therefore, is defined as data that is collected, collated, processed, logically organized and analysed so as to be used by the decision-maker.
- Information is not only relevant but also critical for the decision-maker as the quality of the decision depends on the quality of the information.
- Data is the raw material used for obtaining information. It is derived from a number of sources, both internal as well as external. If the data is collected for the first time by the researcher, it is known as *primary data*. If, however, is borrowed by the researcher from other sources, it is referred to as *secondary data*.
- There are three types of information required for the decision-making process, namely strategic-level information, tactical-level information, and operational-level information.
- Strategic information requires futuristic inputs like the emerging technologies, competition, consumer preferences, social-economic-political changes, as these inputs would be used for long-term planning.
- Tactical information would be used for medium/short-term planning by the middle management, budgets, forecasts, analysis, cash/funds flow projections, etc., are part of tactical information.
- Operational information is mainly concerned with current happenings within the organization and is mainly drawn from internal sources.
- Information must possess some essential attributes, such as timeliness, currency, periodicity or frequency, relevant, completeness, comprehensibility, verifiability, brevity and cost-effectiveness.
- Centralized IS architecture enables the deployment of all of a central server's computing resources, administration and management. All server components are installed on the same host.

- In decentralized IS architecture, all system information are constantly replicated to all sites in the network. It means that the system does not have any single point of failure. In distributed IS architecture, any or all of the server components are installed on dedicated hosts.
- Electronic Data Interchange (EDI) describes both the capability and practice of communicating information between two organizations via computer systems, instead of through traditional forms of communication for managing distribution and procurement systems.
- EDI has a highly structured message communication system, with tight, pre-decided formats of documents, which allows effective, speedy and reliable communication between different locations.
- The major advantage of EDI is that it provides fast, error-free and reliable exchange of data between different entities in a supply chain.
- An organization needs to anticipate market demand and forecast long, intermediate and short term customer demands. Based on these forecasts, the supplies have to be ordered appropriately and production has to be carried out. These activities together are referred to as supply chain management.
- The Information systems have played a major role in automating business transactions, streamlining routine operations and have also helped organizations to take quick and well informed decisions and thus enable the organizations to have better intimacy of customers and suppliers. In view of the role, integrated MIS can play; organizations are implementing these systems replacing their old or legacy systems.
- Integrated information systems play a very important role in integrating the various functional areas of a business organization.
- Highly integrated information systems like ERP Systems are process-oriented and one of the pre-requisites for the implementation of ERP systems is business process re-engineering (BPR).
- Highly integrated information systems, which are based on an integration approach, enables an organization to follow standardized systems and procedures across the organizational units.

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13.8 KEY WORDS

- **Heuristics:** It refers to an approach to problem solving or self-discovery that employs a practical method, not guaranteed to be optimal, perfect, logical, or rational, but instead sufficient for reaching an immediate goal.
- **Electronic Data Interchange:** It refers to the transfer of data from one computer system to another by standardized message formatting, without the need for human intervention.

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- **Supply Chain Management:** It refers to the management of the flow of goods and services and includes all processes that transform raw materials into final products.
- **Brevity:** It refers to the exact and concise use of words in writing or speech.

13.9 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. How is data processed into information?
2. Why is information useful for decision makers?
3. What is strategic-level information in decision making process?
4. What is the difference between planning information and control information?
5. Briefly explain centralized IS architecture.

Long-Answer Questions

1. Why are decision making processes important?
2. Describe the different attributes that influence the quality of information.
3. Discuss the benefits of Electronic Data Interchange (EDI).
4. Discuss the significance of MIS in businesses globally.

13.10 FURTHER READINGS

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UNIT 14 SECURITY AND ETHICAL CHALLENGES

Security and Ethical Challenges

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Structure

- 14.0 Introduction
- 14.1 Objectives
- 14.2 Risk to Online Operations: Denial of Service and Spoofing
 - 14.2.1 Types of Information Security Attacks from Outsiders
 - 14.2.2 Incident Response
 - 14.2.3 Some Attack Techniques and Technologies
- 14.3 IS controls - Facility Control and Procedural Control
- 14.4 Managing Social and Ethical Issues in Information Society
 - 14.4.1 Ethics for IS Professionals
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- 14.6 Summary
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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. The unit is all about the security and ethical challenges of IT faced by business organizations. Such challenges refer to the difficulties that organizations face in the management of complex information and communication technologies from malicious external threats.

The unit discusses the security measures need to be taken in order to prevent security incidents. You will also learn about the types of information security attacks from outsiders and the risk to online operations, Denial of Service (DoS) and spoofing has also been discussed in the unit. Additionally, the topics like information security controls, facility controls and procedural control and ethics to IS professionals have also been taken into consideration in this unit.

14.1 OBJECTIVES

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

- Discuss the security measures to prevent security incidents
- State the types of information security attacks from outsiders
- Examine the risk prone to online operations, DoS and spoofing

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- Describe Information Security controls- facility control and procedural control
- Analyse the management of social and ethical issues in information society
- Understand the ethics for information security (IS) professionals

14.2 RISK TO ONLINE OPERATIONS: DENIAL OF SERVICE AND SPOOFING

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.

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:

1. Procedural or business control measures—those that define access and other security policies, usage guidelines, security education, training and awareness (SETA) programs.
2. Technical measures—includes authentication measures, monitoring techniques, tools and filtering mechanisms.

14.2.1 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 are the major forms of attack:

(a) 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 organization's system. He can upload applications, modify applications, modify data without anyone's knowledge, steal data and cause widespread

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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.

(b) Denial of service (DoS)

This is another form-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.

(c) 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.

(d) 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

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.

14.2.2 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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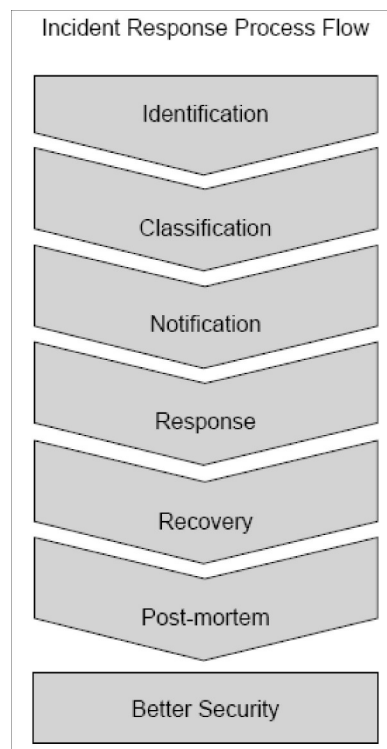


Fig. 14.1 Incidence Response Flow Chart

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14.2.3 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.
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

1. What are the two categories of data security measures?
2. Why is perimeter security of a network important?
3. Name the three different types of hackers.
4. What is reconnaissance in network security?
5. Which is the most difficult forms of attack against which an organization is to be secured?
6. What do you mean by IP spoofing?

14.3 IS CONTROLS - FACILITY CONTROL AND PROCEDURAL CONTROL

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. 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. Figure 14.2 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.

SCIM Components

SCIM Components are given below:

- (a) Business process control
- (b) Identity management

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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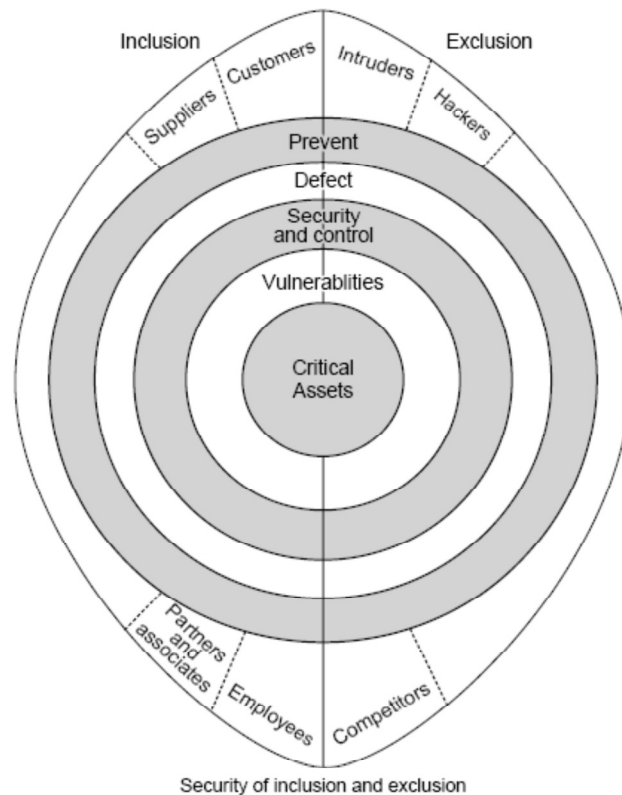


Fig. 14.2 SCIM Issues

(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:

1. **Authentication** is the process by which the identity of a user is verified by a security system/security apparatus before granting access to the system/area that contains information assets. If the user is unable to provide the correct information then access is denied.
2. **Username and password** is 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.

3. **Digital certificates** 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.
4. **Biometric control** 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.
5. **Smart cards** 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. Some 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.

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This approach requires more administrative time to manage and control access as lot of duplication of effort takes place.

- Role based—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—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.

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.
- 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.

14.4 MANAGING SOCIAL AND ETHICAL ISSUES IN INFORMATION SOCIETY

*Security and Ethical
Challenges*

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 Table 14.1.

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Table 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.
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 other 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.

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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 in 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.

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 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.

14.4.1 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.

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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.

Check Your Progress

7. What are SCIM solutions?
8. How do smart cards work?
9. What is cyberstalking?

14.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The two categories of data security measures include: procedural or business control measures like security policies, usage guidelines, training and awareness programs, and technical measures such as monitoring techniques, tools and filtering mechanisms, authentication measures.
2. Perimeter security of a network is of vital importance as it aims to halt an attacker from gaining access into the system.

3. The three different types of hackers include ethical hackers, crackers, and phreaks.
4. Reconnaissance is the first stage of computer attack where an intruder, before embarking on a full-scale attack, tries to gather information about the system 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.
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 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.
7. 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.
8. Smart cards 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. Some such cards are embedded with RFID chips so that RFID scanners may detect them from a distance and therefore authenticate them. In this type of identity management, the system interacts directly with the hardware device (smart card) which holds a unique code that verifies the identity of the user.
9. 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.

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14.6 SUMMARY

- 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.
- 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.

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- Most hacking incidents follow a typical pattern or method which comprise of five stages, namely reconnaissance, vulnerability scanning, securing/getting access, maintaining access and covering tracks.
- 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. Now attackers use a many-to-one mode of attack for DoS. This is known as distributed denial of service (DDoS).
- 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. It is therefore a good idea to check the attachment files in e-mails before opening them.
- 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.
- 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.
- 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.
- IP spoofing is a technique of using forged 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.
- 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.
- 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.

- 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.
- 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.

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14.7 KEY WORDS

- **Perimeter Security:** It refers to routers, firewalls, and intrusion detection systems implemented to tightly control access to networks from outside sources.
- **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.
- **Gullible Users:** It refers to the internet users who can be easily deceived, tricked, duped or cheated.
- **Phishing:** It refers to the fraudulent practice of sending emails purporting to be from reputable companies in order to induce individuals to reveal personal information, such as passwords and credit card numbers.
- **Incident Response:** It refers to an organised approach to addressing and managing the aftermath of a security breach or cyberattack.

14.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What is hacking?
2. What is vulnerability scanning used for?
3. What is the objective of a denial of service (DoS) attack?
4. What does DDoS attack mean?
5. How do social engineering attacking system work?
6. Write a short note on incident response process.

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7. List the measures required to ensure physical security of the IS.
8. What ethical and legal issues may arise from the world of IS?

Long-Answer Questions

1. Explain the three different types of hackers.
2. Discuss the five phases involved in hacking a network.
3. Describe malicious codes and its types.
4. Critically evaluate the human attributes used by social engineering attackers.
5. Assess the five different components of identity management.

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