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MANAGEMENT INFORMATION SYSTEM

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INTRODUCTION

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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

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.

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BLOCK I
BASICS OF MANAGEMENT INFORMATION SYSTEM

UNIT 1 FOUNDATIONS OF INFORMATION SYSTEM

Structure

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

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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

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.

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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

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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.

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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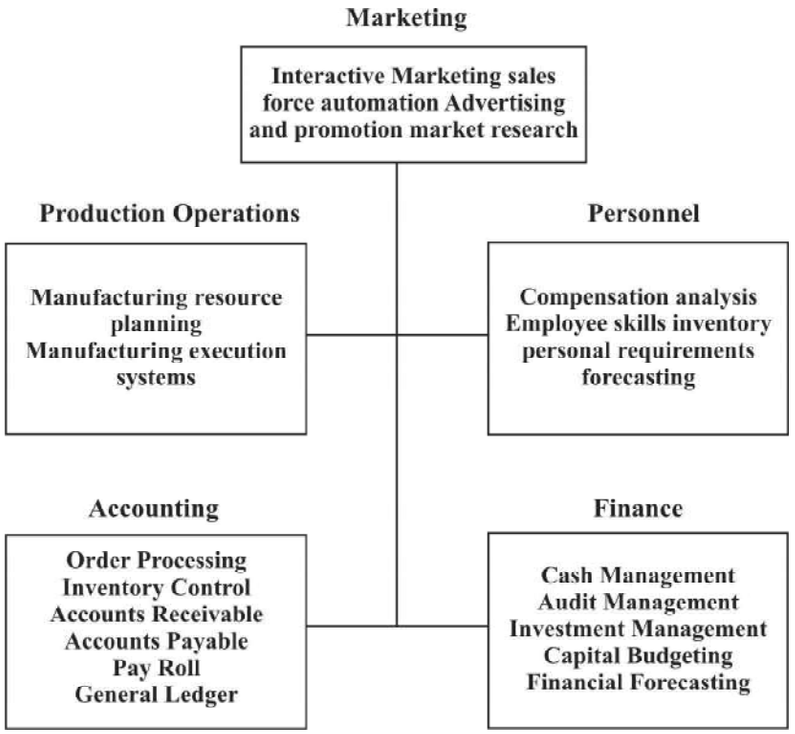

Fig. 1.1 *The Application Areas of Information Systems*

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.

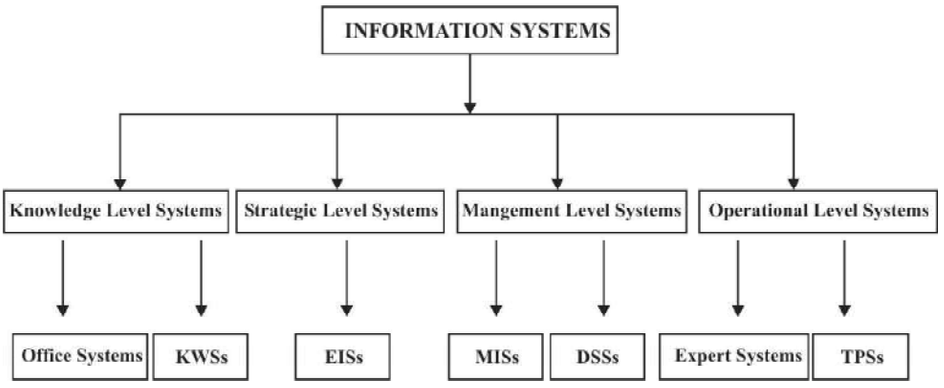

Fig. 1.2 *The Classification of Information Systems*

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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 Procesing 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.

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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UNIT 2 INFORMATION SYSTEM

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Structure

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.

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- **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.

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?

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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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- **Response Time**: It is the time taken by a system to react to a given input.
- **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:
  - The hardware reliability of the system.
  - Physical security of data.
  - 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.

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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 Matrix*

Information Requirements ↓

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,

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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.

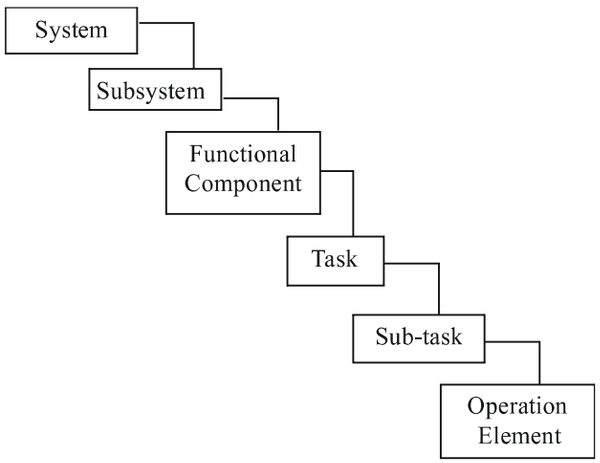

Fig. 2.1 *Decomposition of an Information System*

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.

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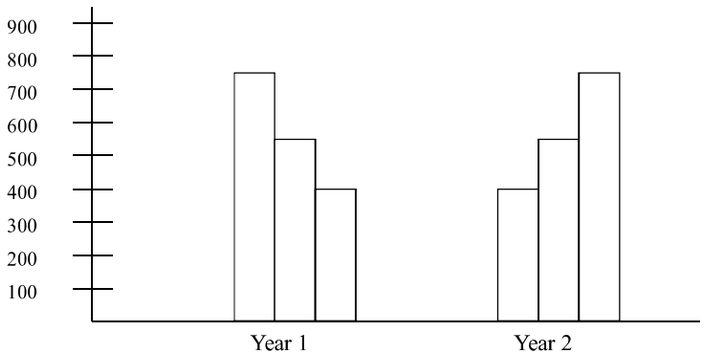

Fig. 2.2 *Graphical Format of Output as Bar Chart*

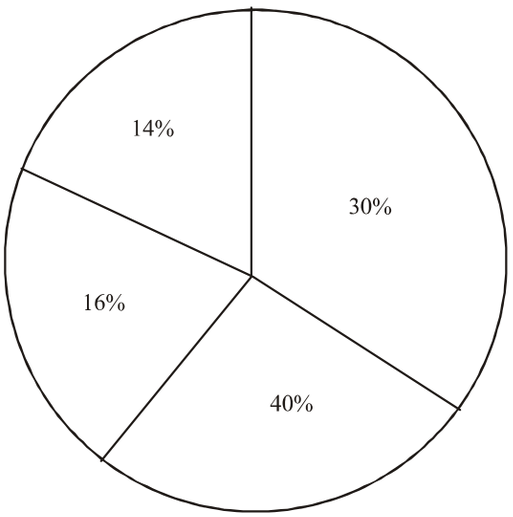

Fig. 2.3 *Graphical Format of Output as Pie Chart*

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 wants 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.

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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 sould 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.

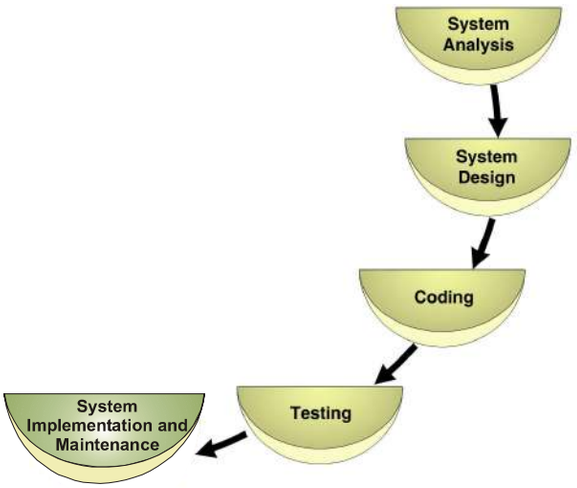

Fig. 2.4 *The System Development Life Cycle*

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).

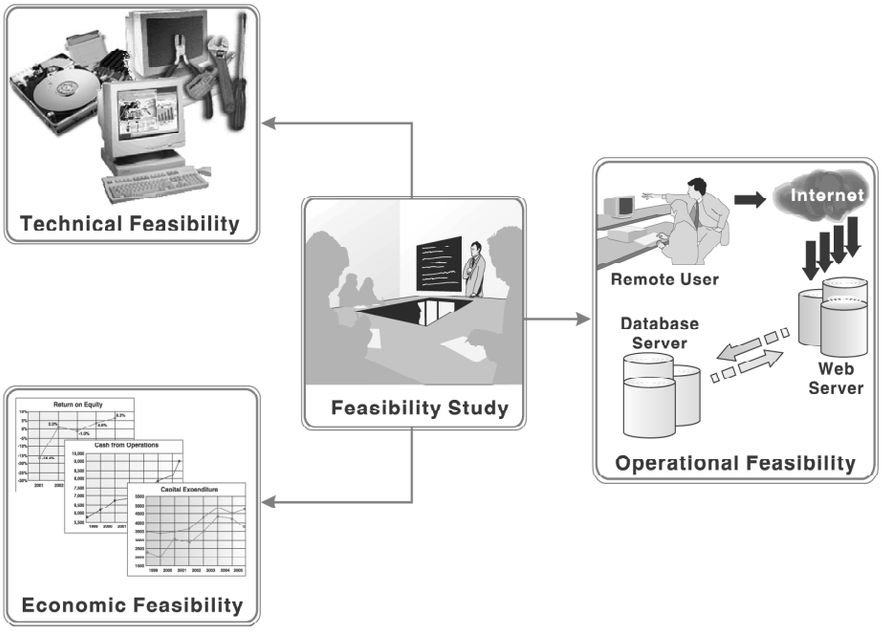

Fig. 2.5 *Different Aspects of Feasibility Study*

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.

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.

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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:
  - ***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.
  - ***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.
  - ***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.
  - ***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.

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2.5 EVOLUTION AND ELEMENT OF MIS

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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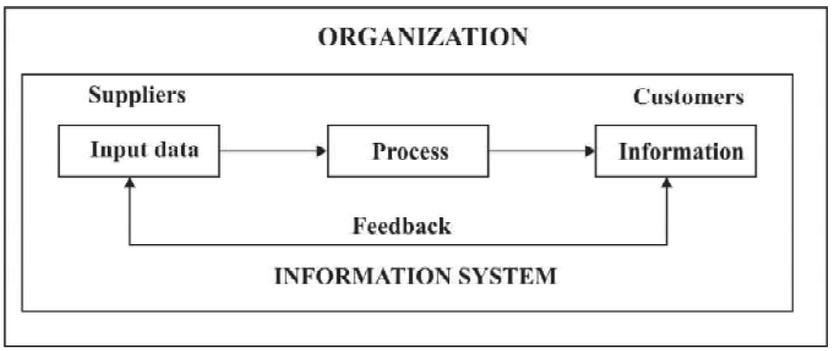

Fig. 2.6 *The Information System in a Business Context*

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.

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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

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 is 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.

2.10 FURTHER READINGS

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UNIT 3 MANAGEMENT INFORMATION SYSTEM (MIS)

Structure

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

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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.

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

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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.

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.

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 comminucate 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.

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.

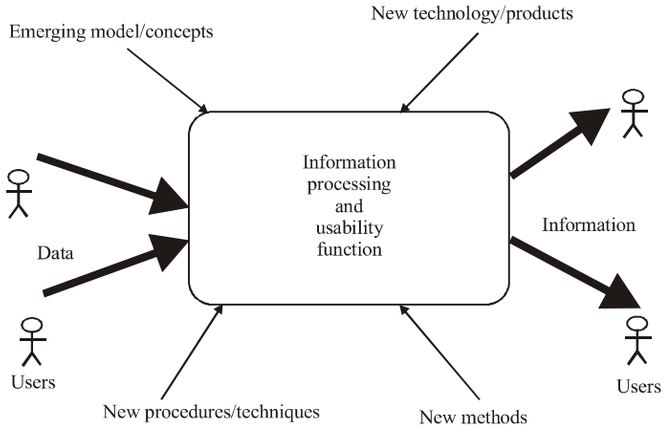

***Fig. 3.1** Information Processing and Usability Function*

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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.

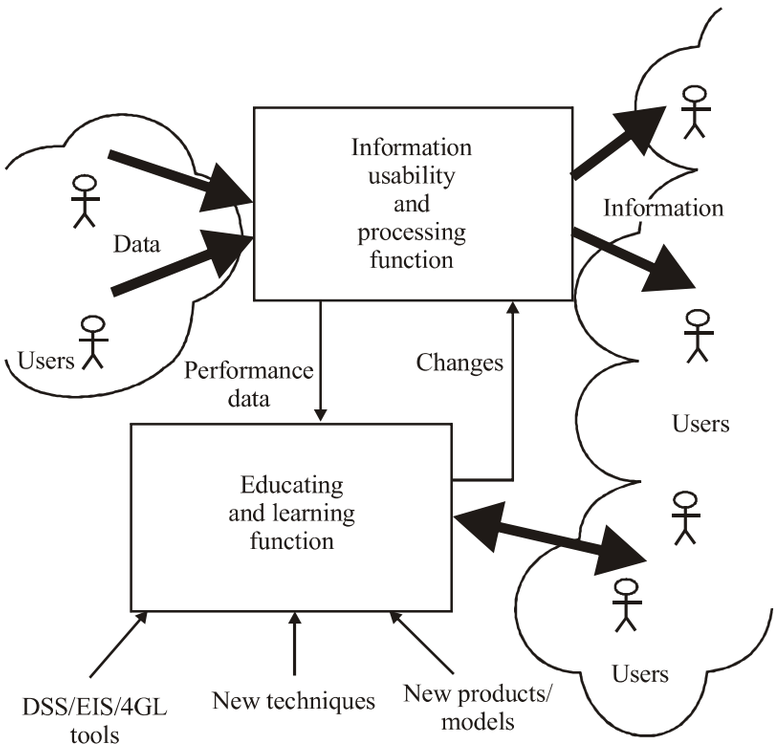

Fig. 3.2 *Information Usability and Processing Function*

(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.

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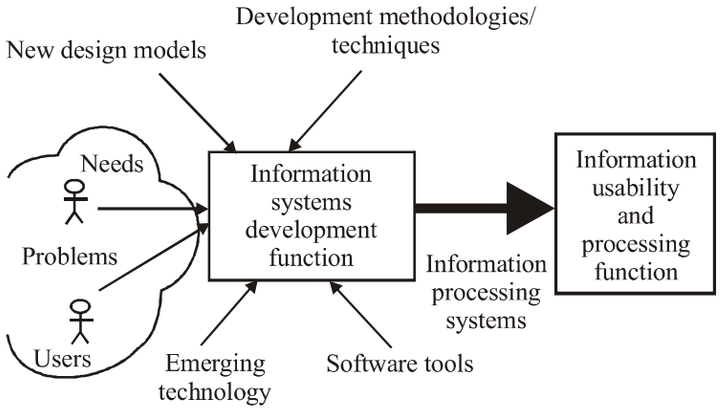

Fig. 3.3 *An Information Systems Development Function*

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:

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- **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.

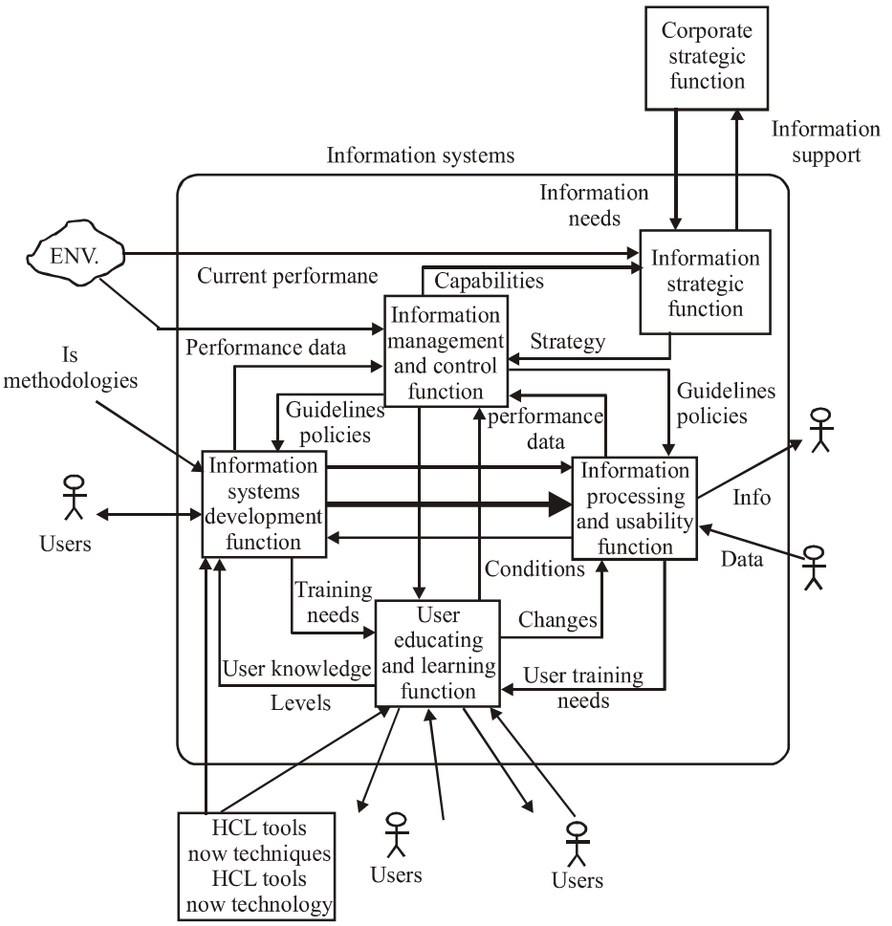

Fig. 3.4 *Information Systems Functional Model*

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.

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.

- **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

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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.

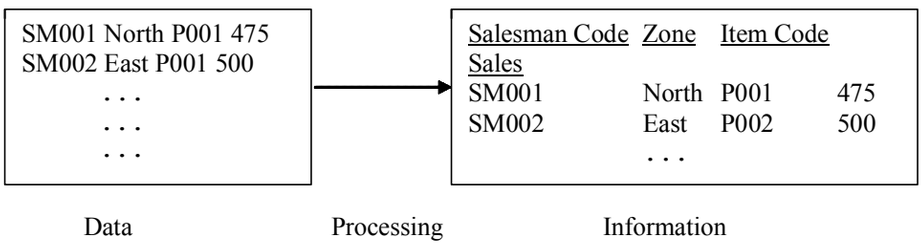

Fig. 3.5 *Data and Information*

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.

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.

Using MIS, one is able to:

- Gather information and store it.
- Retrieve information and modify it as required by the manager, clients or financer.
- 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, financers 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?

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.

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

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Structure

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 versins availability; information for problem solving and modeling; information on the business status; non – moving inventory, overdue payments and receivables.

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.,

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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.

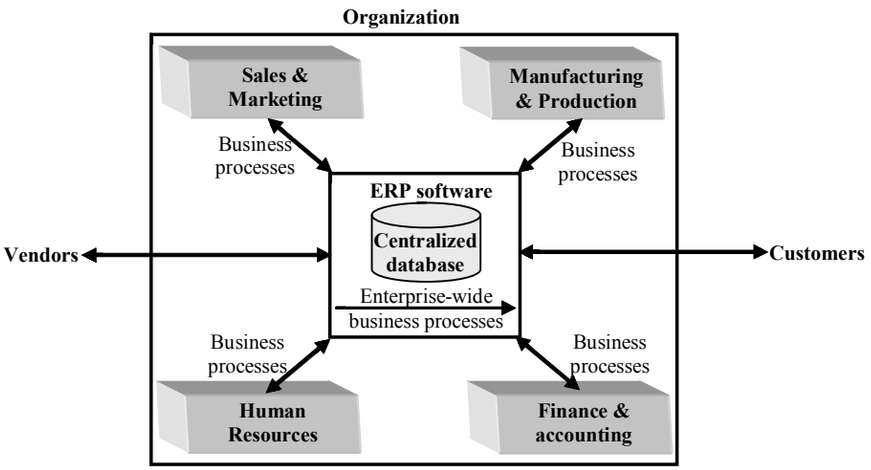

Fig. 4.1 *A typical example of an ERP System*

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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 mi*ning*.
  - 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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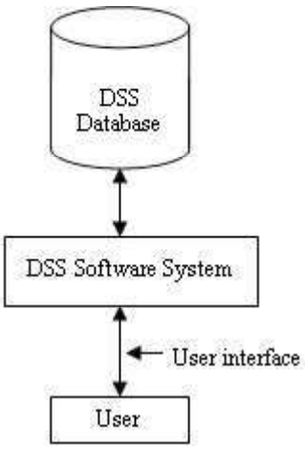

Fig. 4.2 *Components of Decision Support System*

- **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:
  - ***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.
  - ***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.

- ***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.
- ***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.
- ***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.

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- **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.

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

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UNIT 5 MIS AND ITS USES

Structure

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.
  - ***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.
  - ***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.

- ***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.

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:

   Outcome × Probability = Expected Value

   1,00,000 × 0.02 = 2,000

   10,000 × 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

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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			
	N1	N2	N3	N4
S1		a ←		→ Pay-off
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:

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

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 ← Minimum Pay-off
S3	–5

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.

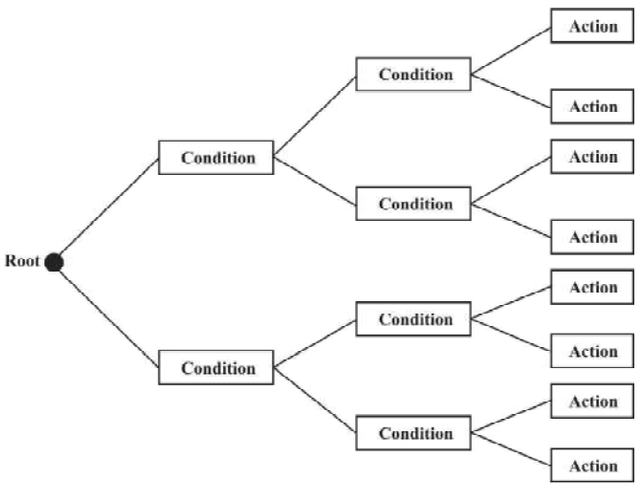

Fig. 5.9 *Decision Tree Sequence*

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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.

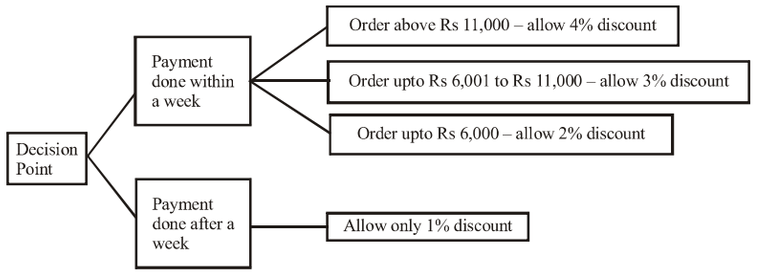

Fig. 5.10 *Decision Tree for Discount Policy*

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.

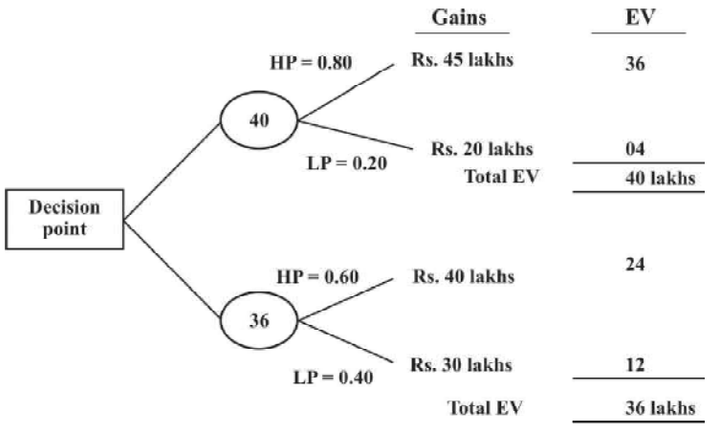

Fig. 5.12 *The Decision Tree*

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.

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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.

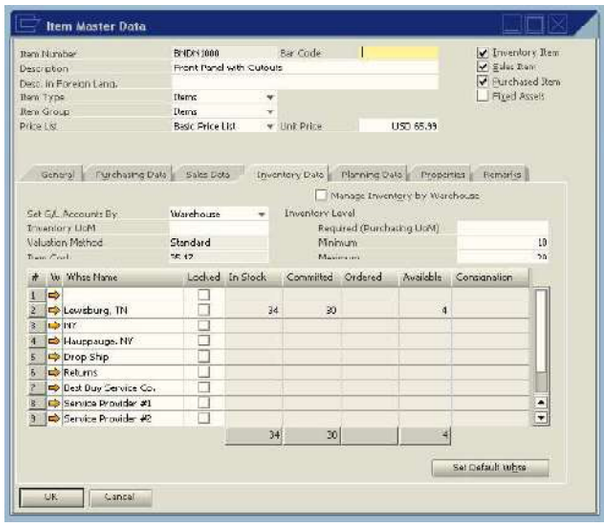

Fig. 5.13 *Screenshot of SAP R/3 Production Planning Module*

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.

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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.

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 ARTIFICAL 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.

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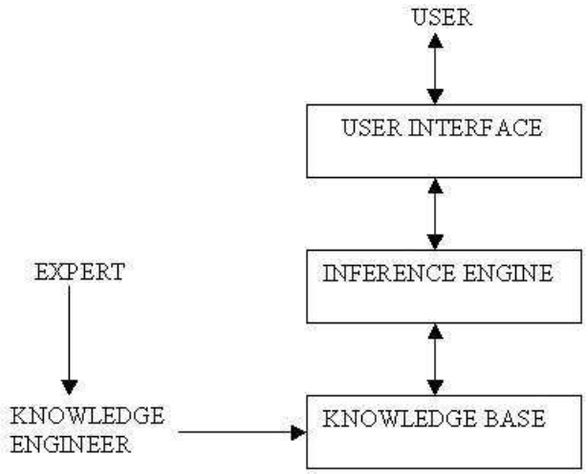

Fig. 5.14 *Working of an Expert System*

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 LISt 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

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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 Kasporov (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

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.

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.

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5.7 SUMMARY

- 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

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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

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

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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 programms 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

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 offerred by his organization is inadequate.

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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:**
  i. Top managers use MIS to get relevant information to make the right decisions.
  ii. MIS support for decision-making falls into two categories:
    1. MIS enables managers to analyse a situation by providing the relevant information.
    2. MIS might also include recommendations on what action to take.
- **Improves Communication and Develops Team Spirit:**
  i. MIS enables information management and facilitates communication between diverse teams.
  ii. A Collaborative Management Information System (CMIS) is used to improve team work.
  iii. One aspect of Electronic Data Interchange (EDI) is Electronic Funds Transfer (EFT), which enables payment without physically sending money.
- **Facilitates Organizational Transformation:**
  i. 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.

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:

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- 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

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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.

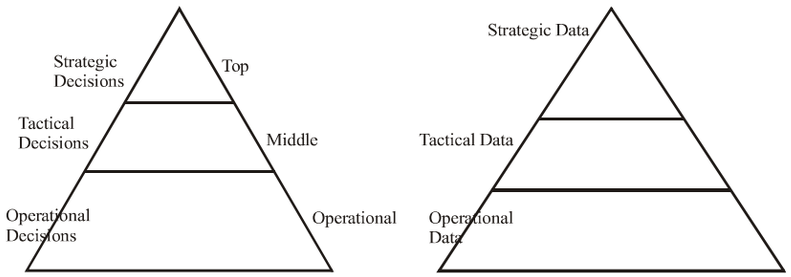

Fig. 6.1 *Pictorial Representation of Management vs Information Pyramid*

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

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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 both1, 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

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.

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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.

- 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 th4e 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

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

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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

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.

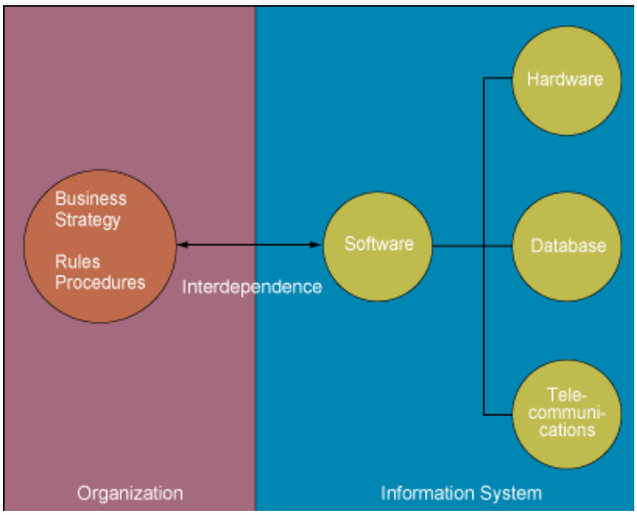

Fig. 7.1 *The Interdependence Between Organizations and Information Systems*

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.

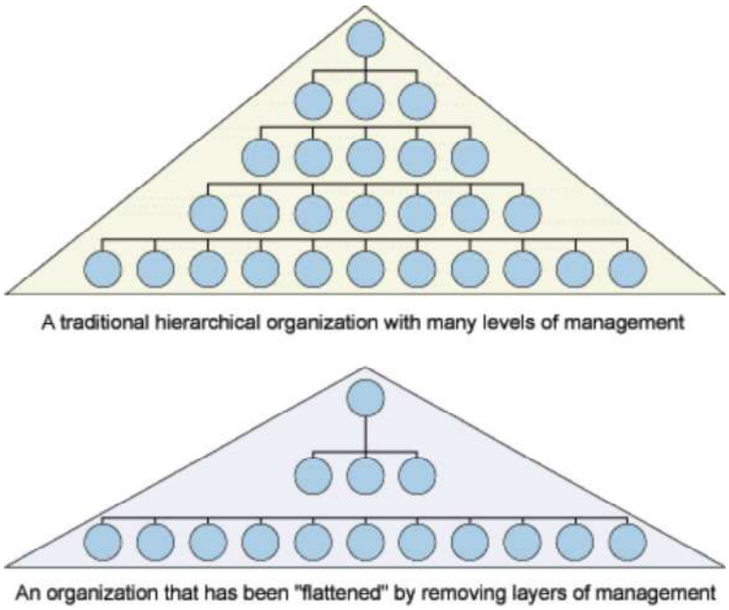

Fig. 7.2 *Comparison of a Traditional Hierarchical Organization with a Modern Day Digitalized Organization*

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

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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

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

- **E-Mail**

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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

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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.

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.

NOTES

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.