UNIT 13 MANAGEMENT INFORMATION SYSTEMS

Structure

13.1 INTRODUCTION

There are many kinds of Information Systems in the real world which use hardware, software and the people to transform data to meaningful information for business needs and decision-making. Every business process relies on information for day-to-day activities and decision-making. Management Information System have been playing a key role in helping the managers at various levels of business functions for decision-making. In early days of business information system, data processing is used to generate various day to day reports. In today's world, as business is operating in a more varied and complex environment, managers have realized the need for specialized computer-based information systems for special activities and business needs. Keeping this in view, various types of Business Information Systems have evolved over time such as Transaction Processing Systems, Management Information Systems, Decision Support Systems and Expert Systems.

13.2 OBJECTIVES

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

- gain insight into various Business Information Systems;
- learn the way Information Systems support business transactions;
- understand the support given by Information Systems to organizations to perform business operations , decision-making and for problem solving; and
- Know various types of Information Systems and distinguish between them

13.3 ROLE OF MIS IN AN ORGANIZATION

Management Information System helps the organization to produce information that organizations need to improve decision-making, problem solving, control operations and creating new products or services. Many organizations have implemented computer-based Management Information System to retain competitive edge over their competitors. The role of Management Information System (MIS) has expanded significantly over the years. Until the early 1960s, the role of MIS was simply processing transaction data, record keeping and other data processing activity. The early 1970s, evolved MIS for reporting to managers in a specified format for managerial decision-making. The early 1980s have been the time for decision support system which helps individual managers in decision-making. The early 1990's have been the age of expert system that provides knowledge based expert advice to managers for decision-making. All these have increased importance of MIS for the success of an organization.

Management Information Systems can help a business in that they contain important information about a particular client or event that takes place in the organization or the environment surrounding it. MIS is not as important for smaller organizations as it is for the larger corporations. The smaller locally run businesses are run usually by owners who rarely need instant access of information that larger companies require. Large corporates with varied product lines definitely can't do without a computer based MIS in order to survive and keep pace with competitors.

Any MIS performs various roles in an organization:

- Supports day-to-day business operations;
- Supports managerial decision-making;
- Supports strategic decision-making and competitive advantage;
- Optimising operational cost;
- Provide timely and accurate information; and
- Provide expert advice to the managers on selected domains.

For example, an organization may use MIS to keep track of inventory, evaluate sales trend of different products, keep information about client and employees, etc.

Management Information Systems are used for –

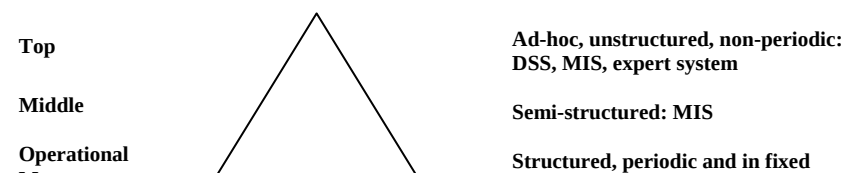
- **Operational control:** Information for control of day-to-day business operations. Information required by operational managers to control their daily work. This includes information on current stock of items, employee attendance, employee performance sheet, etc. Such information is very much structured and computational in nature and is produced in fixed format. Example : In an inventory control system, report on minimum inventory levels for reordering of inventory, sales performance figures by product line, sales person or sales region can be obtained with the help of MIS.

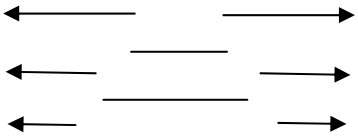
- **Management control:** Information for short term planning (few weeks and months). Information is rather un-structured or semi-structured such as cash flow statement, sales trend analysis, monthly and annual financial statements . This type of information is used by mid-level manager for planning and control of organizational sub-units. Example : Sales trend figure in different regions of the country for product. Managers can carryout what if analysis like effect of price on sales figure, effect of cut on advertisement on sales.

- **Strategic planning:** Information for long-term planning, developing policies and long-term goals for the organization. Such information is ad-hoc and unstructured such as human resource forecast, market trend analysis, etc. This type of information is mostly useful for top management.

13.4 DIFFERENT KINDS OF INFORMATION SYSTEMS

Depending on the end use, the information systems may be classified broadly to operation information systems and management information systems. Operation information system generally helps to support business operation, whereas management information system helps in managerial decision-making. Transaction processing systems may be classified into Operation information system. Decision support systems, MIS and expert systems may be classified into different forms of MIS for specific purposes. The information requirements of managers are directly related to the position of manager in hierarchy ladder as shown in Figure 13.1. Keeping this in view, various types of information systems have evolved over time.





Level of Management **Type of Information Requirement**

Figure 13.1: Levels of Management and their Information requirements.

The types of information systems to be discussed subsequently have specific focus areas to support an organization's information requirements. Table 13.1 depicts various functions of Information Systems.

Table 13.1: Functions of Information Systems.

Systems	**Transaction Processing Systems**	**Management Information Systems**	**Decision Support System**	**Expert Systems**
Information Source	Process Data resulting from business operation	Process data from business operation as well as external data	Use analytical models and specialized database in addition to internal data.	Use knowledge of experts from a specific field
Types of Support	Provides support for day-to-day operation of business process	Provides data for managerial decision-making	Provides interactive decision support to managers for decision-making	Provide expert advice on a specific domain of activity
Format of Reporting	Periodic and routine type in fixed format	Reports are semi-structured and ad-hoc type	Provides report like sensitivity analysis and what-if analysis	Provides advice like human expert
Used by	Operational management	Strategic decision-making for managers	For decision support tailored made to individual managers	Managers for expert advice on a specific field.
Examples	Sales transaction processing system, on-line railway reservation system	Marketing management information system	Geographic Information System (e.g. IBM's Geo-Manager, which integrates interacticve computer graphics with geographic database.	Expert System for medical diagnostic (e.g., MYCIN)

13.4.1 Transaction Processing System

Businesses offer service and products to the customers. In simple terms, transaction processing system is an information system that supports business in the delivery of

various business transactions. A transaction processing system records and processes data resulting from business transaction. Transactions are events that occur as a result of business operations like transfer of money from one account to another account, purchase of items, etc. Transactions are basically a series of related operations that must all succeed or fail as a group. A single transaction of withdrawing money from a bank account actually involves two operations are a debit to an account and credit to another account. Transactions processing system allows the two operations to group into a single transaction. When both the operations are successfully completed, then the transaction is said to be complete. TPS can be classified into the category of Operation information system. Example can be Sales Transaction Processing System. These systems are transaction intensive and results of such transaction processing are used to update various databases like customer databases, inventory databases and accounts receivable databases. Transaction Processing Systems are also used to make day to day decisions that control operational processes.

Transaction processing systems (TPS) could be on-line or off-line. In case of On-line Transaction Processing systems, data is processed by the system immediately after the transaction occurs. Point of Sale (POS) is a common example of the On-line Transaction Processing System (OLTP).

The following are major characteristics of Transaction Processing Systems :

- Support business operations;
- Focus on data resulting from business transactions; and
- Captures and processes data of business transactions.

For example, consider a Sales Transaction Processing System. Sales Transaction Processing Systems handle routine business operations like sales and maintain records related to those activities. TPS transforms large number of inputs to outputs, using simple processing logic and operations. Compared to other types of information systems, TPS handles far more volume of inputs and outputs but generally involves simple processing logic.

Transaction Processing Systems perform the following operations (Refer to Figure 13.2):

- Data is captured from documents or business operation and input into the system to record a transaction.
- Then, data is processed. That is, calculations or other logical operations are performed for output.
- The relevant files or databases are then updated with the results. Output of a TPS includes documents and reports.

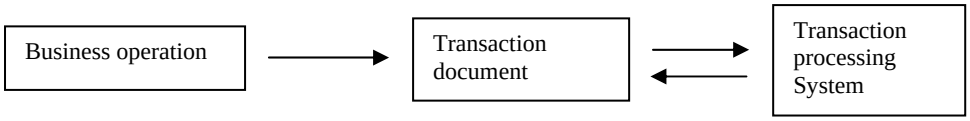
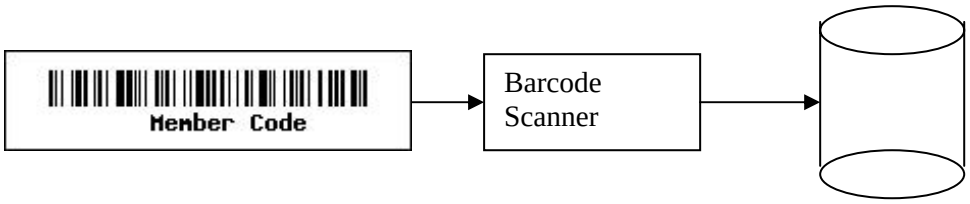


Figure 13.2: Business Operation and Transaction Processing System.

To save time, storage space, and reduce errors of data entry, it is desirable to capture the information electronically at its point of origin, i.e. from the point of sales terminal (POS). This is referred to as source data automation. Rarely, non-conventional methods are used to facilitate data entry. For example, in a library, the barcode printed on the library members card can be used to capture required information such as name of the member, address, validity date of the membership etc. Figure 13.3 depicts a Transaction Processing System at a Library.



Library Database

Figure 13.3 : Transaction Processing System at a Library.

The TPS should have the ability to process work flows of a business and each state of the business transaction can be represented by a step in the work flow. TPS captures and processes data of every business transaction and updates the relevant files and databases. It produces a variety of information for internal and external use.

Components of a Transaction Processing System

Consider a typical Transaction Processing System as depicted in Figure 13.4.

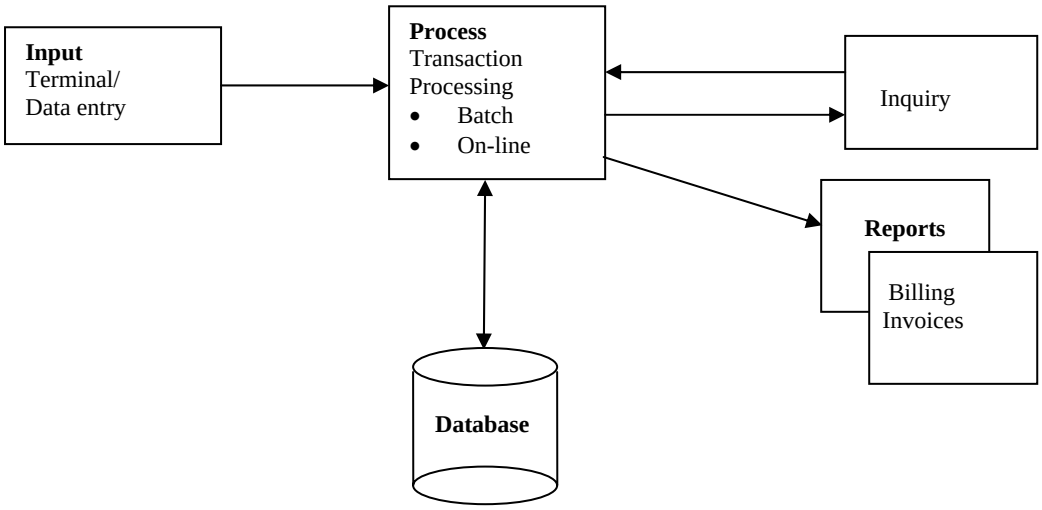


Figure 13.4: A typical transaction processing system.

- **Data entry:** Data can be captured directly from machines which consists of data when it is entered during business transaction or the data can be directly keyed in. Sometimes, Data is also converted to a machine-readable form by scanning.
- **Transaction processing:** Input data is processed basically in two ways, namely Batch Processing or Online Processing. Table 13.2 compares the both.

  - **Batch processing:** In this technique, accumulated data over a period of time is processed periodically depending on the requirement. This type of processing is economical. It is suited for situations when it is not required to process the transaction data as occurs and report generated are required only at a scheduled interval.

  - **On-Line Transaction processing (OLTP):** In this technique, the data is processed by the system immediately after the transaction is over. This type of processing is well suited for small transactions and where turn around time is important. The database is always up-to-date since these are updated as when the transaction data is generated. Responses to the user inquiry are immediate. Since the database is accessed and updated after every transaction, care must be taken to protect the integrity of the database. Controls are some times built-in to the software for this kind of applications. Information systems related to Banking are examples of OLTP. The drawback of OLTP is high costs associated with the necessary security and fault tolerance features.

Table 13.2: Batch and Online Transaction Processing

	Batch Processing	**Online Transaction Processing**

Process	Transaction data is accumulated in regular intervals for processing at a scheduled interval	Transaction data is processed as and when generated by the business process
Updation of database	When the batch is processed	When the transaction is processed
Response time	Several hours/day	Immediate
Associated cost	Economical with efficient utilization of resources	High
Example	Processing pay cheques received for clearance in a banking system	Point of sales terminal, Online Railway reservation system

- **Database**: It is the most important component of TPS. TPS updates the organizational database that reflects day-to-day business transactions carried out by the organization. For example, stock from the inventory database is reduced when an item is sold from POS stock. Stock from inventory database is increased when an item is received. Debtor's and creditor's database is updated depending on amount received or paid in an accounts receivable database. The data generated and processed by TPS are subsequently used for other Information Systems such as Decision Support Systems etc.

- **Inquiry processing**: The transaction processing system supports query by the end-users. This inquiry processing is done by separate sub-system of the TPS. The user can make specific query by using the sending query to the inquiry processing system sitting on a LAN and receive response immediately.

- **Document and report generation**: The final stage of the transaction processing system is document generation. The collection of documents generated by the TPS is called transaction document. Invoice generated by a POS terminal is an example. Transaction logs are specific types of documents generated for Audit and other control purposes. All transactions recorded on the databases are printed.

Examples of transaction processing systems are sales transaction processing system (Refer to Figure 13.5), marketing transaction processing System, financial accounting system. One of the special types of transaction processing system is process control system (PCS). These are the systems that control processes of a manufacturing unit in a plant. Many process have been mechanized by PCS minimizing human involvement.

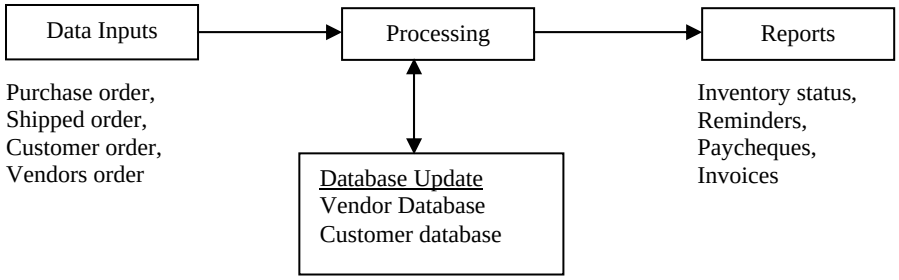


Figure 13.5: Sales transaction processing system.

Check Your Progress 1

1. …… use knowledge of experts from a specific field.

2. …….. use analytical models and specialized database in addition to internal data.

3. …….. process data from business operations as well as external data.

13.4.2 Management Information Systems

Management Information System (MIS) is a special kind of information system that helps managers to take decisions. MIS is tailored to provide specific information to individual managers for long term and strategic decision-making. MIS is used by the middle and top-management for their information requirements for decision-making. The use of MIS helps to produce the information that organizations need to improve decision-making, problem solving, controlling operations, and creating new products or services. Keeping this in view, a number of organizations invest in development of a computerized MIS . The focus of MIS is to provide strategic information required by top-management. Major volume of information for top management comes from events not directly related to day-to-day business operations. Therefore, the information from normal reporting systems is found inadequate for managers. Therefore, special information system is developed for top management to support their activity, which is not met by other information systems.

The following are the characteristics of Management Information Systems (MIS):

- Provides reports to management usually in semi-structured format (in detailed, summary, and exception);
- Usually uses shared database from many sources;
- Often based on management or statistical models;
- Information presented in both textual and graphical forms, but more often in graphical format;
- Provides information on trend analysis, exception reporting and what-if-analysis. It allows the user to ask questions such as , what if we increase price by 10%, the effect on sales of the product? If inflation increases by 5 per cent what will be the effect on the sales forecast?

Table 13.3 depicts a Sales Performance Report. Figure 13.6 depicts a Bar chart.only Figure 13.7 depicts a Pi chart.

Table 13.3: Sales Performance Report.

Sales Region	2000	2000	2001	2001	2002	2002
	Estimated	Actual	Estimated	Actual	Estimated	Actual
East	54353	98877	435	76	76667	76776
West	5453	34534	43	59	867	64465
North	9876	5354	435	567	76667	76776
South	89987	98877	675	345	878	876

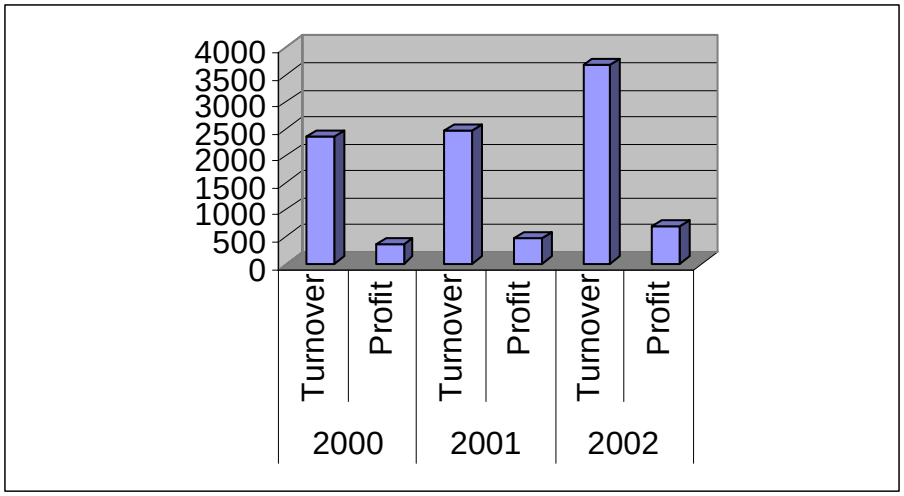


Figure 13.6: Turnover and Profit Ratio (Bar chart).

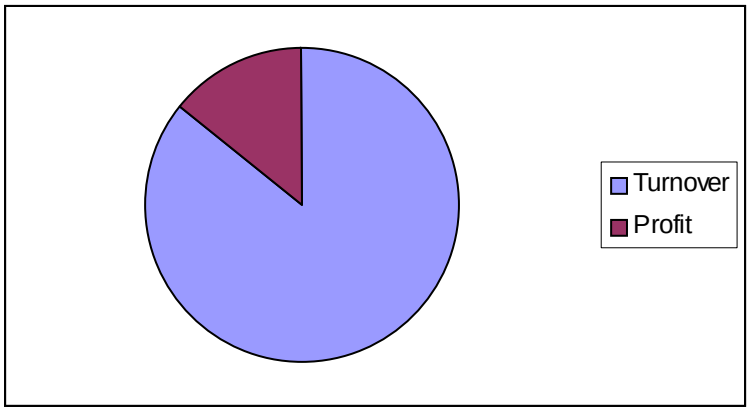


Figure 13.7: Turnover and Profit Ratio (Pi chart).

Components of MIS

The bulk of information requirement of Managers at middle and top levels comes from external non-computer sources like meeting documents, newspaper, telephonic talk, letters, memos, etc. Corporate databases are important for day to day operations of the organization.

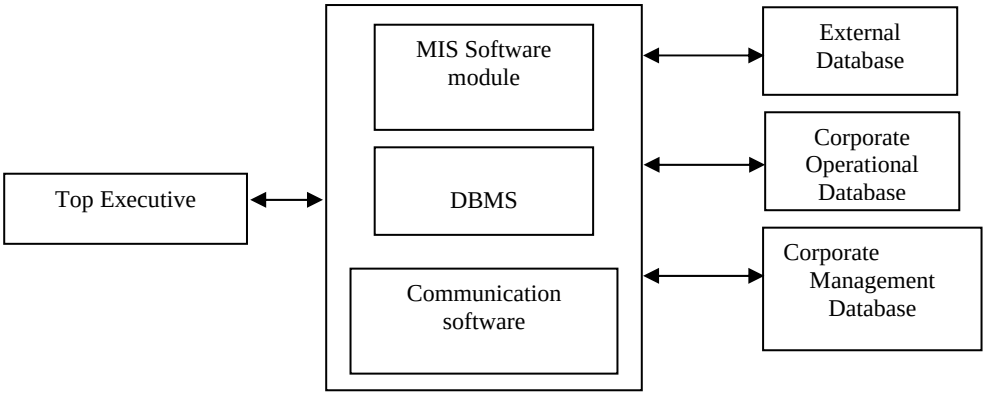


Figure 13.8: Components of an MIS

At the same time, data from external non computer sources provides managers with objective information that helps them to make strategic, long and near term decisions. Various components of MIS are showed in Figure 13.8 and explained below.

External Database: External databases are databases that are not owned by the organization and the organization pays royalty to access these databases. Examples of these databases are: databases of Market research groups, Statistical and Demographic organizations etc. Since organization operates in a social environment it is influenced by various external factors. Impact of theses external factors on the long-term goal and success of organization is very important. Top management needs to analyse data from these sources for long term planning.

Corporate database: Corporate database stores data generated by various business processes through transaction processing Systems. These can be employee database, customer database, inventory database, etc.

Management database: These databases store select data from corporate databases. It generally stores summarized information for the requirements of managers.

MIS Software: This is used to extract and process information from various databases. It acts as a user interface to the managers.

DBMS: Database Management System stores, retrieves and manages data on various databases.

Communication Software: This is used to communicate with customers, suppliers and other stakeholders of the organization. Examples are Messaging Software or Organization's Bulletin board.

13.4.3 Decision Support Systems

In contrast to other information systems which provide general information about organization's performance in fixed format to managers, Decision Support Systems provide information to managers which will be helpful for them to make decisions. A manager at a higher level needs adhoc information for strategic planning and control.

Decision Support Systems (DSS) can be defined as a specific class of information systems that support business and organizational decision-making activities, as needed to managers. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.

The following are the major characteristics of Decision Support Systems (DSS):

- Help decision makers to take decisions rather than replace them;
- Use underlying data and models;
- Have little or no reasoning capability;
- Are tailored to directly support decision-making styles of individual managers;
- Support interactive inquires and responses;
- Are used to aid semi-structured or unstructured decisions;
- Produce information on ad-hoc, flexible and adaptable format;
- Information is produced by analysis of operational and external data; and
- Analyses and supports comparison of specific alternative decisions.

Components of a DSS

Figure 13.9 depicts various components of a Decision Support System. They are explained below:

Data Management System

This is a system where various activities associated with retrieval, storage, and organization of the relevant data for the particular decision context are managed. It also provides security functions, data integrity procedures, backup and recovery,

concurrency control, and general data administration. It can be a relational, objected oriented or any other suitable database.

Model Management System

Similar to Data Management Systems, Model Management Systems perform retrieval, storage, and organization activities associated with various quantitative models that provide the analytical capabilities for Decision Support Systems. This software module is responsible for analytical and limited reasoning capability of a DSS. This may contain various statistical and operation research models.

Knowledge Engine

This module is responsible for activities related to problem recognition and generation of interim or final solutions. The knowledge engine is the "brain" of the Decision Support System. Decisions require reasoning, and less structured decisions require more reasoning.

User Interface

This software module provides functionalities for input/output, error capturing and reporting. A common user interface for various Decision Support Systems is not possible as their designs vary in accordance with the environment of the organization when they are deployed.

Types of User interface: Keyboard, Joystick, Mouse, Scanner, Voice, Pen mouse, Touch screen, etc.

Like all information systems, issues related to the user such as training , skill , motivation levels are critical.

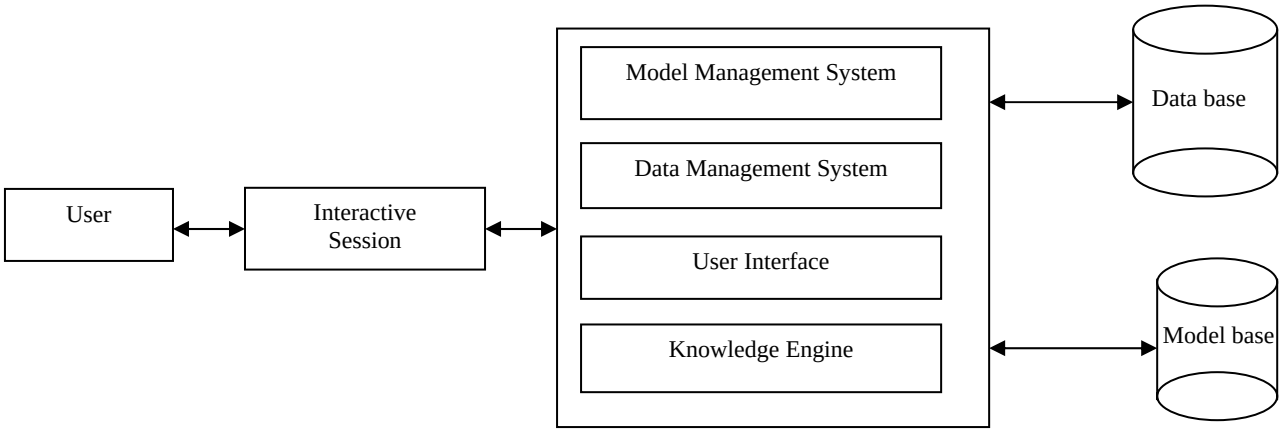


Figure 13.9: Components of Decision Support System.

Types of DSS

Various Decision Support Systems are Communication driven DSS, Data driven DSS, Model driven DSS and Knowledge driven DSS. Table 13.4 draws a comparison between MIS and DSS.

Table 13.4 : Management Information Systems and Decision Support Systems

	Management Information Systems (MIS)	Decision Support Systems (DSS)
Structure of Information	Periodic and often in fixed format	Interactive inquiry and Response to support
Source of information	Operational data/external database	Analytical models/external database and operational database
Target	Support group decision-making by managers	Tailored to decision-making style of individual managers

Check Your Progress 2

1. MIS provides reports to management usually in …… format.

2. Decision Support Systems help decision makers to take decisions rather than ……. them .

3. ……. is the software module that provides functionalities for input/output, error capturing and reporting.

13.4.4 Expert Systems

An Expert System is a computer program that simulates the judgment and behaviour of a human expert or an organization that has expert knowledge and experience in a particular field. Typically, such a system contains a knowledge base containing accumulated experience and a set of rules for applying the knowledge base to each particular situation that is described to the program. Sophisticated expert systems can be enhanced with additions to the knowledge base or to the set of rules. The expert system is a knowledge-based information system to act as a consultant to the user. Expert systems are being used in many specialized field like medicine, engineering and business. An Expert System in the field of medicine can help diagnose illness. Unlike Decision Support System, an expert System interacts with the user to get input and provides expert advice on a problem in a specific domain.

Among the best-known expert systems have been those that play chess and those which assist in medical diagnosis such as Mycin.

The following are the major characteristics of expert systems (ES):

- Captures knowledge and expertise of a problem solver or decision maker and simulates thinking for those with less knowledge;
- Replaces a human advisor/expert for specific domain of knowledge;
- Its domain of knowledge is narrow;
- Has reasoning and explanation capability;
- Types of problem treated is repetitive; and
- The direction of interaction is from machine to the user.

Expert systems are distinct from traditional Information Systems because of two main reasons:

Representation of Knowledge: Information is expressed in declarative form in contrast to procedural expressions used in other types of Information Systems. Here, knowledge is stored in a structured non-procedural way.

Perform Inexact Reasoning: Reasoning – A process by which new information is derived from a combination or combinations of existing, or previously derived, information. In this aspect, an expert system comes closer to human mind, which is hardly seen by traditional software. The ability to perform in exact reasoning leads to easier decision-making because irrelevant alternatives are reasoned out before the execution of the software.

Components of Expert System

An Expert System consists of a knowledge base and a software module (called inference engine) to perform inferences from the knowledge base. These inferences are communicated to the user. Figure 13.10 shows the components of an expert system.

Knowledge Base: It contains facts on a specific subject domain and rules to express the reasoning capability of a subject expert. Knowledge Base is logically divided into a fact base and a rule base. Knowledge means rules, heuristics (non-algorithmic), boundaries, constraints, previous outcomes and other knowledge programmed in by designers. A knowledge base typically incorporates definitions of factual knowledge and rules along with control information. Knowledge base format is specific to the implementation of the expert system software. Figure 13.11 shows the components of knowledge base.

Knowledge base contains much of the problem solving knowledge. Rules are of the form IF <condition> THEN <action>. Rules can be chained together (e.g., "If A then B" "If B then C" since A ⟶ B ⟶ C so "If A then C"). (If it is raining, then roads are wet. If roads are wet, then roads are slick.)

Inference Engine: Inference engine is software that provides the reasoning capability to the expert system. It processes rules and facts to provide advice on a specific problem. Rule based expert systems make use of two types of inferences for reasoning by forward chaining and backward chaining. Some expert systems use forward chaining by applying rules and facts to reach the conclusion where as others use backward chaining methods where it is verified whether the stated conclusion can be reached by applying the rules to the facts. The types of data processed by the inference engine are symbolic rather than numeric or character data types processed by other types of information systems. It usually takes the help of heuristic to solve a problem which other wise leads to combinatorial explosion.

In addition to above, expert systems may contain a knowledge acquisition module which in reality does not form the component of an expert system but is certainly important for development of knowledge base of an expert system. Specially designed languages such as LISP and PROLOG are used for programming expert systems.

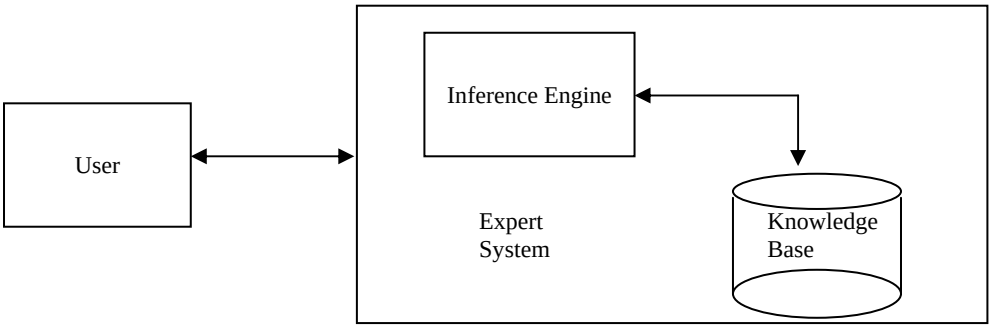


Figure 13.10: Components of an Expert System.

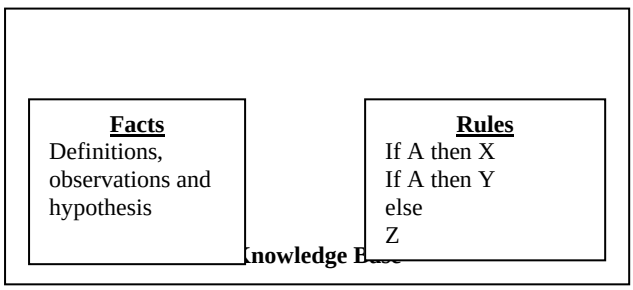


Figure 13.11: Components of Knowledge Base.

An expert system starts with an interactive query session, which is directed from the expert system to the user. In this interactive query session, expert system asks a series of queries to the user and expects reply from the user similar to a doctor asking a series of queries to the patients before reaching any conclusion on the diagnosis of the disease. The user is expected to give reply to all the queries based on which the expert system recommends a solution like human expert. The advantage of computer based expert system is that it is unlike a human expert who is prone to environmental condition, these systems are consistent, fast and accurate in providing expert advice. It can also be programmed to give advice on behalf of several experts. This is the reason why expert systems are used as knowledge based strategic information resources for the managers in an organization. Various information systems are developed with an expert system component built in to it. These are called expert assisted information systems.

Knowledge Acquisition by Expert Systems

Expert systems must liase with people(experts) in order to gain knowledge and the people must be specialized in the appropriate area such as Medicine, Geology and Chemistry to name a few. Knowledge Engineer acts as an intermediary between the specialist (human expert) and the expert system. This process of picking the brain of an expert is a specialized form of data capture and makes use of interview techniques. The Knowledge Engineer is also responsible for the self-consistency of the data loaded to the expert system. Thus, a number of specific tests have to be performed to ensure that the conclusions reached are sensible and accurate. Figure 13.12 depicts communication between expert system, knowledge base and human expert.

Figure 13.12: Communication between Expert System, Knowledge Engineer and Human Expert.

There are various applications for expert systems in business, engineering and medicine. Expert systems ask the user, a series of queries and based on the feedback from the user, deliver expert advice on the specific subject. Expert systems are used in the field of Medical diagnosis, Sales forecasting etc. Expert Systems are being used by managers for credit management, employees performance evaluation, portfolio analysis and production monitoring. Although expert systems are used in many fields, it can never replace a human expert. Expert system can provide expert advice based on the available information and knowledge. Expert systems lack learning capability like human being and have very limited focus area. It fails in the areas where advice requires a broad knowledge base.

Table 13.5 draws a comparison between Decision Support Systems and Expert Systems.

Check Your Progress 3

1. …… is a computer program that simulates the judgment and behaviour of a human expert.

2. …….. is logically divided into a fact base and a rule base.

3. …… acts as an intermediary between the specialist(human expert) and expert system.

Table 13.5: Decision Support Systems and Expert Systems.

	Decision Support System (DSS)	**Expert System (ES)**
Objective	To assist human decision	To mimic human decision
Reasoning capability	No or limited	Yes
Database	Adhoc, factual information	Procedural and factual knowledge
Domain	Broad	Narrow, very specific domain
Types of Data	Numerical, character based	Mostly symbolic
Direction of Query	Human to machine	Machine to human
Decision Maker	Human takes the decision with support from DSS	Computer makes the decision

13.5 SUMMARY

Information needs vary among different managers depending on their hierarchy in the corporate ladder. Information systems are being used since their evolution for planning and operation of the organization. Specialized information systems have evolved for different executives at different levels.

During the initial years of evolution of MIS, Computers are mostly used for data processing activities. Transaction Processing Systems have evolved to process data generated from various business transactions. When the data is processed as and when it is generated, it is called Online Transaction Processing System. Some times, the data is processed in batch depending on the business requirement, called batch processing system.

Management Information System (MIS) helps decision-making process of managers. Interpretation of data and interface with external data base is required due to broad nature of top management functions.

Decision Support System (DSS) helps to automate routine decision-making functions by managers. Structured decision is easy to program. Various statistical and analytical models are used to provide decision support to the managers.

Expert System has been designed to give expert advice to managers in specific domain. A series of queries are put by the expert system and based on the response of the user, it comes out with advice. Expert systems are accurate and consistent in providing expert advice. Expert systems are found in many applications in the field of portfolio analysis, medicine, building regulations etc.

13.6 SOLUTIONS/ANSWERS

Check Your Progress 1

1. Expert Systems
2. Decision Support Systems
3. Management Information Systems

Check Your Progress 2

1. Semi-structured
2. replace
3. User interface

Check Your Progress 3

1. Expert System
2. Knowledge Base
3. Knowledge Engineer

13.7 FURTHER READINGS

Joey George, J Hoffer and Joseph Valacich; Pearson Education *Modern System Analysis and Design*;2001

K.C.Laudon and J.P.Laudon; Pearson Education *Management Information Systems*;Seventh Edition;2002

Reference Websites

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