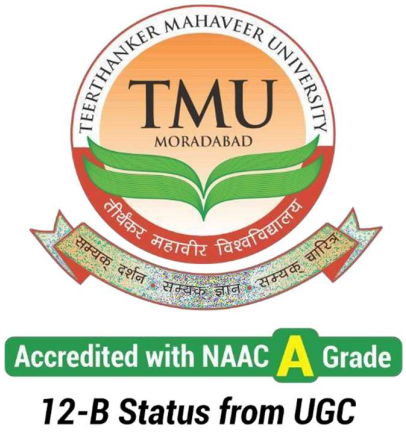
TEERTHANKER MAHAVEER UNIVERSITY
MORADABAD, INDIA

CENTRE FOR DISTANCE AND ONLINE EDUCATION



Programme: Bachelor of Business Administration

Course: Management Information System

Course Code: BBACC202

Semester-II

SYLLABUS

Management Information System

Objectives: The course aims at providing fundamental knowledge and exposure to the concepts, theories and practices in the field of MIS. The course will explain the relationship among and between information systems and management, analyze how technology can be used to synthesize complex data to make sound business decisions.

Unit I

Introduction: Definition, characteristics & significance of MIS. Introduction to business systems: Operations Support Systems, Management Support Systems, Expert Systems, and Knowledge Management Systems. Information Concepts: Data Vs Information, types of information, quality of information.

Unit II

Decision Making: Simon's model of decision making, structured & unstructured decisions. Database Management: Objectives, role, advantages & disadvantages of DBMS, SQL, use of databases for integration across functional areas. Introduction to Decision Support System.

Unit III

Design Methodology & Techniques: System development life cycle, software development models. System Analysis – SRS, DFD, DD & Decision tables. System Design – design methods, detailed system design, design documentation. System Implementation & testing.

Unit IV

Implementation & Evaluation: Planning, organizing, testing & changeover. Evaluation approaches. Brief introduction of emerging concepts and issues in Information Systems: Supply Chain Management, Customer Relationship Management, ERP, Data Warehousing, Data Mining.

Suggested Readings:

1. D.P. Goyal : Management Information Systems. MacMillon.
2. Davis & Olson: Management Information Systems.
3. Murdick, Ross, & Clagett: Information Systems for Management.
4. Kenneth, Laudon and Jane Laudon MIS: Managing the Digital Firm, Pearson Education.

Table of Contents

CHAPTER 1: MANGEMENT INFORMATION SYSTEMS

STRUCTURE

1.0 OBJECTIVES

After reading thus chapter, the students must understand:

- Concepts of Management Information Systems
- Significance of Management Information System
- Characteristics of Management Information Systems
- Functions of Management Information System

1.1 INFORMATION SYSTEMS

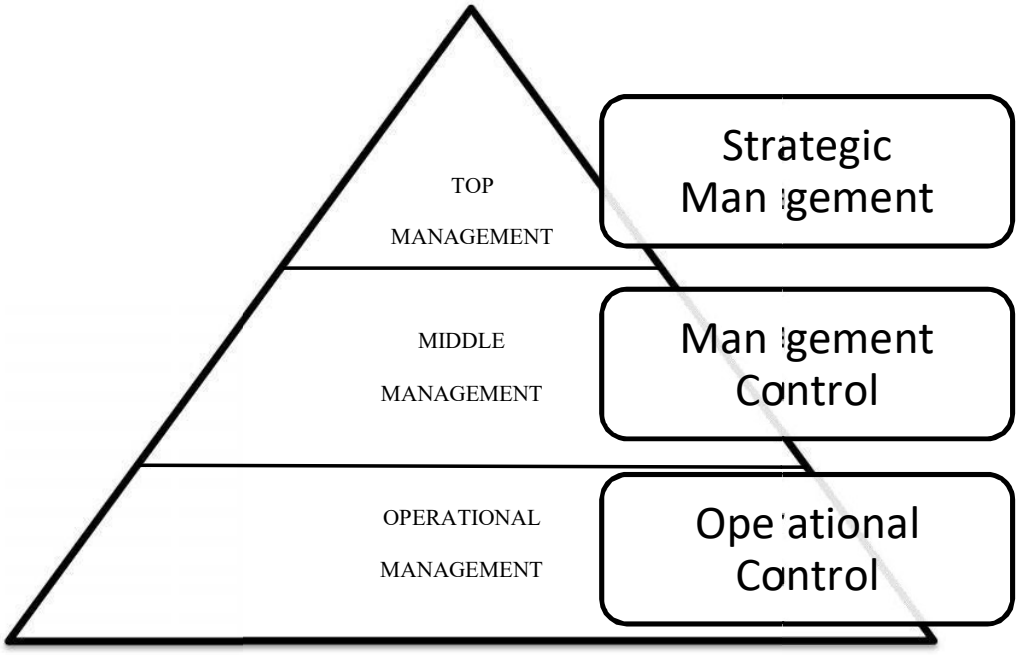
An Information System is any organized set of interrelated components which help to collect organize, store, process and communicate information in whichever way it might be required by the end user. An information system can be as simple as a calendar on our desk, a monthly planner, a journal etc to an extremely complex database system used to process vast quantities of data.

The main objective of the information systems is to provide relevant information to the users in the form in which it is required. They may vary in size, implementation, input required,

output provided etc. according to the type of users who have to use them. In application, information systems exist in all shapes and sizes. They may range from simple transaction processing systems to expert systems and ERPs. They can be differentiated on basis of the need and the users who eventually need to use them. They can be used at:

- Strategic level
- Management control level
- Operational control level

Information systems at strategic level are used by the top management for long term objectives, goals of the organization. They are not concerned about minute operational details of various processes going on in the organization; need to get a bigger picture of the issues. Therefore the top management finds applications in the information systems (as shown in the diagram below (which can be used for strategy formation and implementation such as such as Strategic Information Systems (SIS).



Middle Management which basically works at Management Control level uses Management Information systems so they can effectively guide and provide feedback to the top management.

The operational management i.e. the supervisor level workers in the organization take care of operational control i.e. effective working of business processes at the ground level which generally works on routine tasks with the help of transaction Processing Systems.

1.2 MANAGEMENT INFORMATION SYSTEM

Management Information System is an information system that evaluates, analyzes, and processes an organization's data to produce meaningful and useful information based on which the management can take right decisions to ensure future growth of the organization.

Management Information systems as suggested earlier are generally used at management control level decisions. They help middle level mangers to take decisions and also to provide appropriate information and feedback to the top management for strategic level decision making.

Management information system is made up of three words i.e. Management, Information and Systems. All these words are extremely vast subjects in themselves and understanding each them is pivotal in understanding MIS as a concept, so let us touch upon them to understand them better.

1.2.1 MANAGEMENT

Management is an extremely vast concept and has been extensively discussed by scholars over time. One of the most widely used definitions of Management, given by Koontz, says ‘Management is the art of getting things done through and with the people in formally organized groups’. However this definition just emphasizes on the basic essence of management, in practice it is done by a continuous and systematic processes consisting of various management functions.

According to Henry Fayol "To manage is to forecast and plan, to organize, to command, to co-ordinate and to control. These are the basic functions that a manager performs in order to effectively manage all the aspects required in the organization are also known as managerial functions. The Five functions of Management as given by Koontz and O’Donnel are:

- Planning
- Organizing
- Staffing
- Directing

- Controlling

Planning is the act of determining the organizational objectives, formulation of short term goals from them and then using those goals to make operational procedures, policies etc. to be implemented. Planning basically aims at foreseeing the future and making the organizational objectives to be synced with that future that we see for our organization. Planning is done in order to move from 'where we are' today to 'where we want to be in the future'.

Before doing any task a manager has to decide in advance that how to work on a particular task. It involves answering questions such as what to do, when to do, how to do, where, when, how, why and whom it is to be done. Planning may involve formation of long term objectives, strategy, policies, procedures, methods, rules, programmes, budgets etc as and when required by the organization.

Organizing is the part where the actual implementation of the plans formed by the manager is done. According to Henry Fayol, "To organize a business is to provide it with everything useful or its functioning i.e. raw material, tools, capital and personnel's". The process of organizing involves:

- Identifying the jobs
- Dividing the job in doable subparts/tasks
- Allocating the resources to the jobs (human, material etc.)
- Delegating the authority as was planned in the panning process

Staffing deals with manpower management and encompasses all the functions such as:

- Manpower Planning (estimating man power in terms of searching, choose the person and giving the right place)
- Recruitment, Selection & Placement
- Training & Development
- Remuneration
- Performance Appraisal
- Promotions & Transfer

It is the process of putting the right person at the right job. The two functions i.e. organizing and staffing may appear similar and in many ways are related to each other but the focus of

the processes is different. The organizing function deals with the job, its structures, the processes involved etc where as staffing directly talk about the people performing those jobs and their management.

Directing involves concepts like supervision motivation, communication and leadership in order to achieve the set goals and objectives. Traditional views generally consider directing related to Henry Fayol's concept of command but these days it is considered a much wider concept. It optimizes organizational processes to ensure efficient work being done in order to achieve pre set objectives. This is the step at which the actual work starts as all the earlier steps are mere preparations of what needs to be done and this is where the workforce is actually managed and the goals and objectives and ensured to reach their fate.

Controlling is basically ensuring that the required results are achieved. According to Theo Haimann, "Controlling is the process of checking whether or not proper progress is being made towards the objectives and goals and acting if necessary, to correct any deviation".

The process of controlling contains the following steps:

1. Setting performance standards.

   The criteria against which the actual performance is to be checked are set. These can be in both qualitative of quantitative terms
2. Measurement of actual performance

   The actual performance id measured and in the same and in the same units as the standards.
3. Comparing actual performance with standards.
4. Analysis of deviations.
5. Taking corrective measures.

What we can note here is that Information systems can be of vital importance for any of these functions of the management. So the concept of MIS and information system should not in myopic view automation but as an integral part of the broader phenomenon of effective Management.

1.2.2 INFORMATION

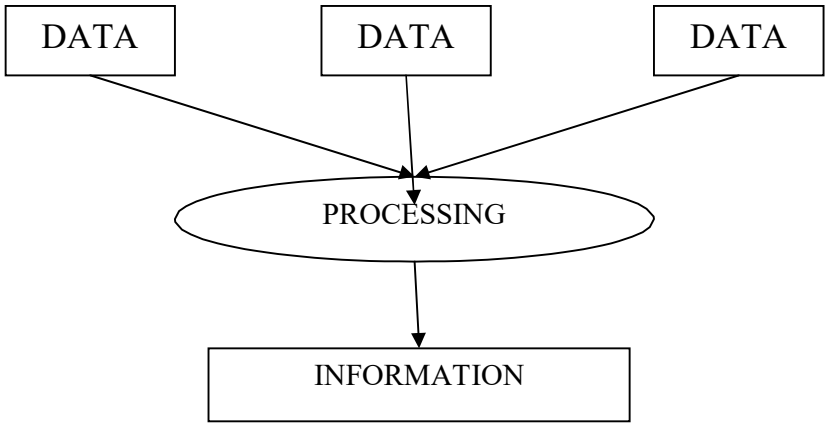
Information is the next concept that forms the basis of a MIS. Information is considered the most valuable resource by any management for effective efficient working of any system.

Information provides that edge that if used by the mangers has the potential to greatly affect businesses and even business environments on the whole.

Some of the very closely related concepts we come across in this area are

- Data
- Information
- Knowledge
- Wisdom

Each of these concepts has its own special role in and organization and also in relation to the other. Data is collected and analyzed to create information suitable for making decisions, while knowledge is derived from extensive amounts of experience dealing with information on a subject. Some complement the series "data", "information" and "knowledge" with "wisdom", which would mean the status of a person in possession of certain "knowledge" who also knows under which circumstances is good to use it.

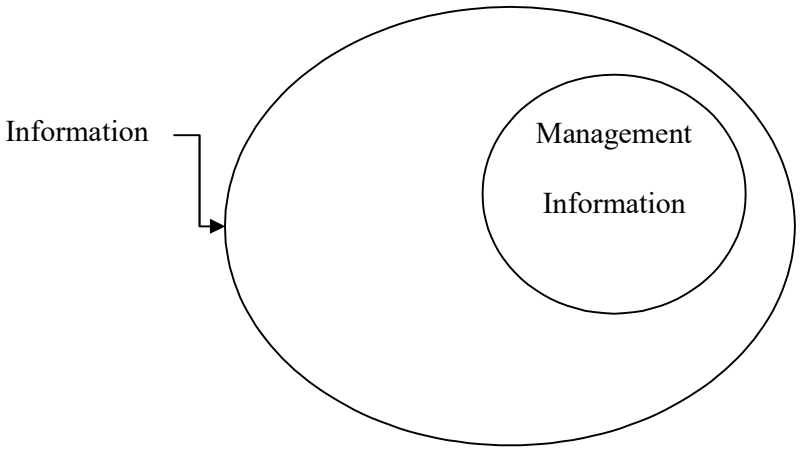


Beynon-Davies uses the concept of a sign to differentiate between data and information; according to him “data is a series of symbols, while information occurs when the symbols are used to refer to something.”

Data usually refers to unprocessed data or we can say raw data consisting of just facts, figures and numbers on a particular thing. It is gathered generally through the simple acts of measurement and collection. Once the data is analyzed and processed, it is considered as information. Information is "knowledge communicated or received concerning a particular

fact or a piece of data." It is a sequence of symbols characters, numbers etc. that can be interpreted as a message. It provides knowledge or insight about a certain matter.

Basically, information is the message that is being conveyed, whereas data are plain facts. Data in itself is fairly useless, until it is interpreted or processed to get meaning, to get information. Once the data is processed, organized, structured or presented in a given context, it can become useful. Then data may eventually used to become information, knowledge and even wisdom and actually forms the basis of these much wider terms.



As shown in the diagram above it can also be noted that not all the information that can be generated from the data present in the business environment the organization resides in is important to the management for decision making or operational purposes etc. Within the scope of Management information, the usage varies according to the type of information we are dealing with. It can be classified and used on basis characteristics, management hierarchy, usage etc. It can be used by top, middle, operational level users or can be used to implement strategic, tactical decisions. Therefore it should be kept in mind that in context of MIS we deal with management information which is just a subset of what might be available in totality in the complete business environment.

1.2.3 SYSTEM

The ‘systems concept’ forms the very backbone of Management Information Systems. They especially form the basis for the structure of MIS. The major concept of the systems involves basically the pattern or a way in which one thinks about managing optimally. In MIS,

systems approach acts as the framework for the analysis of the internal and external factor affecting the environment, integrating the various components into one entity.

System refers to the unification of some related processes, activities, procedures which lead to a common goal. It can be seen as an arrangement of some specific things organized in a particular way. System is a combination of Smaller independently acting Subparts or components which are so interlinked that they form a unified whole. Particularly for the management Information Systems, a system consists of certain specific set of elements that can be identified as the belonging together because of the common purpose, goal or the objective.

To put it simplistically a man made system can be viewed as an input output system as shown below.

Every system, no matter the field of study it hails from, has some common characteristics or component. These components are:

- Goals
- Subsystems
- Environment
- Boundaries
- Life cycle

The whole system is always unified by a common goal or objective. All its components may be performing different functions but their ultimate intention is to facilitate the objective of

the system on the whole. All the components despite their operational differences are required to act in unison in order to function properly and produce the desired results.

Every system is further broken down into smaller parts generally called the subsystems. These subsystems can be considered as individual entities performing individual functions with distinct objectives and actually act as systems themselves. These subsystems are interconnected to each other in one way or the other and interact with each other.

Anything other than the system that may or may not be affecting the system is the Environment. A system may be termed as an open or closed system based on the fact that whether or not it interacts with the environment it resides in.

The system is separated from the environment with the help or boundaries. Similarly subsystems, which as earlier stated, act as individual systems also have distinct boundaries of their own.

Every system also follows a life cycle of design, development, implementation and maintenance in order to reach its ultimate operational goal.

In the management Information Systems, the concept of the system is very much important and one should have an in depth knowledge of it. The study of this concept actually puts us into perspective with the fact that the actual importance here is of the interaction of the subsystems, their interactions with one another and the environment and of the unified and synergetic action they are required to perform.

1.3 SIGNIFICANCE OF MIS

Management Information Systems can be seen as one of the main deciding factors in organizational success or failure. No matter the kind of organization, manufacturing or servicing, the industry in which it is to be applied, the working conditions, geographical divides, every organization can benefit from MIS. It ensures effective flow of data which then may translate into information or knowledge and helps the managers and top management to gain control over the whole system with better understanding. It can help organizations gain competitive advantage over others in the same business by being proactive to the changes in the internal and external environments.

Management information systems can bring about efficiency and effectiveness in every business process of the organization. It can range from the management functions of planning control, direction etc. on the whole but also plays a rather pivotal function in aspects such as strategic management, customer relationships management, production optimization, inventory intelligence, management of legal, ethical and social issues, organizational behavior workplace psychology, leadership, creativity, innovation etc.. A successful organization needs insights into these phenomenon and many more and how they are affecting their organization, MIS can help them do the same.

MIC helps us achieve this i.e. helps us enhance the quality of management and the overall growth of the organization just by providing the right information at the right time so that it can utilized to improve the planning and control functions. This accurate and timely information actually forms the cornerstone of a good Management information system. No organization can succeed without timely appraisals or rather we can say proactive appraisals of their performance and MIS helps us achieve that based on the data and information it generates.

A Management is said to as good as the information it has of the organization and the environment it resides in, therefore it should always be kept in mind that the MIS is strictly based on the specific needs of the mangers. They are generally tailor-made for organization, situations and circumstances. Also a cost benefit analysis should form the basis of formation of any MIS. A MIS always should follow a comprehensive approach and consider every aspect of the organization and should always be flexible enough to meet the ever changing business requirements of the organizational environment and needs.

1.4 NEED OF MANAGEMENT INFORMTION SYSTEMS

The need for effective management information generates the need well managed data and a Management Information System helps us achieve that. A Management Information system:

1. Enables recording: Business processes generate data each and every second that they are in operation and it has become rather vital to keep track of each and every step of these processes in order to base our judgments and decisions based on the comprehensive information based on these everyday operations. A Management Information System helps has keep track of every transaction or event happening at the operational level, this data can be easily collected, stored and updated regularly.

2. Facilitates planning: Due to increased size and scale of businesses today the top management has in many cases lost the direct contact with the lower level operational activities these days. There Management Information Systems provide the management at higher levels with comprehensive reports about the happening at the lower level managements and help keep the lost contact alive through technology. With the help of detailed reports containing relevant information decision making about the future plans and how to go about them can be easily and effectively done.
3. Minimizes information overload: along with absence of information what can be really damaging to a decision maker can be too much information. A manager may stand confused in case of very large amounts of data that is everyday produced out of the everyday operational activities of the business. Management Information Systems change large amount of data into relevant reports in summarized form which avoid confusion and save the manager form information overload. The managers do not need to be aware of detailed facts in order to make tactical and strategic decisions therefore having to deal with detailed datasheets and fishing out information can be rather frustrating, this is where a Management Information System comes into play and facilitates efficient management.
4. Measurement: The data collected at the lower levels of management can be easily measured for the performance levels by using set standards. These metrics can easily determine whether the operational business processes are going the way they are required to or not. The Management Information Systems work on the principle of exception and whenever a the data indicated performance that is not the way it should be according to the standards it can immediately noted by the management , thus keeping a regular eye on performance.
5. Encourages decentralization: Management Information Systems as already discussed can help monitor performance at operational levels making it easier to bring out necessary changes when required. This can help bring about decentralization of decision making powers as operational level decision can be easily made using the Management Information Systems.
6. Brings coordination: Management Information Systems integrate the various independently acting functional area of the organization together bring out better coordination between the individual subsystems. Their linkage is pivotal to the system as well as the organization, it should never be forgotten that beneath their individual functional goals, all these departments have to work for the ultimate organizational

objectives. Management Information System facilitates integration of specialized activities i.e. the functional departments. This is done by keeping each of them aware of the requirements and problems of each of them, thereby increasing understanding and coordination. Various decision centers of the organization are thus connected by communication which drastically improves the performance of the system on the whole.

7. Makes control easier: ass already discussed that performance can be easily measured based on standards metrics set for performance at operational levels. This also helps effective and timely control. The lower level managers can take corrective actions based on the data provided of the Management Information System. The decision making can now be decentralized; a simple change in operational activities does not have to go through the hierarchies of the organization, delaying decisions to control performance. A Management Information System helps in achieving this by easier data processing, storage capabilities with lesser effort and reduced costs thus establishing a link between planning, evaluation and control and thus helping to improve the overall performance.

EXERCISE I (State whether true or false)

1. MIS stands for Management Informative Software.
2. Strategic information is used by the top management.
3. Data and information are interchangeable terms.
4. Systems can be open or closed in nature.
5. MIS makes management control easier.

1.5 CHARACTERISTICS OF MANAGEMENT INFORMATION SYSTEMS

A Management Information System has the following characteristics:

1. Management oriented: Every Management Information System is Management oriented. Its purpose is to enhance the quality and proactive-ness of the management of the organization and it should be designed such that it helps the organization in doing that. It should be strictly based on the management's needs. The starting point of the MIS design should always be the organizational objectives. The basis of Management Information System development plan should always derive its central

driving force from the business's overall mission and vision or the long term business plans.

2. Focus on Management Control level: A Management Information system finds its application mostly at Management Control level. Specific type of information is required by mangers at different levels of the management hierarchies. As already discussed top level managers need information to make strategic decisions, middle level mangers deal with tactical decisions, and lower level managers or the supervisor managers deal with operational decisions. So according to use and application top level managers may use Strategic Information Systems, middle level managers may use Management Information Systems, lower level managers may use Transaction Processing Systems. These are not hard and fast rules and it just depends on the extent to which information systems have been implemented in an organization.
3. Systems Approach: Management Information /systems follow the systems approach. It is a holistic approach where even though the subsystems exist as separate entities, they still work in synergy for the common objectives. Subsystems may have individual objectives of their own but there is a subordination of individual goals to the central goal of the systems on the whole. The emphasis in the systems approach is also on the interaction of the subsystems with each other which helps reach the common goal of organizational decision making.
4. Tailor-Made Approach: Management Information Systems should be strictly based on the needs of the managers it is implemented for. They should cater to the need of the organization on the whole also focusing specifically to the level of mangers that have to use them. This applies to any information that needs to be implemented in an organization. It should be noted that every organization even if they are n the same industry do not have exactly same business environments, therefore a Management Information System should always be tailor made specifically according to the needs of the organization. The needs cannot be generalized or universally implemented.
5. Functional Applications: Organization and generally subdivided on the basis of functional operations. We can divide an organization into the Human Resource, Marketing, Finance, Production, Inventory etc and the Management can be devised according to these individual aspects of the organization. We can have a MMIS for the Marketing department dealing with Sales orders, supplier management, and customer relationship management etc. A HRIS for the Human /resource department

performing functions for attendance, performance appraisal, training and development activities etc. An Operations Management Information systems dealing with issues such as order processing, distribution, inventory etc. and so forth.

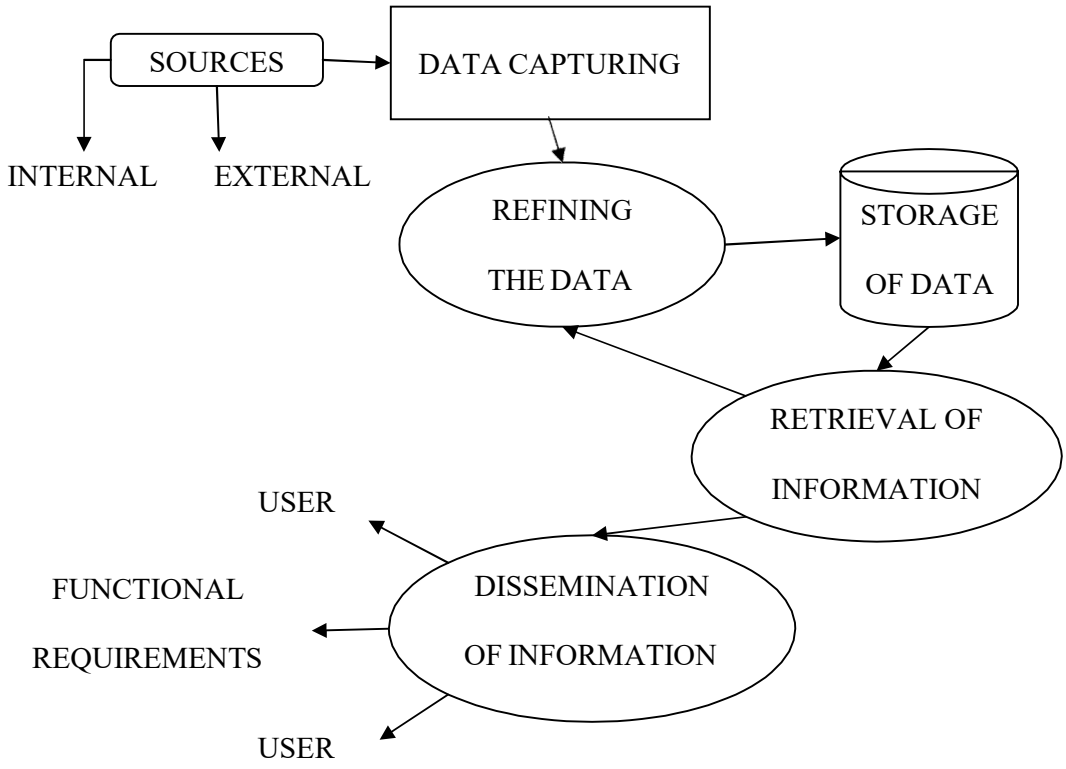
6. Integrated: Integration is extremely important for a Management Information System. This can be looked upon from two point of views, first that the Management information system is formed of several smaller subsystems which have to perform individually but should be integrated to each other in order to meet common objectives, secondly integration is extremely significant because a Management information system is expected to produce information that is meaningful for the organization. Therefore if the system is not integrated it may miss out on certain aspects and provide incomplete or misleading information to the mangers which can further lead to erroneous decision making. This eventually defeats the purpose of implementing an Information system, therefore it can be said a Management Information System that does not follow an integrated approach can turn out to be useless for the organization.
7. Formal Information Network: Management Information Systems work on accurate information provided by authentic data sources. The Management Information systems are made to aide decision making and the decisions can only be as good as the information they are based upon therefore huge emphasis is laid upon the data sources that are used for implementation of the system. Management Information Systems are based on specific information that is collected systematically and routinely according to preset, well defined rules. Thus it can be said that they are collected through formal information networks of the organization and eventually act like one.
8. Common Data Flows: As we have discussed above the reliability of the decisions taken based on the information provided by the Management information system can only be relied upon if it is based on authentic data. This again can turn to be meaningless if the treatment of data is not done in the manner in which it should be done. The processes of data gathering, storage and dissemination should be free of duplication, redundancy and contradictions. The data should be stored in such a way that it flows smoothly in all the various subsystems generating no contradictions when subsystems interact with each other.
9. Decision Making: The main focus of an Information system is to make decision making easier. The aim is to provide relevant information to the managers from the

large amount of data that is present in the organization so that decision making can be timely and accurate. Advanced information systems are also designed such that they can take decisions for the managers based on predefined parameters which depend on the implementation level of the information system. So the key here is better management based on effective decision making and this is what should form the basis of formation of any Management Information System.

10. Security: Management Information systems deal with vital information of the organization. One of the most precious assets of an organization, and can be rather strategic in nature if the possession gets into the hands of the competitors therefore the security of the data and the Information System is of prime importance to the organization.
11. Future Oriented: An Information System should not only work on the historical or past data but should have the capabilities to be proactive and provide projections etc for the future. Also it should be kept in mind that developing a Management Information system is a long process, such systems cannot be formed overnight. Therefore the developers and the mangers have to look at long term orientations and should always keep in mind the future objectives of the organization when designing and developing the system.

1.6 FUNCTIONS OF MANAGEMENT INFORMATION SYSTEMS

The ultimate aim of a Management Information system is to provide the management information. To reach that objective the following important functions are performed by a Management Information System:



1. Data Capturing: Management Information systems capture data from various internal and external sources of information. In recent times competition has increased drastically and organizations focus really hard on where and how they can get relevant information. It is important to scan all possible sources of data which can be made easier using a Management Information System. Data capturing can be manual i.e. received from pen and paper physical records present in the organization or can be directly taken from Transaction processing systems earlier present in the organization or those used by the operational staff in the organization.
2. Refining the data: Handling large amount of data can prove to be a daunting task manually, but Management Information System can not only help capturing it but also help keep it in a standard form which would further enable to extract valuable information out of it. Sometimes data needs to be viewed from different perspectives so as to bring out hidden information and gain advantage from it. Management Information Systems help analyze and refine data using methods such as calculating, comparing, sorting, classifying and summarizing the data. This helps in organizing, analyzing data much easily so that it can be useful in the future.

3. Storage of data: Storage of large amounts of data can be easily done using a Management Information System. All the data whether processed or unprocessed is kept in the Information system for future use. Any information that is not immediately required may be stored for future references or in the form of historical data. Everything is stored in an organized manner in the form of databases containing data in the form of records fields and entries. Segregating the data according to the uses is also one of functions that a Management Information System can help us perform.
4. Retrieval of information: The information Stored by the Management information System can be retrieved when prompted by any user. The key to performance of any management is the availability of right information with the right person at the right time and MIS helps us achieve that at the organizational level. Information can be retrieved as and when required which then can be disseminated to the user in the form of managerial information or can be further processed in order to be processed or refined or to be used in combination with some newly acquired data or information.
5. Dissemination of Managerial information: The Management information is the ultimate product provided by the Management Information System which can be disseminated to the end users. This is the ultimate tool which helps the managers to take decisions based on the precise, accurate and timely information provided by the system. Decision making is the task for which these systems are made and they help the managers to look at the problem at hand from various perspectives and thus helping in taking decisions. This can be done by generation of reports and graphical representations of the information
6. Fulfilling functional requirements: Management Information Systems help in fulfilling the functional requirement of the various functional departments of the organization such as Marketing, Human Resources and Operations etc. The requirement of each of these departments is different and MIS also aids these functional mangers in decision making.

EXERCISE I (State whether true or false)

1. MIS are management oriented.

2. Security of data is not a big concern for the organizations.

3. MIS have to be future oriented and flexible in nature.

4. Functions such as refining storing and retrieving data are done by MIS.

5. MIS is an umbrella term sometimes referring to even other types of Information systems.

Answers to Exercise I

1. False
2. True
3. False
4. True
5. True

Answers to Exercise II

1. True
2. False
3. True
4. True
5. True

1.7 REVIEW QUESTIONS

1. Explain the basic concepts of MIS.
2. What is the need of MIS for the managers in an organization?
3. Give various characteristics of MIS.
4. MIS helps managers in various ways in an organization. Discuss.

1.8 SUGGESTED READINGS

1. Sahil Raj :Management Information Systems
2. D. P. Goyal :Management Information Systems Managerial Perspectives
3. G. Davis, M. Olson :Management Information Systems
4. R. Murdick, J. Ross :Management Information Systems
5. K. Laudon, J. Laudon :Management Information Systems Managing the Digital Firm

CHAPTER 2: INTRODUCTION TO BUSINESS SYSTEMS

STRUCTURE

1. OBJECTIVES

After reading thus chapter, the students must understand:

- Concepts of Business Systems
- Concepts of Operations Support Systems
- Concepts of Management Support Systems
- Concepts of Expert Systems
- Concepts of Knowledge Management System

1.1 INTRODUCTION TO BUSINESS SYSTEMS

A Business comprises of innumerable methodological procedures which are going on in the organization in order to complete and effectively meet the objectives of the systems. The processes may belong to different functional units of the systems, each intended to produces some specific effect and form a very small part of the bigger business puzzle. These smaller business processes, which perform similar tasks or are working towards common, form the

building blocks for the various business systems that exist in the organization. These business systems perform specified tasks such as keeping a track of sales made of the organization, managing the inventory levels in an organization, managing the workforce etc. Every business systems maintain or rely on the business information produced by these systems for future operations in the form of business information systems for each of them or for the organization on the whole. Therefore these systems sustain individually in the organization working for a common goal yet relying and communicating which each other. Each of them can be viewed from a different perspective and used from a different level of management as and when required.

1.2 OPERATIONS SUPPORT SYSTEMS

Operation Support Systems as the name suggests are those systems which help the management carry out the operational activities of the organization with efficiency. Data and information were earlier handled using manual information systems such as record-books, ledgers, attendance sheets etc. but as the scale of operations of businesses increased, the need for more efficient and time saving methods to store the data and later retrieve them when required came about. With the advent of computers and other modern technology, this became possible through implementation of what we call the Operations Support Systems.

Operational support systems are used by the lower level managers who have run the day to day routine functions for the organization. The lower level managers or the supervisor managers basically supervise the operational activities happening in the organizations and there have to make decisions based on these routine activities.

Operation Support Systems can further be of many types:

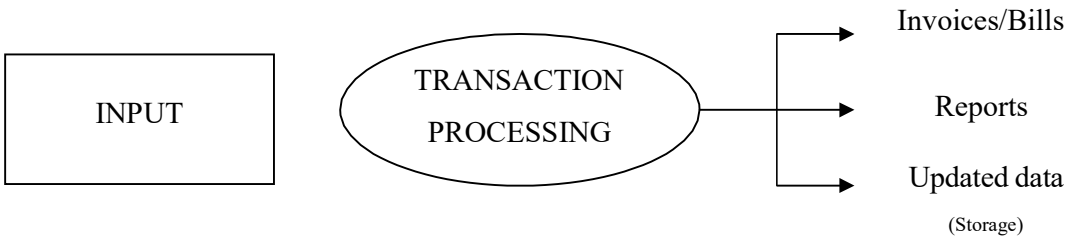
I. Transaction Processing Systems:
II. Process Control Systems
III. Enterprise Collaboration Systems

1.2.1 TRANSACTION PROCESSING SYSTEMS: A Transaction Processing System is an information processing system which is used for collection, storage, modification and retrieval of the data on various transactions carried out by a business.

Transaction processing systems can be considered as just the starting point of automation and use of technology in an organization. We know that before the advent of computers and other

such technologies, the record of any business were kept in the form of manual record in registers, ledgers and manual sheets etc. Slowly these records were started to be stored on computer terminals in order to ensure speedy retrieval and processing. This gave birth to the very basic automated business systems i.e. the Transaction Processing Systems.

A Transaction Processing System does nothing but stored the transactions that are done at the operational level of the organization directly into the system, for example sales in a retail shop, or the banking transactions by customers in a bank etc.



Most Transaction Processing Systems take input in the form of various daily activities performed in the organization which is recorded and then processed to produce the output i.e. the information required by different users. The input data is the transaction i.e. the daily activities happening in the organization. These can be financial or non financial in nature. A financial transaction is any economic event involving exchange in monetary or monetary equivalent terms that affects the assets of a firm. These are also reflected the account books of the firm and measured in monetary value. Some financial transactions can be sales of good to the customers, purchase of materials from the suppliers or payment of salaries to the employees etc. On the other hand a non financial transaction does not involve any monetary exchange. Basically any additional information that is a non financial one is considered otherwise. In an organization if the company is collecting customer feedback post a customer care call that data may be stored in the company's Transaction Processing System or a company might want to add a new demographic in the existing employee profile which may be stored in the Transaction Processing System of the organization.

A good Transaction Processing System must perform well on the following features:

- PERFORMANCE: Good performance on the basis of response rate of the systems is measured. The general measure of performance used is the number transactions the

system can process in a unit of time. The more the number of transactions processed the faster the system is, and is said to perform better.

- INTEGRITY: How well the system can maintain the integrity of data is another way to check the quality of the Transaction Processing System. Integrity means the ability to maintain the quality of data. In case of hardware or software failures, the systems may change the data in half of the record while the other half may remain the same due to failure in hardware or software. This may generate data which is not consistent. There a Transaction Processing System must ensure that either transaction is carried out completely or not at all in an event of failure in hardware or software. This is referred to as integrity of data which should be maintained all through.
- EASE OF USE: A useable and user friendly interface should be provided in the Transaction Processing System because it is to be used by end user who may or may not have a technical background.
- EXPANSION CAPABILITIES: Transaction Processing Systems are not generally made such that every operation or function is the organization id automated at the same time in the organization. They are generally done in incremental fashion so that cost, testing etc. can be easily monitored. Therefore a good Transaction Processing System should have the flexibility of addition, deletion, expansion of new modules which can be later added to the system as and when required by the organization.
- UNINTERRUPTED AVAILABILITY: Organizations want uninterrupted and continuous operations from a Transaction Processing System. Any hardware or software failure which can bring the operations to a halt is undesirable or rather we can say can be harmful to the organization, therefore the system should be such that it can ensure uninterrupted availability. The provision of backup and recovery systems should also be present.

1.2.2 PROCESS CONTROL SYSTEMS

Process Control Systems are used generally in the manufacturing and production sector to control the operational process in the complete system in order to enable the automation of the ongoing processes in the system. They are extensively used in very large scale generation or in processes which require great amount of preciseness. It is a discipline that uses concepts like architecture, mechanisms and algorithms in order to produce a desired output which falls into a specific range as required in the process. Process Control systems are widely used in

the industry and helps in producing consistent products overtime in mass production systems by continuously operated systems such as power plants, chemical manufacturing, oil refining, paper manufacturing etc. Some other examples of controlled processes are:

- Controlling the temperature of a water stream by controlling the amount of steam added to the shell of a heat exchanger.
- Operating a jacketed reactor isothermally by controlling the mixture of cold water and steam that flows through the jacket of a jacketed reactor.
- Maintaining a set ratio of reactants to be added to a reactor by controlling their flow rates.
- Controlling the height of fluid in a tank to ensure that it does not overflow.

TYPES OF PROCESSES UNDER PROCESS CONTROL SYSTEMS: in practice the processes may be of the following types:

- Discrete: Many production processes require production of discrete pieces of product such as metal stamping. Generally seen in automated production systems in the form of motion and packaging applications using robotic components.
- Batch: Batch processes are generally used when intermediate quantities of production are required for example in production of food, beverages, medicines etc. They require missing up of specific materials for production of products in batches combined in particular ways for some duration to produce the required end results.
- Continuous: These processes require certain conditions to be maintained continuously over a period of time. The system is represented through some variables which are smooth and uninterrupted over the period of time. The control of the temperature of a heating jacket controlling the temperature of a liquid can be an example of continuous process control. Continuous flows are used where very large quantities of production are required such as production of fuels, chemicals or plastics etc.

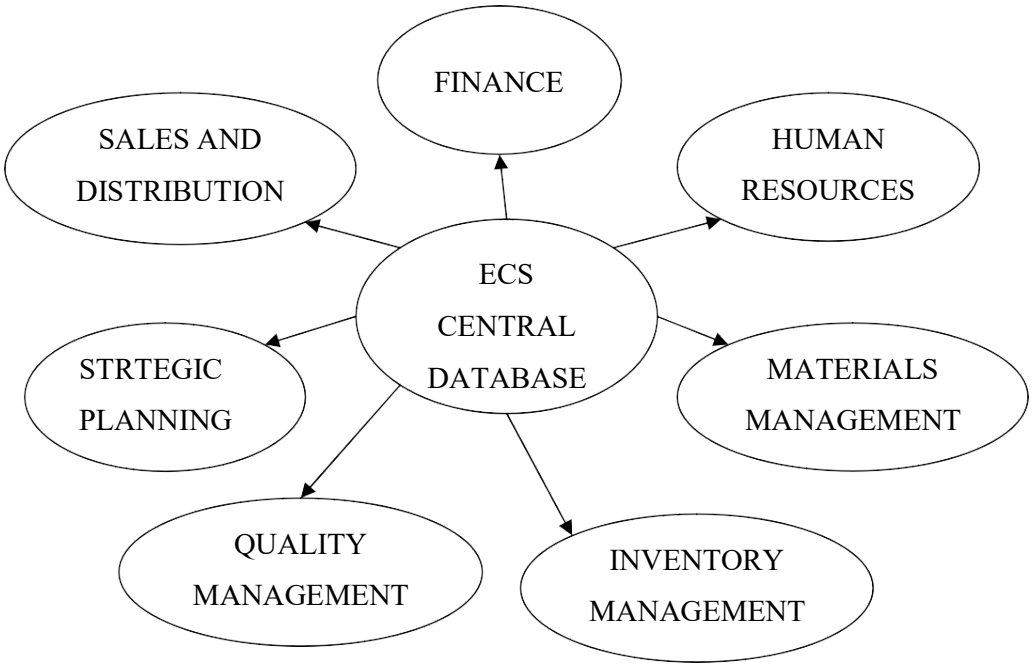
Process Control Systems are of two types:

- Open loop control systems: In these systems the output is based on the inputs given.
- Closed loop control systems: In the closed loop systems the present outputs are also considered and the output to be generated is also varied according to them. They are also known as feedback control systems

1.2.3 ENTERPRISE COLLABORATION SYSTEMS

An Enterprise collaboration system as the name suggests aims at integrating every aspect of an enterprise in one unit. They use a variety of Information Systems in order to join together various resources in order to increase communication and cooperation between the various components of the enterprise. Enterprise Collaboration Systems combine all the functional areas of the business and helps in increasing the overall efficiency of the system.

INTEGRATION OF FUNCTIONAL UNITS: An Enterprise collaboration system is an integrated, real-time, cross functional enterprise wide transactional framework which helps implement and support all the business processes of the enterprise.



FEATURES OF ENTERPRISE COLLABORATION SYSTEMS: An Enterprise Collaboration System can be characterized as follows:

- Accommodating variety: One of the major problems faced when integrating an organizations functional components into one is the variety of processes, information channels, objectives each of them has. An Enterprise Collaboration System always keeps in mind this variety and implements the systems in such a way that individual aspects eventually assimilate into one another in order to form a system which in turn accommodates all the processes, objectives etc. of the subsystems yet fulfils the organizational objectives on the whole.

- Integrating data model: We know that an Enterprise Collaboration System collaborates enterprise wide functions into a single unit. This is done through various complex processes of data warehousing etc. Individual data models of each of the functional units of the organization may be already present in the organization and integrating them may prove to be a herculean task for the managers. Information Systems in every unit may be present in different formats, designs, may be designed to perform different outputs operations etc. Therefore in order to organize and use all this information through a central system and generate useful information out of the data present extensive integration of data models is required. An Enterprise Collaboration System integrates various information systems individually present in the organization to produce a central system which increase the efficiency and effectiveness of the organization on the whole.
- Seamless integration: As already discussed Enterprise collaboration system combine all the functional areas of the business which might be earlier working as individual units operating independently. Their communication and collaboration enhances the capabilities of the organization and an Enterprise collaboration system should help do that by seamlessly integrating the various functions. It should help produce the synergy that the combination aims to produce. There should not be any glitches and black areas which may affect the enterprise's overall operations.
- Resources Management: The Resources of the whole organization in an Enterprise collaboration system are central. All the components of the enterprise are connected through a central system and all the data storage in done in a central database. As the decision making is centralized the allocation of resources is also central which helps in a more efficient allocation of resources as the objectives of the entire organization are kept central in case of such decisions. The individual objectives of the various functional components take a back seat and resources are managed such that the entire organization as one unit is at benefit.
- Integrating management information: The decision making capabilities of any Information system are reliant on the kind of Management information it produces. In case of Enterprise collaboration systems information from each and every component of the organization is stored in the central databases which provides a comprehensive view of the whole organization. The integrated information helps view every aspect of

the business from different perspectives which helps in effective use of the information present with the system.

EXERCISE I (State whether true or false)

1. Information systems are the backbone of any organizations operations.

2. OSS and MIS find applications at different levels of management.

3. Transaction Processing systems are just an automation of the manual systems in the organizations.

4. Process control systems are generally used in manufacturing industries.

5. Integration of business functions is also done by these systems.

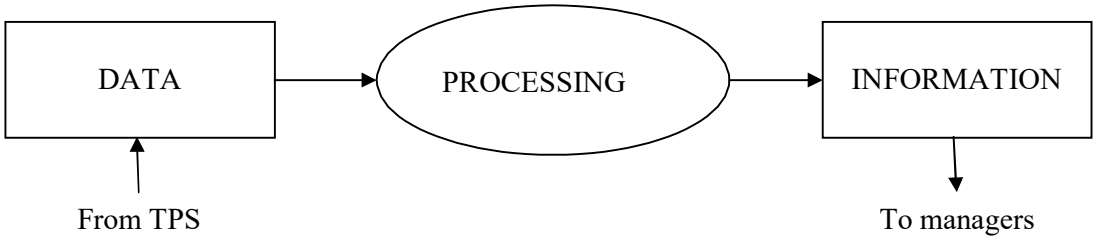
1.3 MANAGEMENT SUPPORT SYSTEMS

When information systems focus on aiding the managers in the decision making process by providing valid management information is a Management Support Systems. Providing management information for different types of managers at different levels can be a rather complex process, therefore different types of management support systems are present at different levels. There are:

I. Management Information Systems
II. Decision Support Systems
III. Executive Information Systems

1.3.1 MANAGEMENT INFORMATION SYSTEMS

Management Information systems provide information to the managers in innumerable easy to use and view formats to allow easy effective and timely decision making. This is carried out smoothly by providing management information to the user according to his/her requirements. So MIS can be seen as systems which provide information by processing the data given to them.



So as shown in the diagram above a typical MIS converts data into meaningful information. The data maybe directly fed to the system or from the transaction processing systems working in the organization. The information generated by the system may be used by control of operations; strategic and long term planning, short range planning, management control and other managerial problem solving. It generally deals with the area of management control by providing the information in the form of various reports etc.

Management Information Systems have already been defined as integrate systems. The basic aim of the systems I to provide management control in the organization by providing management information at the various functional levels of operations. These can be at the marketing, production, human resources, finance etc. and maybe used as individual systems used as Marketing Information System, Human Resources Information System etc. Alternatively they may be used as a system integrating all the business functions using a common structure. These systems can be integrated in the following ways:

- Hierarchical integration
- Horizontal integration
- Cross functional integration

In Hierarchical Integration the operational control systems provide information to the systems higher in hierarchy i.e. the higher level systems. The operational systems feed data to the management control levels or even higher to strategic control systems.

In Horizontal Integration means integration within the functional areas of the organization. A system of all the subsystems that a product may pass through in say the production department can be integrated into the departmental production integration system.

In the Cross Functional information systems integrate the cross functionalities of the business processes on the whole, a marketing information system may send the data regarding sales of a particular product to the production information system in order to maintain the inventory levels or in order to regulate the speed of production in the organization.

1.3.2 DECISION SUPPORT SYSTEMS

Decision Support Systems and their concepts have been evolved from the Management Information Systems. With the ever changing business environment, managers not only need to make decisions but have to keep in consideration the dynamic business environment and various factors changing continuously around them. In order to produce accurate decisions in such an environment, the reports and information provided by management information system may not prove to be sufficient, therefore the need for decision support systems arise.

Managers today not only require the right information but they should also be able to analyze the complex situations in front of them from various perspectives and dimensions. Moreover they need specialized information systems which can help them to consider all the critical parameters of a particular situation in order to reach the required decisions. This led to the formation of new types of more advanced information systems i.e. Decision Support Systems.

Decision Support Systems are a new category of Information Systems which specifically aid business and organizational decision making activities by computerized information support. Decision Support Systems are interactive software based systems which helps the managers to compile useful and usable information from the various sources of raw data i.e. documents. Personal knowledge, business models to identify and solve problems and therefore make decisions.

CHARACTERISTICS OD DECISION SUPPORT SYTEMS: The following are the basic characteristics of Decision Support Systems:

- Interaction: They are made for interactive use by the users i.e. the decision makes in the organization. There can be sequence of interactions or operations which can be performed.
- Task oriented: They have capabilities to support one of more tasks which need to be performed in order to provide decision support. They can be intelligence and data

analysis, identification of possible alternative, choosing between the available alternatives and then ways of decision implementation etc.

- Facilitation: they are just the facilitators of the decision making activities or processes to the actual decisions makers in the organization.
- Ancillary: They can help and support decision makers at any level in the organization. They are supposed to help and act as ancillaries to the decisions makers, not intended to replace them completely.
- Repeated use: Decision Support Systems are meant for repeated use by the decisions makes by varying the parameters of the use of the systems. They may be used in routine in case of everyday tasks or on ad hoc basis as and when needed.
- Identifiable: Decision Support Systems are independent systems which are supposed to produce identifiable results which may be generated from collected or replicated data or maybe a part of a subsystem of a much larger integrated information system.

COMPONENTS OF DECISION SUPPORT SYSTEMS: The following are the distinct components of a decision support system:

- Database Management Subsystem (DBMSS)
- Model Base Subsystem (MBSS)
- User Interface Subsystem (UISS)

Database Management Subsystem: Managers need to store huge amounts of data which are generated in the day to operations of the organization. It is this basic transactional data which is its comprehensive and consolidated form makes the basis of various decision making processes for the Decision support Systems. This data is stored in form of central databases which can be used and operated by any part of the system and provides the same consistent and reliable data in form of results to the various systems. All these things are done through the database management subsystems. The data is stored in the DBMSS in a structured manner so that it can be easily and uniformly accessed when needed by the system. This is done using association such as:

- One to one association
- One to many association
- Many to many association

Also various DATABASE MODELS are used on the basis of these relations ships. These models are:

- Hierarchical Model
- Network Model
- Relational Model

In the Hierarchical structure the data is stored in tree like structures depicting the hierarchy that is present in the data items.

In the Network Model is more complex that hierarchical model and also show the many to many associations which are not shown in the hierarchical model.

In the Relational model the data is stored in the form of tables with rows and columns representing the records and fields. The cells in the table represent the field values for a particular record.

Model Base Subsystem: This is the part of the Decision support system where the actual decision making takes place. A manager encounters many complex situations where taking rational decisions can be extremely difficult which is done here using the Model base subsystem. Decision making can be done in three scenarios which are:

- Decision making Under Certainty
- Decision making Under Risk
- Decision making Under Uncertainty

Decision making Under Certainty is done where the value of the various parameters required for making the decision is known. This is done using the mathematical linear programming models. Linear programming id a branch of operations research which helps the user in choosing the best course of action according to the given data based n the model formed using the linear programming.

Decision making Under Risk is models used can be PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method). Pert is a probabilistic method and CPM is a deterministic method, are used as and when required. CPM is used when the duration of activities is precisely known and PERT uses three types of time intervals i.e.:

a. Optimistic time

b. Most likely time
c. Pessimistic time

Decision making under Uncertainty is done based on the Game Theory model where the alternatives that the players have while playing the game are considered. The payoffs for each of them are calculated an analyzed in order to reach decisions. This is done in case of uncertainty in order to get an idea of what may happen.

Use Interface Subsystem: The users of the Decision Support Systems are generally managers in the organizations, they may or may not be from a background such that they can understand the intricate details of the software present in front of them, therefore it becomes pivotal that a good user interface which can be easily understood by any user id provided with the system. The interface has to facilitate the interaction of the managers with the decision making models. It is the face of the Decision Support system and should be user friendly and easy to use. A UISS can have various types of interfaces i.e.:

a. Command based interface
b. Q&A type interface
c. Menu based interface
d. Icon based interface
e. Speech/Dialogue based interface

The type of interface to be implemented can be decided according to the type of users who have to use the software in the future.

1.3.3 EXECUTIVE INFORMATION SYSTEMS

Executive Information Systems as the name explicitly suggest are made specifically designed to support executive decision making in the organizations. They are highly interactive systems which give easy access to the executives in order to flexibly access the information in order to monitor the operational results and general business conditions. Executive Information Systems are also referred to as Executive Support systems and they generally came into play where the basic Management Information System or Decision Support Systems fall short. Traditional Management information Systems actually just produce reports and information based on pre specified parameters producing similar results over time. Executive Information Systems OR Executive Support Systems on the other hand may be used to monitor or control certain indicators or parameters over time. Therefore they help

more in the functions of control and direction which are performed by higher level managers in the organizations.

CHARACTERISTICS OF EXECUTIVE INFORMATION SYSTEMS: Executive Information Systems have many distinct characteristics which differentiate them from the other types of information systems used by the mangers in the organization. These are:

- Exception reporting: Most Executive Support Systems have the ability to effectively execute exception reporting i.e. the ability to report whenever the operational working conditions of the organization so astray. Ranges for the acceptable limits may be specified giving graphical or alert warning signals to indicate any such happenings.
- Degree of use: The usage is rather higher as it needs complete and round the clock monitoring of the ongoing processes. It should also be highly consistent in showing the above said information.
- Flexibility: An Executive Information Systems should be highly flexible or rather we can say that customizable according to the decision making style of the executive using it.
- Decision support: It should be able to support decisions related to the upper management level i.e. should work well even where unstructured decision making is required.
- Graphical: IT should be graphical and should have a great presentation style sin order to represent the tracking and control information such that it can be comprehended just by taking a look on the system.

A successful Enterprise Support System tries to decrease the amount of hardcopy reports generated and viewed by managers and yet keeping the executives up to date with the day to day working and health of the organization

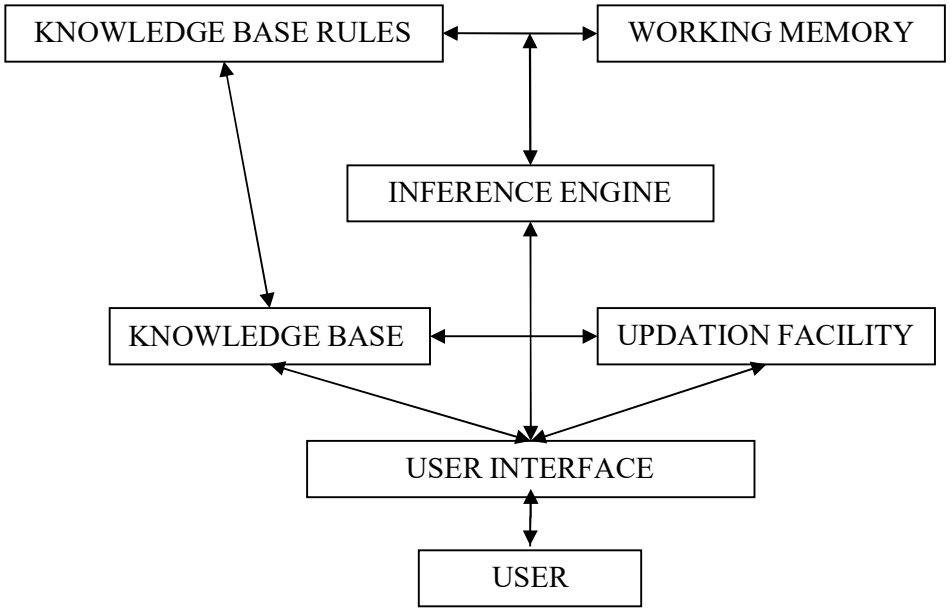
1.4 EXPERT SYSTEMS

An Expert System is an information system which tries to reproduce the information with one or more human experts, generally related to one specific domain areas into a system which acts and performs and responds just as an expert of that area would do. It is a traditional subfield of the concept of Artificial Intelligence. These systems exist for two basic reasons; firstly the advances in the field of artificial intelligence have made it possible for us to implement the information systems in view of new perspectives and dimensions and secondly

it the unique feature of human exerts to be able to reason and produce results according to situations therefore if such a system can be produced with the help of technology, they can be highly useful.

COMPONENENTS OF EXPERT SYSTEMS: The major components of expert systems are:

- Knowledge Base
- Inference Engine
- Updating Facility
- User Interface



Knowledge Base: As discussed earlier that an expert system is supposed to act as an expert on a specific domain area. It is supposed to act just a real expert would in case referred to. Therefore these systems are supposed to have vast knowledge in their domain. It contains facts and heuristic knowledge. It should be noted that the knowledge should not be confused with the entries in a database. Knowledge is collected by conducting extensive interviews etc. with the experts of that particular domain, their past experiences, cases and general knowledge is accumulated and then stored such that it can be retrieved when similar consequences arise. This is done using IF THEN ELSE constructs which help the system

extract particular information in case a given situation arises. For example in case of medical expert system, IF a given symptom is there THEN prescribe given medicine.

Inference Engine: Inference engine performs the rather crucial task of matching the entry or the query made by the user to the expert system to the knowledge present in the knowledge base. So described earlier the knowledge base has the domain knowledge stored in it which is checked for whenever a user inputs something in the system, therefore in order to fetch the right kind of knowledge based on that, the right kind of logic has to be applied. The task of inference engine can be therefore considered to be highly crucial.

Updating Facility: The knowledge base contains the information that is to be used by the expert system in order to produce the required results to the queries made to the system. The knowledge of every field though is highly dynamic in nature and keeps on changing and increasing with time. Therefore the facility of updating is provided in order to keep the system producing relevant results.

User Interface: User interface provides the means of interaction between the system and the user. It facilitates communication between the system and the user. It should also be noted that expert systems are generally interactive and they require certain inputs from the user in order to generate results and should be easy to use. These systems also provide interface guide which along the way keep on telling the users about how to proceed further.

1.5 KNOWLEDGE MANAGEMENT SYSTEM

Knowledge in an organization is a composite of information, insights, experiences etc. which may be present with individual or the business processes going on in the organization. It is the sum total of the range of activities or practices going on in the organization.

All the systems we have already studied also come in the domain of knowledge management systems such that we can say that knowledge management encompasses all of them, they are not radically different from them but are advanced in comparison, extend the existing systems by adding more information and knowledge.

The difference in all these systems can be easily understood if one has the understanding of the difference between the concepts of data, information and knowledge.

Knowledge Management system helps to implement enterprise intelligence by usage of document management, information creation, sharing and management and information implementation. Sources of knowledge in an organization can be intranet, data warehouses and knowledge repositories, decision support tools, groupware for supporting collaboration, networks of knowledge workers or internal expertise.

Knowledge management systems are made up of various software modules connected to a central database system. These systems allow data mining on basis of the user input and histories also providing things such as documents hiring etc. They can help users with functions such as training and orientations, support better sales, help leaders in critical decision making etc.

The terms business information management or business intelligence i.e. making decisions on the basis of management information can be confused with knowledge management but it always be kept in mind that these are just parts of the greater knowledge management concepts used at enterprise levels driving decisions in more fundamental ways.

EXERCISE II (State whether true or false)

1. Management Support systems rely more on data as compared to information.

2. MIS find application at the management control level in the organization.

3. Decision support systems are meant to replace the decision makers in the organizations.

4. Expert systems use the expertise of experts to act just like them.

5. Knowledge Management systems work on the context and content of information.

Answers to Exercise I

1. True
2. True
3. True
4. True
5. True

Answers to Exercise II

1. False
2. True
3. False
4. True
5. True

1.6 REVIEW QUESTIONS

1. What are the different types Business Information Systems?
2. What kind of Information System is used by which level of management?
3. Discuss in detail various types of operational Support Systems.
4. How do Management Information Systems differ from Decision Support Systems?
5. Discuss the basic components of Expert systems.

1.7 SUGGESTED READINGS

1. O'Brien : Introduction to Information Systems
2. Sahil Raj :Management Information Systems
3. D. P. Goyal :Management Information Systems Managerial Perspectives
4. G. Davis, M. Olson :Management Information Systems

CHAPTER 3: INFORMATION CONCEPTS

STRUCTURE

1.0 OBJECTIVES

After reading thus chapter, the students must understand:

- Concepts of data, information and other related terms
- Difference between data and information
- Characteristics of information
- Types of Information
- Quality of Information

1.1 BASIC INFORMATION CONCEPTS

Information is vital for any organization to operate, competitive advantage in any field in reliant on using the information proactively in order to make good decisions for the future of the organizations. This is what efficient and proactive systems help us achieve and this is where data and information with the organization comes in handy. So in order to understand what the information systems rely upon, we must understand some basic terms and how they are similar yet different from each other. These terms are:

I. Data
II. Information
III. Knowledge
IV. Wisdom

1.1.1 DATA

Data can be defined as the representation of facts, symbols and signals in form of values which may be represented in qualitative or quantitative terms. It is a distinct way in which the facts can be presented and it the usage of this data that gives it meaning. It can be measured, collected, represented, reported and analyzed and can also be graphically visualized. Data is a general concept which represents facts which can be then coded represented formatted etc. to be used in the form of information, knowledge etc.

'Raw data', as generally referred to as in Information system concepts, is the unprocessed data i.e. just a collected of numbers, characters, variables etc. which have to be worked upon in order to produce some meaningful information. Data if seen in the very basic terms can be viewed in terms of:

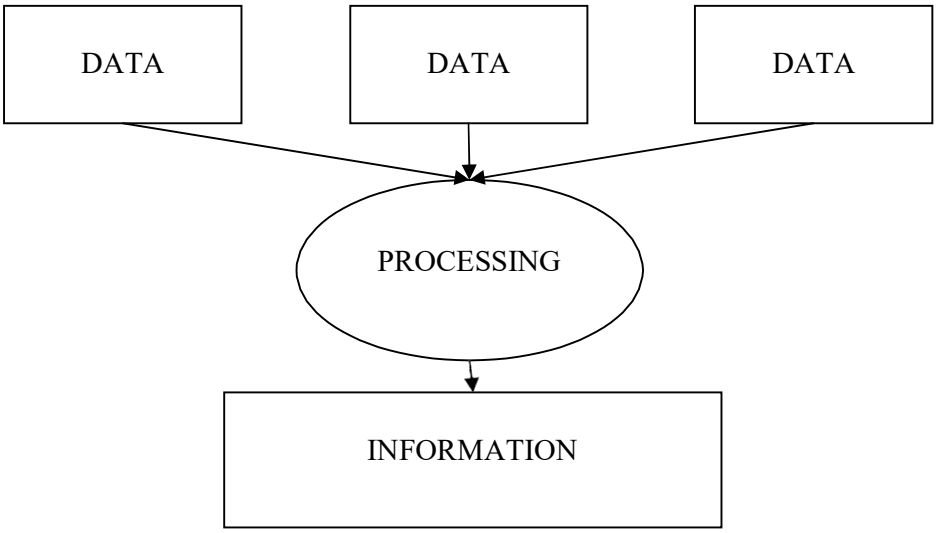
- Data as a Fact: Jennifer Rowley in her study on Hierarchy of DIKW i.e. Data Information Knowledge Wisdom has seen data "as being discrete, objective facts or observations, which are unorganized and unprocessed and therefore have no meaning or value because of lack of context and interpretation." Phrases such as 'material facts', 'chunk of facts about the state of the world', 'merely raw facts' have been used by researchers about it. Facts have the basic qualities of being either true or have an objective reality or they can be verified which according to these researches applies on data too.
- Data as a Symbol: Data can be seen as symbols or a set of signs which may be presented in the form of words numbers, images, diagrams etc and represent activities events, response to a stimuli, perception and many more such phenomenon. So data here can be viewed as the building blocks of communication.
- Data as a Signal: Researchers in the subjective domain see data as "sensory stimuli, which we perceive through our senses" or sensory signals which may include the reading of senses such as light, sound, smell, taste and touch also termed as subjective

data. Information in these terms can be simply viewed as adding meaning to these sensory stimuli.

1.1.2 INFORMATION

Information comes from a Latin word *Informare* which means 'to inform'. Information is clearly organized and classified data which produces some meaningful message for the receiver. According to Davis and Olson,

"Information is a data that has been processed into a form that is meaningful to recipient and is of real or perceived value in the current or the prospective action or decision of recipient."



Information is nothing but meaning fully interpreted data, for example if we write down a simple number in a text box as 919287656756, it can be seen as any random number but when we write it as +91 92876 56756, it starts making complete sense to us and conveys a particular meaning. So Information is seen as nothing but processed data. When raw data i.e. raw facts and assimilated and organized they start conveying some information and decisions can be based on them. This is what makes them vital for Information Systems, decision makers and organizations on the whole.

1.1.3 KNOWLEDGE

Knowledge is a concept which can be difficult to define in absolute terms. It is always seen in relation to information. All these terms are interrelated and depend on each other in one way or the other.

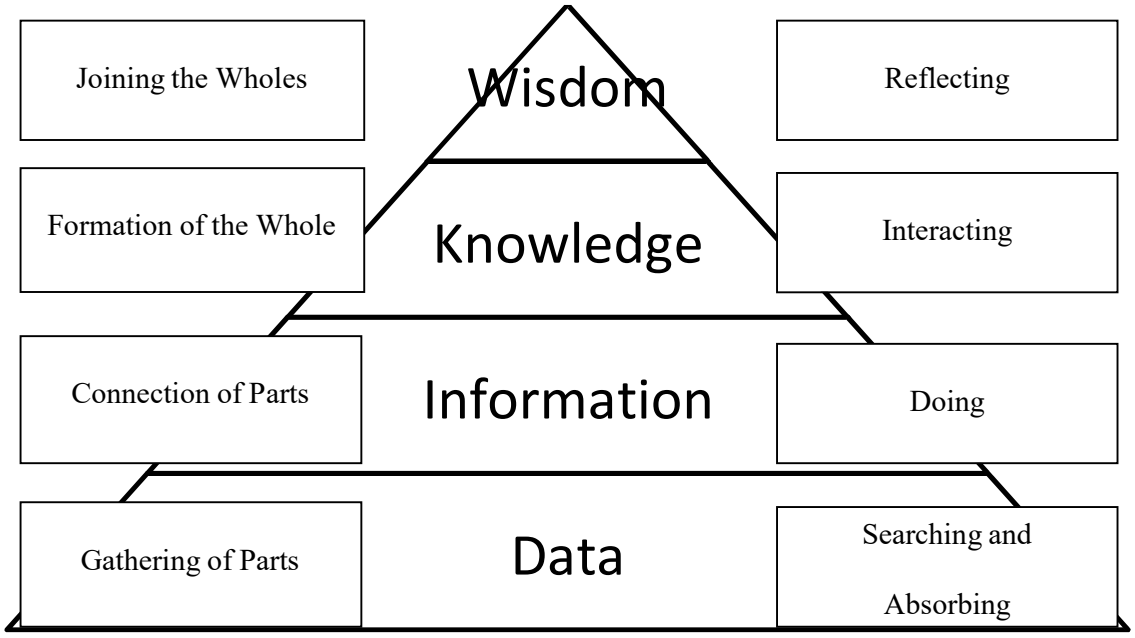
Knowledge can be termed as information read, heard, or seen and interpreted. One of the most frequently quoted definitions of information gives quite an elaborate insight into the concept, "Knowledge is a fluid mix of framed experience, values, contextual information, expert insight and grounded intuition that provides an environment and framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations it often becomes embedded not only in documents and repositories but also in organizational routines, processes, practices and norms."

1.1.4 WISDOM

Wisdom can be defined as distilled and integrated knowledge and information. Literature defines wisdom as; "Wisdom is the ability to increase effectiveness. Wisdom adds value, which requires the mental function that we call judgment. The ethical and aesthetic values that this implies are inherent to the actor and are unique and personal."

All these concepts are extremely interrelated and one derives meaning from the other. Without data there can be no information, knowledge or wisdom and without these data would lose any relevance. It is the ability of data to produce meaningful information that makes it important and relevant.

It should also be noted that all these concepts though applicable in similar situations have extremely different objectives and usage. This can be clearly seen in this diagram showing the relationship and the hierarchy that exists in these highly interrelated terms



1.2 DATA VERSUS INFORMATION

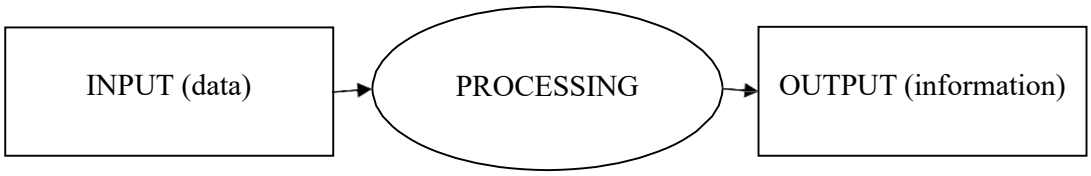
Data and information are related concepts with same application areas yet different usage. It can be easily said that one gets its meaning from the other. They are highly interrelated concepts and are usually used interchangeably which can prove to be a big mistake practically.

We have already discussed the definitions and concepts of data and information in detail earlier in the chapter; let us now discuss some of the explicit differences in the two:

- Data is used as input for a system whereas Information is the output of data.
- Data is unprocessed facts and figures and Information is processed data.
- Data does not depend on Information but Information depends on data.
- Data is not specific. Information is specific.
- Data is a single unit and a group of data which carries news and meaning is called Information.
- Data does not carry any explicit meaning and Information must always carry a logical meaning.
- Data is the raw material and the Information produced from it is the product.

DATA PROCESSING CYCLE

Data processing is carried out in three simple steps. This is done in order to increase the usefulness of the data so that it can be used for a particular purpose. This is done by restructuring and reordering of data by people or machines that understand the data and know for which purpose it is to be used. The steps are shown in the diagram below:



- INPUT: The input is the raw data collected from the various sources in a system. In an organization it is generated from the everyday transactions happening in a business at the operational levels. This data is of no use if it remains unprocessed and the meaning is never interpreted.
- PROCESSING: This is the step which is done to get some meaning from the raw facts and figures present with us. This may be done consolidating some facts or generating comprehensive reports to represent a whole dataset etc.
- OUTPUT: As the result of processing the data, meaningful information is generated this is usable in its direct form. It organization it plays a pivotal role in decision making and helps organization running smooth and effective.

So we can clearly see that these are two highly interrelated terms which though extremely different in application, have a codependent existence.

1.3 CHARACTERISTICS OF INFORMATION

Information comes in all kinds of shapes and sizes, understanding the characteristics of the type of information coming your way can help you understand how to utilize it to its full potential. Features of good information cannot be confused with the characteristics that different types of information may have. Here are some, to help us better understand:

I. Factual and analytical Information

Factual information as the name directly suggests presents facts. It is usually brief or we may say precise directly stating what is asked. They are said to give undisputed direct answers to very specific questions. They do not require or need any explanation along with them or any kind of analysis to go with the information.

On the other hand Analytical Information is analyzed and interpreted in order to draw some inferences and thus conclusions in order to form some opinions, generalization or theories etc. Analytical information aims to answers such as Why and How arising from some information related to a problem. Basic examples of analytical information can be articles, books and research papers

II. Subjective and Objective Information

Subjective Information is generally the writers own point of view. It is one person's opinion about the topic or concept in question. It can also be analytical nature i.e. when the subjective information is based on facts, but in subjective information, the interpretation of the facts is the writers own point of view. Opinion pages in the newspapers can be considered a perfect example of subjective information.

Objective Information on the other hand is supposed to be completely unbiased and representing a neutral point of view without any addition of personal subjective opinions about the data at hand. Objective information may review many point of views, it may present various perspectives but does not add personals opinions of right, wrong and good, bad etc. to it. News reporters are also supposed to present objective information, also sources of information such as encyclopedias etc. are supposed to be objective in nature.

III. Current and Historical Information

The time period of the information and therefore the applications are also highly related. Historical information presents the data from the past and is generally utilized when studying evolution of something, reading and forecasting trends etc. Current data or information on the other hand is instant or very recent in nature which maybe again according to the usage. For example in a stock exchange data from the last week may be considered historical but a balance sheet representing a whole year's or quarter's data may be considered as current data.

IV. Action and Non Action Information

The information which prompts the users to perform some actions is known as Action Information. For example low inventory status in the production department can prompt the managers to restock or initiate procurement of raw materials, no low fuel or a check engine light in a car may prompt a driver to take suitable actions.

The information on the other hand which does not require any initiation of any kind of action to be taken is known as Non Action information. For example simple journal or ledger entries in a simple transaction processing system may not require any action to be taken by the users.

V. Reoccurring and Non Reoccurring Information

The information is which periodically produced after fixed intervals or in cycles is known as reoccurring information. Examples of this type of information can be as simple as monthly sales reports or yearly expenditure report or salary payment reports generated on monthly basis by organizations.

No reoccurring Information is not produced again and again as it is generated related to a specific problem or situation at hand. For example financial analysis of a company based on one year's balance sheets or market research related to a brands specific product before its launch etc.

VI. Internal and External Information

The information generated from the sources of data from within the organization is internal information. For example HR department produced performance appraisals or career paths for employee, sales department generating weekly sales repost etc.

External information on the other hand may be collected from external sources such a governmental report or industry surveys etc.

EXERCISE I (State whether true or false)

1. The terms data, information, knowledge and wisdom are highly interrelated and interdependent.

2. The terms data, information, knowledge and wisdom can be interchangeably used.

3. Data conveys useful information to the people who posses it.

4. Processing of data generates information.

5. Subjective information cannot be analytical in nature

1.4 TYPES OF INFORMATION

Information as discussed can be characterized in several ways. It can also be classified in different kinds on the basis of various criteria which can be on the basis of:

- **PURPOSE**: Information may find application for different purposes in an organization. Essentially used for decision making but the type of decisions for which it is being used may vary. According to the purpose of information it can be of the following three types:

    I. **Strategic Information**: The information which is used by the organization for strategic decisions and formulation of organizational strategies. Strategic information generally affects the long term decisions of the organization which have long lasting implication in the organization. Certain decisions may have the capacity of being game changers for the organizations and require strategic information in order to be implemented by the think tanks of the organization. Longer term policy making that eventually defines the goals and objectives of the organization come under this, for example adding a new plant, expansion of product line etc.

    II. **Tactical Information**: This type of information generally arises from the current activities and practices going on in the organization. Tactical information generally acts as a tool for control in the organization which maybe in the form of control over resources, budgetary control, inventory control, service level maintenance, productivity and quality checks etc. This type of information comes in the category of short term planning information and is generally used at the management control level of the organization. For example, for sales analyses and forecasting, annual financial statements, resource allocations etc. Generally this arises from the internal sources of information but even arise from external sources in cases such as tactical responses to competitor actions.

III. **Operational Information**: Operational information is generally required in order to take immediate decisions. It is used at short term decision making which may vary from a few hours to a few days. Operational information is generally intended to ensure that a particular task or activity is being performed the way it should be. It is used by the operational management when there is requirement of immediate action to be taken. Actions such as completion of outstanding orders, maintenance of work in progress levels etc can be based on operational information.

- **MANAGEMENT HIERARCHY**: The information used at different levels of management is different. At the lower hierarchy the information required is more related to the daily working and aspects of business where as the top management requires information that is more comprehensive in nature and provides data from long periods consolidated in very short and easily interpretable form. According o this parameter information can be divided into the following three types:

I. **Supervisor level information**: As the name suggests supervisor level information tries to aid supervisor level employees to work and operate effectively. At the operational level, the lower level managers have to ensure that the day to day activities going on in an organization go about smoothly and efficiently. This is implemented by them using the supervisor level information. This includes the data and information arising from the basic activities going on in the organization in the form of simple transactional exchange. This information has very short term implications which may vary from a day to a few days.

II. **Middle level information**: The middle level management or the Management Control level requires taking decision which has longer implications as compared to the operational level information. Middle level managers use tactical information in order to exercise control in the organization. They require management information in order to exercise control over the lower level management activities. Also on the other hand they are the one who facilitate and provide information to the upper levels of management. In a way the middle level management acts as a link between the executives and operational level employee and therefore the information requirements of these managers are far more wide

spread as compared to operational level managers. They utilize tactical information in order to exercise management control in the organization.

III. **Top level information**: they top level executives or the top management requires strategic data in order to formulate or change as required the long term plans, policies, goals and objectives of the business. This is only possible if they have a comprehensive and consolidated knowledge of the operations and managerial activities going on in the business. This is made possible by the top level information which caters to these needs of the top management.

- **APPLICATION**: The area of application of information can also form the basis for classification of information. On the basis of the area of application, information can be of the following types:

I. **Planning information**: As the name suggests the information which is required in order to make the future plans of an organization. This requires information related to the specific norms or rules or policies that might exist related to the activity that we are planning for. There might be industry standards or governmental norms which should be followed in order to produce a viable product which may act a source of planning information. Planning information can be used at all the three levels or management for strategic, tactical or operational management. Examples of planning information can be time standards of the industry or design standards by an organization, or safety standards provided by the government, or tax laws to be followed before budgetary allocations etc.

II. **Control information**: Every control mechanism is basically based on a feedback mechanism which helps the controller maintain the levels required. This type of information provided by the feedback systems or by systems maintains the current status or scenario in order to facilitate control activities is known as Control information. Management control is generally executed using the concept of exceptions wherein any exception to the normally accepted behavior or performance is reported and control measures are then adopted in order to control

them. Whenever there is a deviation from the required goals and objectives, the management induces decisions or action leading to control.

III. **Knowledge information**: Collection of information in order to create a knowledge base in order to facilitate general decision making on all aspects of the business is known as knowledge information. It can also be seen as information about information where the application of the available information is clear to the management. This is generally acquired through rich experiences, researches, data collected over long periods of time by the organization. This data in a comprehensive form or even at minute levels may help the management to make informed decisions on the basis of the knowledge base the organization may have developed.

IV. **Organizational information**: Organizational information can be referred to both, the information used by every level in the organization such as procedures, protocols etc., or can be the information about the organization in general. Organizational information may be information about the organizations culture, the environment it resides in, in the light of its goals and objectives. Generally HR activities fall in this area as things like payroll information, employee information or any such related information can be used by anyone in the organization.

V. **Functional information**: Information that is specific to the various functional areas of the organization. Although all the functional departments or units of an organization are highly dependent on each other for example marketing and production department rely deeply upon the information provided by the other department on day to day basis but in some cases the information can be so specific that it is of no use for the other functional areas, this type of information is called functional information. Examples of such information can be certain design standards which have to be maintained while making a product can be of no use for the Human Resource department or the rating scale used by the Human resource department while appraising the employees might be or no use for the procurements department.

VI. **Database information**: When information has multiple uses and applications and it kept in central databases which can be accessed by every unit or division or function of the organization, such information id termed database information. Such information is stored, retrieved and managed in from central databases. For example supplier information may be stored and used by different departments such as procurement Human Resource department.

1.5 QUALITY OF INFORMATION

Quality refers to the fitness of use of the information which is being provided by and information system. Information quality and data quality though sometimes interchangeably used are very different concepts. Information quality ensures that the information serves the applications it is supposed to in a system. **Wang and Strong** have termed the following as the dimensions or elements of Information Quality:

- Intrinsic: Accuracy, Objectivity, Believability, Reputation
- Contextual: Relevancy, Value-Added, Timeliness, Completeness, Amount of information
- Representational: Interpretability, Format, Coherence, Compatibility
- Accessibility: Accessibility, Access security

Various other researchers in general have given a wide variety of metrics which the information should have in order to be accepted as good quality information.

- **Reliability** – Reliable information is that which is dependable i.e. it produces the same results in different scenarios and over a period of time. For example a test producing highly variable results when taken by the same person on different days is not said to be reliable in nature. It is the extent to which you can rely on a piece of information, how dependable, authentic, trustworthy, reputable, genuine the information is. The ultimate measure of reliability is consistency i.e. how similar results are produced by same information over time and across situations.
- **Timely**- Information is used in decision making in organizations. For effective decision making it is pivotal that the decisions are timely otherwise they may lose

their relevance. A late decision can sometimes prove to be as bad as not making a decision at all. Businesses can suffer loses or there can be a loss of opportunity or a competitor may take advantage of a opportunity leaving the organization empty handed, therefore it is extremely important that the information that is required for decision making is readily available and at proper time. Delay may destroy the value of information therefore they must reach the recipients it id intended to in a specific time frame i.e. exactly when it is required. Timely information can ensure correct executive decisions to be taken at the right stage. Another aspect of timely means that the information should be up to date i.e. current information because of the information provided is based on past data then the organization is not utilization its information potentials to the fullest and fault inferences and conclusions and thus faulty decisions based on incomplete information may be on the way.

- **Relevant** – Relevance is another very important attribute for the organization's management information needs. Information is said to be relevant if for the organization it answers all the questions such as Why How When Where and Who? The information provided should always be current and valid information and it should always aim to reduce uncertainties. In other words the information systems should provide the managers the kind of information that is useful for them and helps them make relevant and informed decisions. It should also be kept in mind that relevant information for one user may not be relevant for some other user, therefore information in some particular format would not make it formal but providing information strictly according to the user needs will make it relevant and thus useful. From the same production department, a person from sales may require different types of information, someone from R&D may want different information and a person from accounting may require different type of information.

- **Accurate** – Accuracy is yet another attribute that is vital for decision making based on the management information. Accuracy simply means that the information provided should be free of errors and mistakes, true, and not deceptive. It simple means that one plus one should come out to be two. It should accurately reflect the meaning the data on which it is based actually reflects. It reflects an accurate picture to the user in a speedy manner which can be done in any form i.e. tabular, graphical etc. Accuracy of information is extremely important because wrong information

would lead to wrong decisions, which an organization cannot afford to make. The organization should always keep a balance in the levels of accuracy, as accuracy to the minutest details sometimes may not be required at the cost of other factors such as promptness or cost incurred on getting those tiny details. Therefore the accuracy should be so maintained that the decision making by the users of the information is not affected in any way.

- **Sufficient** – The information provided by a system should be such that it should be sufficient to make decisions solely on basis of that information. The system should not assume that the user must be aware of some information already. For the problem at hand and the specific solution to be reached all that is required should be provided. It should be adequate in quantity, so that decisions can be made on its basis. Insufficient information can be seen as good as no information at all because the information is not providing us the ability to reach the decision that we need to, therefore becomes useless.

- **Unambiguous** – Management information system providing ambiguous information is actually moving in reverse direction. Management information should be expressed in clear terms. It should be in should be comprehensive i.e. should reflect clearly and accurately the data on which is it based even if presented in a consolidated manner. It can vary in the level of detail or consolidation of data on the basis of the level of management using it but ambiguity at the level would mean confusion thus leading to faulty decision making by the managers.

- **Complete** – The management information provided should meet all the needs in the current context. It should meet the requirements of the user at the time when it is requested. Incomplete information can prove to be costly for the organization as fully informed decisions cannot be made based on that and organization may suffer loses or lose business opportunities in that respect. Even if in a situation complete information is not available and cannot be presented the users of the information should be duly informed so that they can keep this in consideration while making decisions on basis of the information in front of them.

- **Unbiased** – Management information should always be unbiased and explicitly based directly on facts and figures or the data present with the organization. It should be

impartial, free from any bias or in other words, it can be said that it should have integrity. It should be provided to the user for decision making and it the prerogative of the user to view it in whichever light he/she may want according to the type of decision at hand. The information provided to user should not add any additional opinions which may affect the decision making, should be extremely objective and directly based on facts.

- **Explicit** – Explicitness is also a very important attribute of the management information provided by the information systems in the organization. Explicit information would be such that it does not need any further explanation. A report is said to be good and explicit if it does not require any further analysis but the user of the information for decision making, it directly conveys the meaning and the message at the face value and does not need any further work to be done on the information. On the other hand a poor quality report would require the mangers to work on them further in order to reach the desired results. This would lead to wastage of time. Thus reports should be such that they do not waste the management's time. This is also the reason that various types of information systems find application in different scenarios and at different management levels because the type of output required at different levels id different. A good report keeps tabs on that and does not waste a managers time on extracting the type of information he/she may need from the report.

- **Comparable** – In an organization generally information is not used in isolation. When making decisions data and information from various functional aspects. Different time frames it used, therefore it is very important that it should be of uniform in collection, analysis, content, and format so that it can easily be compared and related to the other information present with the users of the information.

- Reproducible – Management information may be required by management at different time frames in different scenarios in order to make different types of decisions, therefore the information being generated by an information system should be easily reproducible. It could be stored by clearly documented methods on the same data set to achieve consistent outputs over time and situations.

EXERCISE II (State whether true or false)

1. Tactical Information is used by the top level managers in an organization.
2. Planning information may include norms rules or policies related to an organization or and industry.
3. The terms knowledge information and organizational information can be interchangeable used.
4. Wang and Strong have named Intrinsic, Contextual Representational and Accessibility dimensions of quality of information.
5. Consistency is a measure of accuracy of the information

1.6 REVIEW QUESTIONS

1. Discuss the terms data, information, knowledge and wisdom in detail.
2. Differentiate between data and information.
3. What are the various types of information?
4. What are the parameters of good quality information? Discuss in detail.

Answers to Exercise I

1. True
2. False
3. False
4. True
5. False

Answers to Exercise II

1. False
2. True
3. False
4. True
5. False

1.7 SUGGESTED READINGS

1. D. P. Goyal :Management Information Systems Managerial Perspectives
2. Sahil Raj :Management Information Systems
3. G. Davis, M. Olson :Management Information Systems
4. R. Murdick, J. Ross :Management Information Systems
5. K. Laudon, J. Laudon :Management Information Systems Managing the Digital Firm

CHAPTER 4: DECISION MAKING

STRUCTURE

4.0 OBJECTIVES

After reading thus chapter, the students must understand:

- Basic concepts of Decision Making
- Simon's Model of Decision Making
- Types of decisions
- Challenges in Decision Making

4.1 INTRODUCTION

Decision making is the essence of Management. Whatever a manager does in an organization, everything is done through decision making. Decision making is considered a core management activity and is pervasive in nature. Decision making is required at every level at every stage in the organization. Whether big or small, operational or strategic, decisions are taken at every instant in an organization. It is the duty of managers to take decisions based on the information available with them which is provided by the information systems in the organizations.

Managers constantly find themselves working in extremely dynamic environment trying to find solutions to everyday operational problems arising from complex business dynamics.

Therefore taking decisions is essential and rather pivotal in working of n organization. With the changing requirements, information systems have also changed. Information systems now aim to assist the managers more and more and facilitate prompt decision making. They aim at providing timely and accurate meaningful information so that managers can take decisions instantly without the need for analyzing and interpreting long reports as was earlier models. Nowadays systems incorporate decision making models which have better capabilities to assist the managers in decision making and we shall discuss them in detail in this chapter.

4.2 DECISION MAKING

The term 'decision in the term decision making comes from the word decide which is taken from a Latin word which means 'to cut off' which in this context means to come to conclusion. A decision decides the course of action that would be followed from available choice of multiple courses of action that can be followed. It is about making a choice from the various alternative present with the decision makers. Decision making can be seen as a process where the end is a decision. The decision is reached as a result of the process. But it cannot be considered as an end itself and rather something that leads to further action.

With the dynamic nature of the business environment, decision making has to fast accurate and proactive. The decision makers not only have to be responding to the varying situations but also have to anticipate what needs to be done. This makes decision making more and more complex and difficult for the decision makers. The stakes on decision making also have increased like never before and the decisions to be made are turning more complex and affected by a huge variety of variables. Some decisions in the organization are easily made i.e. are routine decisions and do not require any additional mental effort from the side of the managers and are easily made on everyday basics by the decision makers concerned. On the other hand there are situations which arise out everyday dynamics of the business environment that the business exists in. It is such an environment that decision making becomes complex and the decision makers may have to work with absence of information or have to keep in mind the associated risks with the outcome of the decisions to be taken. These days the decision making is supported by the powerful combination of data information models and computers. The information systems that are backing the decision makers with the meaningful information have changed the face of decision making in the organizations. They have changed from the very basic back office data storage and processors to systems that a help the manager in the most important task in the organization i.e. decision making.

4.3 DECISION MAKING PROCESS CONCEPTS

Decision making is and everyday activity and is done at almost every instant of our lives. It may be in the very basic or trivial form of our daily activities or more complex as in the case of long term business decisions. All the decisions usually follow the same process. It is generally the usage of the right information at the right time that leads to effective decision making that in turn helps us realize the goal or objective that we intended to by decision making. It can be a small task accomplishment in case of small everyday decisions or fulfillment of organizational objectives in the case of business decision making.

Let us discuss how we take decisions in detail. Decision making is a process by which we choose from some available set of choices of alternatives one alternatives that helps us realize our goals and objectives effectively. There have been innumerable ways in which this process and concept has been defined by various authors. The most widely talked about and accepted model is the Simon's Model of Decision Making. It is given by Herbert A Simon, a professor of Psychology and Computer Science at Carnegie University Pittsburg. The models consist of the intelligence, design and choice phases which would be discussed in the next section in detail. Simon advocates the approach of looking at decision making as problems and sub problems. Every problem he says can be broken down in to smaller sub problems. When the sub problems are worked upon and solutions are found on them, smaller solutions can be put together to form a bigger picture. Simon has also talked about two related concepts:

- Bounded Rationality
- Satisfying

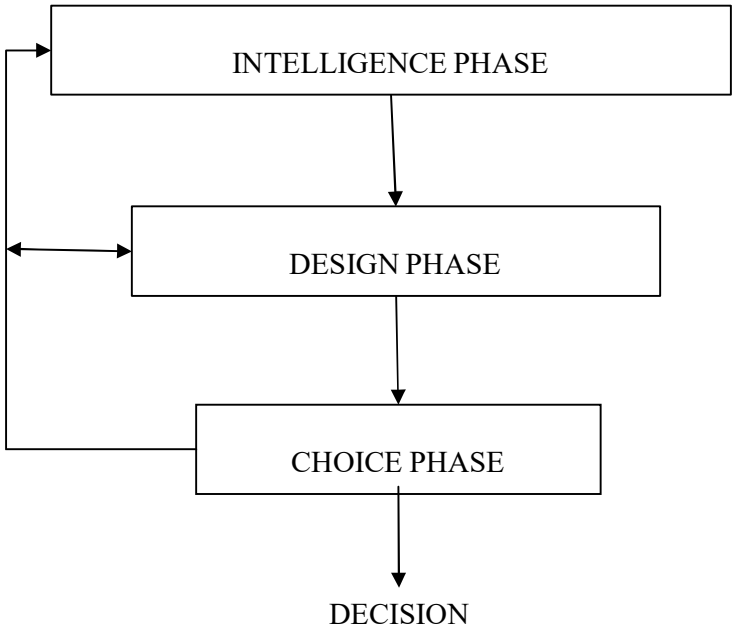
Bounded Rationality is the concept that says that it is not possible to have complete knowledge on all the possible alternatives for a given problem or the consequences of the choices that can be made. Managers have a limit to the degree of rationality that they can bring to the problem as not every aspect can be known. Therefore the managers generally simplify the problems on order to reach the decisions.

Satisfying is the concept that says that people tend to settle for acceptable decisions rather than just looking for optimal solutions and tend to look at problems rather than solving all of them simultaneously. This suggest that the decision makers tend to accept the choice which comes first and is feasible instead of going for an exhaustive search for the best possible or the optimal solution for the problem.

4.4 SIMON'S MODEL OF DECISION MAKING

The decision making model given by Herbert A Simon s the most widely accepted model for decision making. According to Simon Decision making is a rational process which follows the following stages:

1) Intelligence
2) Design
3) Choice



INTELLIGENCE PHASE: Decision making can be long process as the power to make the decision comes from knowledge and information. In the intelligence phase, the problem at hand is identified and the collection of information on that is done. Therefore in the broader sense it can be said that the problem situations and opportunities are considered and understood and data about them is gathered. For example, say an investments company monitors the share prices, whenever the prices will change the decision on whether to buy or sell the stock would be taken.

The data and information collection is done through environmental scanning. The environmental scanning has to both internal and external. In internal scanning the information from within the organization i.e. with the various departments etc is used whereas in the case of external scanning the information external to the organization is used. This may include all

the units that the organization interacts with i.e. suppliers, customers, government etc. Furthermore the scanning can be either continuous or intermittent:

- Continuous needs to be carried out continuous or at very short intervals or whenever there is a change, for example a production managers must be checking the daily scrap reports for keeping a check on the problems relating to quality control)
- Intermittent scanning on the other hand as the name suggests is done after regular intervals of time, for example a sales executive may visit his key customers periodically in order to find out any new opportunities that may come his way.

Scanning of the environment may not be an act of conscious effort necessarily. In very small or trivial everyday decisions we might not consciously go about collecting information but in case of complex business decision it is explicitly done or the executives already have the information through experience etc. For example when we start a car or a scooter, in case of any loud or new sounds which was not expected from regular working of the vehicle arises, we automatically know that we need to detect the possible problems with the vehicle. Thus intelligence phase information may come from some dissatisfaction that is arising from the present way of operations or may be from a new opportunity that we feel may have been arising for us.

The Intelligence phase of decision making process involves:

a) Problem searching
b) Problem formulation

PROBLEM SEARCHING: Problems are found out by making out the difference between 'where we are' and 'where we want to be'. It is nothing but the difference between the expectations and the reality. So the difference can be seen as:

Difference = Desired/Expected – Actual/Reality

Various models may be used to find out this difference. Some of them are:

- Historical models of extrapolation
- Trend models
- Models from outside the organization which may be used by competitors, customers etc.
- Planning models

Understanding this practically is very simple; consider a production manager whose monthly target for production was 10 million units but the actual production he could manage 7 million for this month. Therefore the difference between the standards set and the actually performance i.e. 3 million units which is the problem for the manager

PROBLEM FORMULATION:

Once the problem is found out, in formal settings it is necessary to ensure that the problem is well stated and clearly understood. This is also because in formal settings documentation for every step is required because it is not necessary that the same set of people keep on working on the same issues, so everyone working on the problem should have clarity about it. Sometimes just stating the problem is enough whereas in other cases in more complex situations determining and defining sub problems may also be necessary.

DESIGN PHASE: One the problem has been defined and formulated and the relevant information on the problem at hand has been collected, this phase focuses on identifying the various options that are now available with the decision makers to proceed further. This phase involves the finding, developing and evaluating the various alternatives that may be possible for the decision makers. The decision makers explore every opportunity that can be seen as an alternative and the associated risks and pros and cons of each one of them. This is rather detailed and time consuming activity and also highly crucial because a missed alternative may have proven to be the best of the lot. Developing alternatives also requires a very logical and orderly thought process and aids such as brainstorming etc. are used in order to develop creative thinking and novelty in order to get the best possible solution.

CHOICE PHASE: This is the final stage where the actual decision which needs to be undertaken for solving the problem at hand is chosen. Here all the alternatives defined in the design phase i.e. the earlier step are closely analyzed and ultimate the optimal solution to the problem is selected. When the decision is selected the course of action then falls into place and the decision making process is said to be complete.

It should be noted that according to Simon the phases of the process are such that the decision maker can from one phase to other multiple times while solving a single problem or while getting to a decision on one situation. For example a manager may come up with many alternatives in the design phase but later in the choice phase may realize that none of the

alternatives at hand are optimal or even usable and may again go back to the previous phases for loom at the problem again.

Along with these well accepted phases Simon also talks about the post decision behavior where the actual implementation of the decision taken tales place. This includes the proper follow up and monitoring of the performance of the course of action chosen by the decision making process.

Mintzberg has also spoken about how unstructured decisions are taken at middle and upper levels of management by inductive thinking. The decision making generally starts with a vague or broad idea which when matched with an opportunity at hand helps shape a final construct to take a decision.

EXERCISE I (State whether true or false)

1. The term decision comes from a Latin word which means 'to cut off'.
2. The concept of bounded rationality means that rationality of a manager in decision making has some bounds.
3. Simon's model says there are three phases in the decision making process.
4. The intelligence phase is divided into four subparts namely intelligence gathering, problem searching, problem identification and problem formation.
5. Choice phase ends with the decision being taken.

4.5 TYPES OF DECISIONS

Decisions to be taken in organization vary in a number of ways. They can be classified into various types and on basis of various criteria. The differences are important to know because the way the decisions are later handled and the decision making process may vary. These differences change the way various alternatives are formed or how the decision from the available alternatives is taken. This in turn also affects the way the information systems in the organizations are built and implemented. Decisions can be classified on basis of:

1) Purpose of decision making
2) Level of programmability
3) Knowledge of the outcomes

PURPOSE OF DECISION MAKING: On the basis of the purpose of decision making the decisions can be categorized into three types

a) Strategic Planning Decisions
b) Management Control Decisions
c) Operational Control Decisions

Strategic Planning Decisions are the long term decisions which affect the organization over large periods of time such as long term investment decisions and require long term efforts such as change in overall mission etc. Such decisions are taken by top management and decisions are related to developing objectives, allocation of available resources, introduction of new products, acquisitions etc.

Management control decisions are taken by the middle level managers and are related to the control and direction in the organization.

Operational control decisions are taken at the supervisor levels. The day to day operations which need to monitored and controlled and are generally routine decision are taken at the operational control level. Such decisions can be everyday production decisions such as inventory control decisions, restocking decisions, scheduling decisions etc.

It should be noted that the way each of these types of decisions have to be taken care of very differently and need different approaches to be followed while dealing with them. This can even be seen from the fact that how information systems are developed for them. For example systems developed for and the models used in transaction processing systems used at operational systems or executive support systems are different in application.

LEVEL OF PROGRAMMABILITY: On the basis of level of programmability of a decision, decisions can be of two types

a) Programmed or Structured
b) Non programmed or Unstructured

Programmed or structured decisions are those where everything can be well defined. Information about all aspects of the decision is available. All the available alternatives and all the data about them are available with the decision makers. The specific procedure to be followed or the rules to be taken care of while taking the decision are known. Such decisions are generally routine decisions taken for everyday operations which have been tried and

tested over time and the managers knows the exact pros and cons of the decisions being taken. Little time is required in developing the alternatives in the design phase as the decisions being taken are repetitive in nature. These decisions are taken by using the standard tools which are available i.e. scientific tools such as those used in operations research, mathematical models, simulation etc. for example linear programming, transportation problems. Such decisions are routine in nature and easily computable by standard models therefore are generally automated or passed on to the lower management.

Non-programmed or Unstructured decisions are the ones which do not have any preset fixed pattern which cannot be followed for reaching the decision. These decisions are in no way routine in nature as was the case in the structured decision making. The situations and the problems that the management deals with in the case of unstructured decisions are new and such that they have not been faced by the management in the same form as they may have arisen now. As there is generally absence of any prior experience therefore there is also a problem of availability of information about the various aspects such as which alternatives may be available and further information about the alternatives which may be known. These decisions are generally onetime decisions which may be related to situations such as emergencies or crisis situation which are difficult to deals with because of the extra uncertainty and risk and stress levels. There are no set rules or patterns or procedures which have been developed designed or followed earlier in the organizations or by extra-organizational groups. These decisions are time consuming along with being crucial to the organizations and a lot of time is spent on the design phase. It should be noted that these decisions are strictly taken by the top management in the organization and are taken by executives who have vast experience and knowledge of the domain in which decision has to be taken. This is necessary because such decisions rely upon intuition and judgment related to the situation the organization may be facing and needs to be analyzed from a perspective from which it may not have been looked on before. These types of decisions are generally carried out at strategic levels and are difficult to automate as there are no fixed ways to respond to the situation which may arise.

Decisions in the real world are not so simple in nature that they can be simply put into two baskets of structured or unstructured. They generally exist as a combination of both and even the most unstructured decisions may have some elements of structured decisions in them. Therefore the managers at higher levels cannot survive without deep knowledge about them and even rely on automated systems made for the lower level managers in order to deal with

the unstructured decisions. Also the definitions of structured and unstructured keep on changing from time to time. New models are developed with experience such that some decisions which may earlier be considered as unstructured now may be considered as structured decisions. It is also not necessary that the top management only deals with unstructured decisions and the lower management only deals with simple and structured decisions, this may happen most of the times but it is possible that every level has to tackle a mixed bag of both types of decisions

KNOWLEDGE OF OUTCOMES: On the basis of the knowledge of outcomes, the decisions can be divided as:

a) Decisions making under certainty
b) Decision making under risk
c) Decision making under uncertainty

Decision making under certainty as the name suggests is when we have extensive knowledge about the situation at hand for which we have to take a decision. We know with certainty the various variables in the situation and the relationship that exists in them which would easily help us generate a specific model in order to reach the decision. In this type of decision making the exact outcome of every alternative that the decision maker has is known beforehand. There is generally only one outcome for every alternative making it even more specific and the decision maker has to decide that which outcome or alternative is optimal for the situation. Various optimization techniques are used for that. The problems are generally maximization of minimization problems. Such problems are generally solved using the linear programming models extensively defined in operations research. As the variables and alternative are definite, definitive solutions for the problems can be reached easily.

Decision making under risk involves the presence of a level of probability that is associated with each outcome that can be reached. There is always a possibility of multiple outcomes for each alternative and for each outcome we do have a level of probability that can be attached to each of the alternatives and the outcomes associated with them. Here there is a trade-off between the expected outcome and the probability that that outcome. The decision maker id thought to be rational and decisions are made such that the decision maker considers both the expected output value and the associated probability. Models such as PERT (Project Evaluation and Review Technique) and CPM (Critical Path Method) are widely used in scheduling problems faced by the management.

Decision making under uncertainty is the case as the name suggests where there are multiple outcomes possible for the different outcomes that can be reached and even the probabilities are not known as was the case in the decision making under risk. As there is no knowledge of the probabilities therefore the criteria for optimization cannot be applied. In such situation concepts such as Game theory and the Minimax and Maximin operations are used depending upon the problem that the manager faces.

4.6 CHOOSING AMONG ALTERNATIVES

When a manager faces a situation that needs to be dealt with, the decision maker uses various methods to choose among the alternatives and reach the final decision. Here we assume that the alternatives are already known and in order to choose from these alternatives the following method can be used:

1) Decision Theory
2) Utility
3) Decision Trees

DECISION THEORY or the decision analysis is a technique used extensively in case of decision making under risk and uncertainty. In order to achieve some goal of objective through decision making the manager has to choose from a set a multiple alternatives in case of decision making under risk and uncertainty.

In Decision Theory or the Game Theory, which is based on the concepts given by a mathematician named John Nash, the payoff of the game or the decision is what is of importance. The payoff represents the data in the decision problem effectively. The rows and columns represent the alternatives or the strategies present with the decision maker and the payoff represent the profit or loss which arises on chooses a particular strategy. Given below is a payoff matrix.

	State 1	State 2	State 3	State 4
Strategy 1				
Strategy 2				
Strategy 3				
Strategy 4				

Payoff

In decision making under risk the probabilities are known where as in case of decision making under certainty the probabilities are not known therefore the use of maximization and minimization is not possible therefore the criteria of solving the problems depends on the decision maker. The rules which can be applied are:

- MaxiMax or criteria of optimism
- MaxiMin or criteria of pessimism
- MiniMax or the criteria to minimize regret
- Laplace criterion or the criterion of rationality

MaxiMax or criteria of optimism as the name suggests that the manager has the optimistic attitude and would select the strategies such that he gets the maximum payoff (max) under the most favorable strategies (max).

MaxiMin or criteria of pessimism on the other hand the manager would select a strategy that would give the highest payoff (max) even in the worst situations (min).

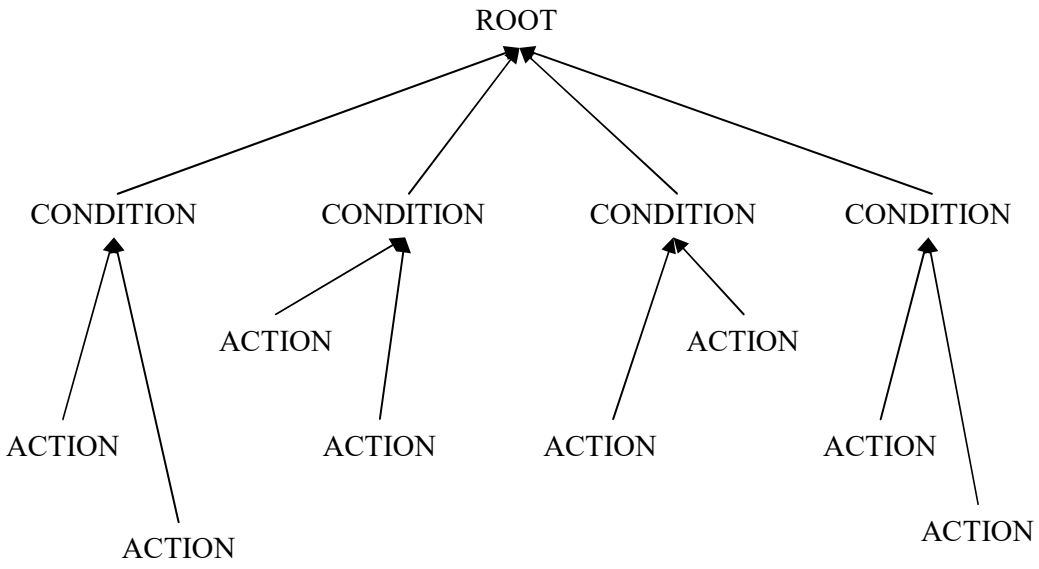
MiniMax or the criteria to minimize regret intends to decrease the regret therefore the decision maker would choose a strategy which would minimize the maximum regret.

Laplace criterion or the criterion of rationality considers the probabilities for every possible alternative to be equal. When the alternatives' probabilities are known the problem changes to a problem of decision making under risk for which the payoffs for each of the alternatives can be easily calculated and the strategy with the highest payoff is selected.

UTILITY is a qualitative measure for decision making. It can be notes that in case of decision theory the payoff is measured in terms of factors such as monetary value, number of units etc. In case of qualitative factors such as goodwill, perception, satisfaction, image of organization etc the decision theory cannot be applied. Therefore another measure called utility (unit is Utiles) is used. The behavior of the curve representing utility follows the law of diminishing returns and is extensively used in organizational decision making in case of qualitative items which cannot be easily quantified.

DECISION TREE is nothing but a graphical representation of the various alternatives of the course of action available with the managers and the ultimate outcomes that will arise from

that. It is an important method and is one of the most widely used tools at it makes the picture clear in the minds of the decision makers in a very simple way.



It is referred to as a decision tree because the various alternatives listed on a piece of paper resemble the branches of the trees shooting from the truck or the roots of the tree (as shown in the figure above). The root of the tree represents the starting of the sequence and can be seen as the problem to be solved and the consecutive branches emerging from it are the various alternatives and the actions or outcomes that arise from them. When a particular branch is followed based on the conditions that exist for the alternative, the decision is made and the action that is then chosen is performed.

The decision tree also helps the decision maker to view the problem in a more structured way and helps in understanding the underlying logic of the problem as well as analyze the problem. However this type of decision tree may fail in case of complex problems with large numbers of alternatives and sub-alternatives. In such a case it would rather create a sense of chaos and may confuse the decision maker instead of inducing clarity in decision making.

4.7 CHALLENGES IN DECISION MAKING

Business Decision Making is a hard task but it has become especially difficult in the present scenario with the increase turbulence and volatility in the business environment in which the organizations operate. Decision making today has become an extremely complex job and

innumerable challenges are faced by the managers in the organizations while reaching an ultimate decision for a problem.

Every decision has to satisfy every stakeholder in the organization. The decision maker has to take care of the conflicting interest that may exist in between various stakeholders such as the employees, customers, shareholders, the suppliers, government etc. the prerogative of each of these stakeholders may be different and each of them have to be taken care of by the decision maker while making the decision. The decision maker has to decide that which interests can override the others while taking a decision. There can be complex issues like customer preferences, employee loyalty and morale, government policies or corruption in the system etc, which the decision maker has to keep in mind and work with and then decide about the ultimate course of action to be chosen even in some cases after knowing the theoretical optimal solution for a problem.

Every problem comes in with a certain level of uncertainty and there is always a little chance of failure. There is always a risk associated with the decision being taken and the manager has to keep a balanced approach and trade off between the outcomes that can be achieved and the risk associated with that possible outcome and the manager has to act rationally considering both these factors.

Decisions which have strategic implication or are long term in nature such as capital investment issues, allotment of funds, mergers and acquisitions, starting of new products etc. require involvement of a variety of technicians and experts such as domain experts, financial managers, lawyers etc. The decision making process has to accommodate each of them, deal with the conflicting interests of each of them and try and synchronize their opinions to reach a common ground. These are people with different backgrounds, expectations, rules etc. therefore every conflict arising due to this needs to be neutralized and decision has to be reached that everyone's opinion is kept in mind.

Decision making can be an extremely time consuming process as in complex decisions opinions and information from different groups may be needed.

In today's day and age managers also face a problem of plenty; data and information is present and available with the decision makers a click away. Therefore it is very important to rely upon and use only the most accurate, relevant, timely and usable information in order to make decisions which ultimately help the organization.

EXERCISE II (State whether true or false)

1. Decisions can only be of two types i.e. structured and unstructured.
2. Strategic decision making is done by the top management.
3. Decision making under certainty means that the decision to be taken is already known.
4. Decision making under uncertainty uses models such as the Game Theory.
5. We can choose among alternatives using a decision tree.

4.8 REVIEW QUESTIONS

1. Discuss the difference between a decision and decision making.
2. Explain the concept of bounded rationality.
3. Explain in detail Herbert Simon's model of decision making
4. What are the different types of decisions? Discuss.
5. Write a short note on the challenges faced while making decisions.

Answers to Exercise I

1. True
2. True
3. True
4. False
5. True

Answers to Exercise II

1. False
2. True
3. False
4. True
5. True

4.9 SUGGESTED READINGS

1. D. P. Goyal :Management Information Systems Managerial Perspectives
2. Sahil Raj :Management Information Systems
3. K. Laudon, J. Laudon :Management Information Systems Managing the Digital Firm

4. G.B. Davis, M.H. Olson :Management Information Systems

CHAPTER 5: DATABASE MANAGEMENT

STRUCTURE

5.0 OBJECTIVES

After reading thus chapter, the students must understand:

- Basic concepts of Database Management Systems
- Objectives and roles of Database management Systems
- Advantages and Disadvantages of Database Management Systems
- Basic concepts of Structured Query Language (SQL)
- DBMS as a tool for integration of functional areas

5.1 INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS

Data is an extremely important organizational resource which is vital for organizational decision making and forms the basis for any decision making that happens in an organization. Data also forms the necessary input for the Information Systems for the organizations. Decision making we know is done in extremely dynamic and volatile or rather we can say turbulent environment and it is almost impossible to work with manual systems in such an environment and ensure effective decision making. The manual systems are extremely slow

and are prone to human errors and also the data cannot be easily processed into information which is ultimately required for decision making. It is the automated Management Information Systems which can provide the information required to make decision by the managers and therefore help then take timely and accurate decisions.

However for providing this output i.e. information, the systems first need to be fed with the relevant input i.e. the data available with the organization. The quality of information a information system would provide would depend on the quality of the system but would also depend on the kind and quality of the data that is being fed into the system, therefore it is pivotal that the data is collected stored and managed in such a way that it enhances the quality of the output produced by the system. Therefore importance of management of data can be understood from the fact that faulty of wrong data may translate into wrong information and therefore faulty decisions by the managers, and this fault should never be attributed to the data management techniques of the organization. This can be avoided by effective management of the data using Database Management Systems.

A **Database** is collection of organized form of data which is kept in a way such that it can be easily accessed, stored, retrieved, updated and managed. We already understand the concepts of data and information and how they are the backbone of the decision making done by the managers in the organization and a database helps us keep that data in such a way that it can be utilized easily and effectively and timely to generate information in the form of reports, results or summaries in order to aid decision making.

A **Database Management System** as the name suggests is the software which allows us to create, define, manage and manipulate data by making databases. Database Management Systems allows various operations etc. to be applied to the data an organization has in order to get the needed results. It also has the task of providing security and protection to the data stored in the database.

5.2 CHARACTERISTICS OF DBMS

Database Management Systems are different from the traditional data management systems such as manual systems in approach. Here are some key characteristics of Database Management Systems:

1) The entity concept: Generally the architecture of modern databases revolves around real life entities, their behavior and attributes. For example for a database for a school

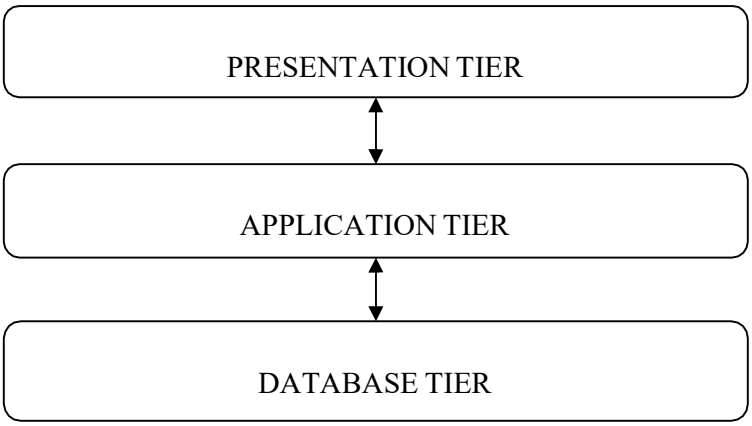
student may be considered as an entity, every student has certain attributes such as a class roll no., a name, telephone number, address etc. which may be stored in the database of that school.

2) Relationship based tables: The data stored in the databases is in the form of tables. The data about every entity in database may be stored in a different table and relationships can be formed in between them. The relationships between all the entities in the database can be easily understood by just looking at the table definitions and how they are related to other tables in the database.
3) Isolation of data from the DBMS: The Database Management System and the data stored in it are considered as two separate entities. A database is the active part of the system and the data a passive part. The Database Management System maintains metadata i.e. data about data in order to make its own work easy and be able to know about the data stored at all times. Database is the active entity which uses the data stored as and when required.
4) Reduces Redundancy: A Database Management System reduces the redundancy of data which was highly prevalent in the traditional manual or file based systems. Database Management Systems are base on the scientific principles of normalization which helps tackle and reduce redundant data in the databases.
5) Consistency: The data present in the databases management systems should be so stored such that when the data in the system is processed upon it should always remain in a consistent state i.e. either the related data in the whole system is changed or nothing at all is. It refers to the fundamental concept that the data retrieved from a database in whichever form must convey same information. Database Management Systems are more consistent as compared to the traditional systems such as file processing systems.
6) ACID: Database Management Systems follow the concept of ACID which is an acronym for Atomicity, Consistency, Isolation and Durability. These properties help keep the data healthy and usable in the environment of transactions that the data in databases undergo.
7) Query Language: Database Management Systems are equipped to handle query languages which help to retrieve data from, store to, update data in the databases. The user can also apply conditions to filter data in order to get the results one may want which was not possible in traditional data management systems.

8) Users: Databases allows access to multiple users according to their requirements. A database can selectively allow some functionality to one users and disallow them to others as and when may be required. For example a Manager from Human Resources may require different types of data as compared to a manager from Sales department and the data each of them needs may be such that it should not be seen by users from other departments. This is can be done easily using a Database Management System.
9) Concurrent access: The concept of multiple users may confuse us on thinking that only one user can access the system at a time but Database Management Systems allow simultaneous access to various users. The multiuser experience is such that users are allowed access in parallel yet the data properties are maintained to ensure consistency.
10) Security: As mentioned earlier Database Management Systems allow multiuser access and in some cases there may be necessity that users from one department should not be able to access data from other departments or there may be some important classified information which can be accessed only by the top management etc. in such cases the Database Management System helps us to use constraints etc. to invoke security features in the database.

5.3 ARCHITECTURE OF DMBS

Database Management Systems exist in two tier or three tier architectures. Generally two tier architectures are used by programmers who have the knowledge of the application used for database management. We in the field of management use Database Management Systems as end users, therefore use the database in the form of three tier architecture. The three tier architecture consists of three levels as shown below



The DATABASE TIER has the database along with the query processing language. This is where all the table and relationship definitions are, also constraint on data access etc are also applied here.

The APPLICATION TIER is the middle tier of the Database Management System. This is the tier where the application program that the end user is using accesses the data from the database. This middle tier acts as the link between the presentation layer the user operates and the database layer in which the database resides. The user is not aware of the database beyond the application layer. There is a level of abstraction that is maintained from the users as they do not need to understand the technicalities of the database and how it is operated.

The PRESENTATION TIER is the layer the end users operate and work upon. This layer is the one that provides the user interface beyond which the user never goes. Multiple views of the data are presented in this tier on the requirements of the end users. The views are generated by the application tier but are viewed here by the end users.

5.4 OBJECTIVES OF DBMS

The basic objectives of a Database Management System are to make data access easy, fast, inexpensive, flexible secure and accurate for the users. Some of the specific objectives can be as under:

1) Data Consistency: Consistency of data is very important when we are maintaining any kind of data. Even in manual systems it is necessary that our records hold the same data and convey the same message and meaning no matter from where they are accessed from but this is extremely difficult to maintain in traditional manual systems. Database Management Systems aim at providing this much required consistency to the data stored by the organizations and it also ensures that this remains so even when multiple transactions may be performed on the data. Consistency is maintained by ensuring that either the transactions being done on the records are completely done or not done at all.
2) Controlled data redundancy: In the traditional systems data may be highly redundant. Same data maybe present in many forms in different files lying in different departments in case of traditional manual systems in an organization. The objective of the Database Management Systems was to remove this deficiency of traditional systems. With techniques such as normalization, data redundancy can be removed

from the databases. Only relevant data is kept and that data can be used again and again as and when required and can also be linked with other sets of data. When data can be easily linked and fields can form a relationship between tables, the redundancy of data is further reduced as we don't have to keep on repeating the same field in every table again and again.

3) Ease of use: Data bases are easy to access and use as compared manual file systems. Retrieval of data from the traditional systems was one big issue. Finding a small entry from a stock of registers can sometimes prove time consuming and tiring but such things can be easily done using a Database Management System. Ease of retrieval of data is extremely high, moreover in Database Management Systems the data can be retrieved using filters i.e. based on some conditions as mentioned by the end user only selective data can be presented to the user by the Database Management System.
4) Centralized: Database Management Systems are centralized in nature, therefore all the data of the organization or let us say a department in present at just one place and everything can be accessed from there. This also decreases the problem of repetition and redundancy as was the case with traditional manual systems. Another aspect is that being centralized they can easily provide consolidated view of the entire data i.e. providing reports and summaries of the data as and when required by the end users which in this case may be the managers in the organizations.
5) Recovery from failure: Databases have very efficient systems which support backup and recovery features. Apart from maintaining a physical backup and recovery option in case of physical damage to the system, the system also has inbuilt features in case of system failures wherein the data of the organization is not lost. Furthermore it is very easy to create backups of the databases in comparison to creating a physical backup of a manual register in order to save them from physical dangers. The additional danger of system failures that has arisen from the technology also can be easily handled by Database Management Systems.
6) Application independence: This concept can be understood by keeping in mind the fact that the database is an independent entity i.e. different from the application software. Data in the database can be stored and accessed as an independent entity and is not dependent on the application that accesses it. A database can even be detached from one application software and attached to another if the managers require that

5.5 ROLE OF DBMS

Roles of a Database Management System are listed below:

1) Storing: Storage of data at one place is one of the basic functions or roles of a Database Management System. Data entry into the system is easy to make and even person who is not a very technically sound person can easily do this task of data entry. Furthermore is was a time consuming task when the data has to be manually entered in registers and copies has to be made for various departments or for office work or for safety of the data. The data stored once into the system is available for life and does not have a shelf life as the manual data storage systems such as files and registers had. Data is stored safely and is available for use whenever required.
2) Organizing: The data is stored in a well defined and organized form. One of the major disadvantages of traditional systems was that the data once stored or entered in the system could not be reorganized or regrouped. There was no provision of filtering etc possible which is now allowed in every database management system. With the filtering and selective reading of the data it is also possible for the managers to organize data in any way they want. On the basis of the given data can be selectively stored and later used. This helps in better organization of data.
3) Retrieving: Finding some specific data out from bulky and old registers and tattered files as was done in traditional manual systems was considered one big task but the same task is made easy by the Database management systems. The query languages help easily apply conditions and filters on retrieval of data so that the data specifying one particular condition can be immediately retrieved. Retrieval is almost instant and can be based on the managers need entirely. It is not necessary that the entire data sheet or an entire table has to be displayed. Only the data which matches the Ɔonditions given by the end user appear on the interface and can be used whichever way the user wants.
4) Controlling: Another task that database management systems help us undergo as managers is control. The kind of transactions that can be allowed and the kind which have to be denied can all be controlled using the Database Management systems.
5) Cataloging: The files the tables and the records for each of them can be cataloged or we can say sorted to the liking of the managers or the end users using the database.
6) Security: Security of data is one of the biggest concerns for any manager and even a database administrator using a database management system. It is the primary task of

the database management system to provide that facility to the users. Physical security under loss or damage is provided through an effective backup and recovery system. Then there is the aspect of privileges and selective access to some people of certain information. Sometimes departmental information cannot be shown to employees of other departments, such features also find place in Database Management systems. Database Management Systems also provide the feature of security tables and fields which also store passwords and confidential fields

EXERCISE I (State whether true or false)

1. Database management systems help store, update, retrieve and manage data of the organizations.
2. Entities in databases may have attributes generally stored in the rows in a table
3. ACID is an acronym for Atomicity, Consistency, Isolation and Durability.
4. In Management the architecture used in Database Management systems has 2 tiers.
5. Controlling data redundancy is one of the most important objectives of Database Management Systems.

5.6 ADVANTAGES OF DBMS

Database Management Systems have innumerable advantages as compared to the traditional systems which existed before these systems. Here are some of the advantages of Database Management Systems:

1) Improved data sharing: Database Management Systems have been able to create an environment such that end users can have better access to better managed data. Data can be shared by multiple employees who may have special privileges to access special category of data or otherwise such data may even be hidden from the users through implementation of abstraction. The data is displayed through an interactive graphical user interface providing a presentable view of the dataset that the user may have requested for. Therefore we can say that the user gets the facility of improved data sharing.
2) Improved data security: Data of the organizations is extremely valuable for them but it can prove to be even more strategically valuable if some competitor can lay his/her hands on it. There are a variety of users accessing this data and that also in high numbers. Database Management Systems provide many ways to ensure data security

and safety as information is the cornerstone of strategic advantage in businesses. security from competitor, from within the organization in case of departmental confidentialities, physical security, backup and recovery all this taken care of by the Database Management Systems.

3) Better data integration: Data present in one place as a centralized system helps us integrate various parts of the organization making it act like a single entity. A well managed Database Management System helps integrate the organization in such a way that is promotes the integrated view of the organization and helps the user view the bigger picture of the organization. This makes it easier to view even the dependence of one part on other. It may help us analyze and understand how an action in one part of the organization can affect the other parts of the organization.
4) Improved data access: Database Management Systems help quick and relevant answers to specific requests of the end users. Database Management Systems have the capability to respond to ad hoc queries made by the users. Users dealing with very large datasets may require specific answers which can be provided by results of the queries which are generated by manipulation of data on the basis of the conditions in the query.
5) Improved decision making: the ultimate aim of any information system is to store data in the best possible way in order to generate meaningful and useful information which may in turn help in decision making in the organizations. The underlying prerequisite for all this is the data input to the whole system is in good quality. The Database Management Systems cannot ensure good quality data but can ensure that the required framework to facilitate good quality is provided.
6) Improved end user productivity: The end users which in our case are the decision makers in our organizations have to ultimately benefit from the Database Management Systems in order to improve the decision making and thus secure the future of the organization. The availability of data combined with the tools provided by the Database Management Systems helps the udders achieve this and make quick and informed decisions.

5.7 DISADVANTAGES OF DBMS

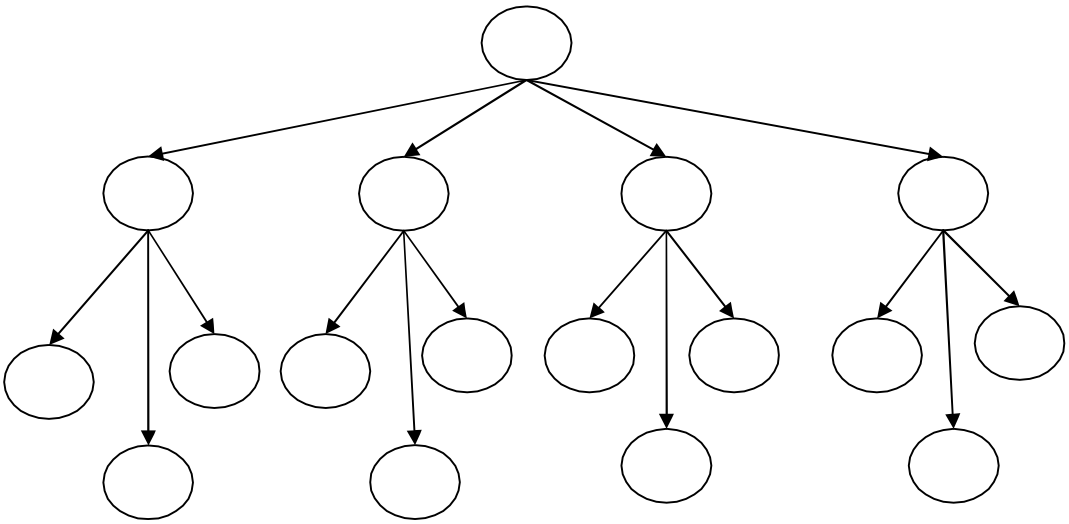
Along with the many advantages of Database Management Systems there are some disadvantages also. These disadvantages are:

1) Complexity: Databases generally cover whole organizations or at least complete departments. Such volumes of data can be complex in mature and difficult to handle if the person dealing with it does not know about the organization in detail. The data in the database may be of a central database of an organization which may be extremely complex and may be difficult for a non technical person to decipher the ways to manage it. Managers generally require outside help or professional help when dealing with Database Management Systems. Apart from designing the systems to even operating them experts may be called for help, also extensive training programmes may be required for the staff to help them understand how to operate them
2) Cost: Cost incurred at developing and maintaining a centralized database and application software can prove to be a costly task as compared to the traditional systems. There is a lot of one term investment which must be incurred when a company just starts of building a database system for the organization.
3) Large in size: Database Management Systems use more space as compared to a traditional file processing system and therefore require larger disk space.
4) Operationality: Databases are central to the organization and are used by a variety of users from the organization or outside. In case of any problems such a systems fault or any kind of failure or database corruption may cause the whole system to be rendered useless all at once. All these users may then have no means to access data from the Database Management System

5.8 DATABASE STRUCTURES OR DATA MODELS

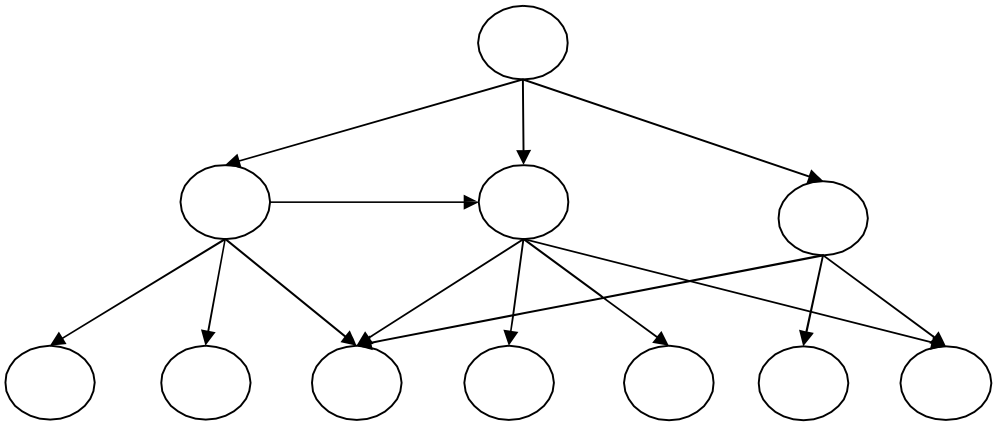
The three types of data models are:

1) Hierarchical model: As the name suggests the data in hierarchal structures follows hierarchies. The relationships that exist in the data are in the form of tree like structures. The records are dependent on each other and are present in a multi level structure. The top node of the tree is called a root and many branches may emerge from one root and being multilevel in nature, multiple sub branches may emerge from the braches and so on forming a complex and dense tree like structure. A parent and child relationship exists between the records related to one another. The highest level in the relationship is the parent and the records lower to it in the hierarchy are the children.



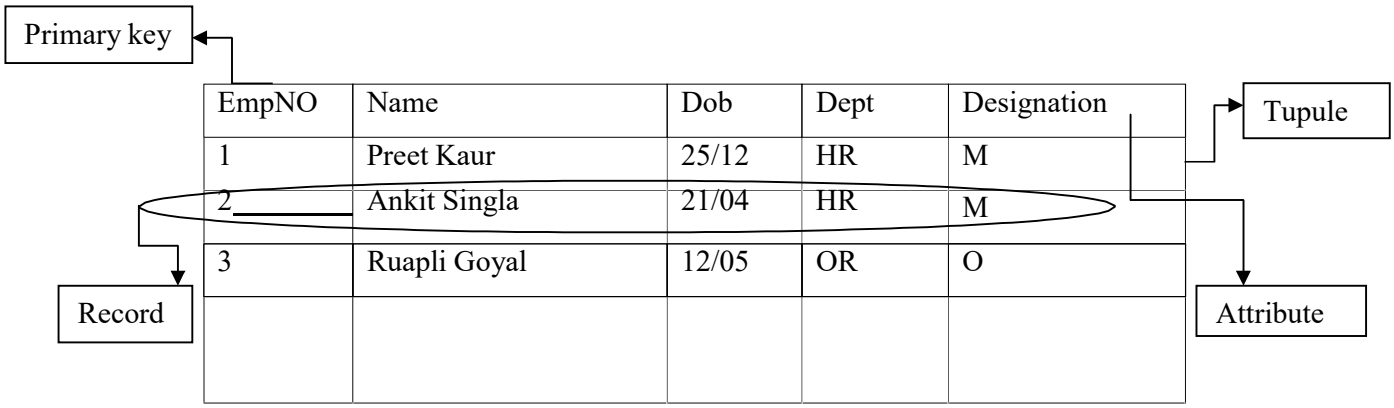
The relationships that exist here are all one to many. This model is simple and easy to design but does not represent many real life relationships that may exist between the records. It cannot represent many to one relationship and can also not represent data where one entity may be present at various levels in the organization.

2) Network model: As already discussed the hierarchical model does not allow complex relationships but simply expects that of data can be represented in one to many functions. The Network model allows more complex relationships such as many to many or many to 1 relationship. These relationships are stored in the form a linked structure as was the case with hierarchal model.



3) Relational model: The relational model was given by DR. E F Codd in 1970 and is based on the mathematical theories of sets and relations. Data in the relational model

is stored in the form of two dimensional tables called relations. In this model every column denotes an attribute of the entity that the table stores the information about. Every row is a tupule which denotes the entire data set about a single entity.



EmpNO	Name	Dob	Dept	Designation
1	Preet Kaur	25/12	HR	M
2	Ankit Singla	21/04	HR	M
3	Ruapli Goyal	12/05	OR	O

5.9 STRUCTURED QUERY LANGUAGE

Structured Query Language is popularly known as SQL, pronounced as sequel, is a query processing language. It is the most widely used language used with relational databases. Its name has three aspects; it is called structured as it follows fixed patterns and behaviors, follows rigorous sets of rules and procedures. It does query processing on databases therefore is called a query language. Other programming languages such as PASCAL and COBOL or C etc. all belong to the 3 GL categories where SQL is termed as 4GL.

SQL comprises of both data definition and data manipulation languages. Using the data definition properties of SQL, one can design and modify database schemas, whereas data manipulation properties allow SQL to store and retrieve data from database.

SQL has the following data languages to define store and manipulate data in Relational Database Management Systems:

1) DDL – DATA DEFINITION LANGUAGE: The commands for defining database schema are given in the data definition language. All data definition Language commands are auto committed which means that it saves all the changes permanently into the database. The following are the commands in Data Definition Language:
   a) Create: command used to create a new table or a database
   b) Alter: command used to alter he fields
   c) Truncate: the command for deleting all the data from the database

d) Drop: command used to drop a table
e) Rename: command used to rename a table

2) DML – DATA MANIPULATION LANGUAGE: as the name suggests these commands are used to perform certain tasks on the data. Data manipulation language commands are auto non committal. This means that the changes made are not permanent in the data and can be rolled back. The following commands come under the data manipulation language:
    a) Insert: the command to insert a new row
    b) Update: the command used to update a existing row
    c) Delete: the command to delete a row
    d) Merge: the command for merging two rows together

3) TCL – TRANSACTIONAL CONTROL LANGUAGE: The commands of the transaction control language are to keep a check on other commands and their affect on the database. These commands used can annul changes made by other commands by rolling back to original state. It can also make changes permanent in the data base. The following commands come under the transaction control language:
    a) Commit: the command used to permanently save
    b) Rollback: the command used to permanently undo changes
    c) Savepoint: the command used to temporarily save.

4) DCL – DATA CONTROL LANGUAGE: As the name suggests it decides the data controls i.e. who gets to access which data. The commands under the data control language are :
    a) Grant: the command for giving permission or right to a particular user
    b) Revoke: the command used to take back any permission or right to a particular type of user.

5) DQL – DATA QUERY LANGUAGE: it uses the command to retrieve or select the records from one or more tables. This is done using the command:
    a) Select: retrieve records of one or more tables

Apart from these commands many clauses such as the ones given below. These clauses are used with the other commands already discussed in order to make the operations on data more specific. These clauses are:

a) Where
b) Like
c) Order by
d) Group by
e) Having

Here are some examples of database queries which can help us better understand SQL.

- To create a database
  Create database student;
- To create a table
  Create table student
  (id int,
  name varchar,
  age int);
- To drop a table
  Drop table student
- To rename a table
  Rename table student to studentrecords

SQL is an ANSI (American National Standards Institute) standard but there are different versions of the SQL language available which may be used over different platforms by different users. However they all support at least the major commands (such as SELECT, UPDATE, DELETE, INSERT, WHERE) in a similar manner in order to comply by the ANSI standards.

5.10 DBMS AS A TOOL FOR INTEGRATION

Database Management Systems act as a tool for integration of the functional areas of an organization. We all know that every organization has functional units which act independently and sometime pretty evidently independent in getting things done. This may be because each and every business unit has his or her objectives to fulfill and functional areas

sometimes focus a little too much individual objectives as compared o the objectives of the entire organization. Despite all the differences in data preferences and data sets required by each of the functional units, the Database Management Systems integrate the entire organization to act and behave ad a single unit. Database Management Systems helps produce a unified image of the entire organization but still keeps in view the different requirements of the functional areas. Database Management Systems help provide the overall view of the organization in order to present the bigger picture about the organizations. It also provides the options of differential or selective access yet such functions do not hamper the thought of integrated system with the centralized data sources. Database Management Systems also helps generate comprehensive reports and summarized accounts of the data about the organizations in order to make decisions for the entire organization.

EXERCISE II (State whether true or false)

1. Complexity of Database Management Systems is an important disadvantage of Database Management Systems.
2. Hierarchal structure has one to many relationships.
3. Relational model of databases has tree like structure.
4. SQL stands for Structured Query Language.
5. Normalization is done in order to reduce consistency of data.

5.11 REVIEW QUESTIONS

1. Discuss in detail the architecture of Database Management Systems.
2. State the advantages and disadvantages of Database Management Systems.
3. Which are the various data models used in Database Management Systems?
4. Write a short note on SQL.
5. Explain how Database Management Systems can act as a tool of integration of functional areas in management.

Answers to Exercise I

1. True
2. False
3. True
4. False
5. True

Answers to Exercise II

1. True
2. True
3. False
4. True
5. False

5.12 SUGGESTED READINGS

1. D. P. Goyal :Management Information Systems Managerial Perspectives
2. Sahil Raj :Management Information Systems
3. A. Silberschatz, H. Korth, S. Sudarshan: Database Systems Concepts
4. K. Laudon, J. Laudon :Management Information Systems Managing the Digital Firm
5. G.B. Davis, M.H. Olson :Management Information Systems

CHAPTER 6: DECISION SUPPORT SYSTEMS

STRUCTURE

6.0 OBJECTIVES

After reading this chapter the students must understand:

- Basic concepts of Decision Support Systems
- Characteristics of Decision Support Systems
- Types of Decision Support Systems
- Components of Decision Support Systems
- Applications of Decision Support Systems

6.1 INTRODUCTION TO DECISION SUPPORT SYSTEMS

Decision Support Systems have evolved from the concept of basic Management Information Systems. Management Information systems did the job of information reporting for the managers to help them make decisions based on those summarized form of data. This was no longer proving enough for the decision makers in the organization in the present day turbulent business environment. The managers in such an environment not only require getting information in an accurate and timely manner but also want it to be precise and exactly what they may have asked for. They may need to look at the same information

present with the organization from different perspectives. The managers may want to consider or even monitor all critical parameters in order to reach decisions; such provisions were not provided by traditional Management Information Systems and therefore came the need to develop Decision Support which provided these facilities to Decision makers.

According to literature, "**Decision Support Systems** are a specialized type of Information Systems which use operational Research models on properly maintained databases with the facility of dialogue; this helps managers to analyze a complex problem from different perspectives and guides them to take rational decisions."

This definition is pretty comprehensive and covers all the aspects of Decision Support Systems; it makes it very clear that the environment is so dynamic that decision makers need additional support from the information systems in order to survive in the cut throat competition. Managers these days need to be proactive in nature and their decisions, they should be able to preempt the future situations and scenarios in order to meet the business expectations and it is exactly this that Decision Support Systems help a manager achieve. It is a combination of some very finely tuned components which work together to provide these features to the decision makers.

Rational decision making is the requirement of the decision makers these days and these rational decisions have to come out of the complex situations the decision makers are in. A Management Information System or a traditional transaction processing systems providing mere summary reports do not prove to be helpful in such situations, this is where Decision Support Systems come in picture analyzing the problems using operations research models helping one analyze the situation from different aspects.

Another interesting and extremely important aspect of Decision Support Systems is that they are interactive in nature. It provides a facility called the 'what if analysis' using which the managers can directly interact with the information system, ask questions which are answered by the Decision Support System by using the models and the data stored in the databases.

Managers and decision makers make semi structured and unstructured decision based on historical and current data collected from external and internal sources of data, also from experiences and knowledge of the decision makers themselves. A well built Decision Support Systems helps the decision makers to reach decisions using this kind of information; this is

executed using tools such as data mining which help gather relevant information so that it can be effectively used in decision making.

6.2 CHARACTERISTICS OF DECISION SUPPORT SYSTEMS

Decision Support Systems as we know are a specific type of information systems used in organization with the specific objective to help in decision making done by the decision makers in the organization. They are nothing but computerized information systems which aid decision making. They are interactive systems which utilize the organization's data, knowledge, information resources such that their effective and optimum utilization is possible in the decision making process of the organization.

According to Alter (1980) the following three were the main characteristics of the Decision Support Systems:

- Decision Support Systems are designed specially to facilitate decision making processes.
- Decision Support Systems should facilitate rather than automate the decision making process in the organizations.
- Decision Support Systems should be able to quickly respond to the changing needs of the decision makers.

Similarly Holsapple and Whinston (1996) identified four characteristics of Decision Support Systems. These characteristics just present a broader concept of Decision Support Systems specifying things such as Decision Support systems should have a body of knowledge of their own, record keeping ability such that they can present the knowledge in the form of standardized report or on the ad hoc requirements as and when requested for, capabilities of deriving smaller subsets of knowledge from the existing knowledge for the purpose of presentation or for the purpose of generating new knowledge on the basis of the new smaller subset and must be designed in such a way that it has the capability to interact with the user in order to perform or execute the flexible choices of the knowledge management activities that the decision maker may want to accomplish. Here is an extensive list of the characteristics of Decision Support Systems as discussed in literature:

1. **Facilitation**: As mentioned by Alter we understand the fact that Decision Support Systems are meant to facilitate the decision making process in the organization. They have to help the decision makers by providing the relevant, timely and accurate

information and knowledge which can be utilized in instantly usable form to the decision makers so that they can instantly reach a decision. It is important to understand that Decision Support Systems are not meant to replace decision makers in any sense in an organization and it is also not possible to do that. Automation is not the objective of Decision Support Systems but the objective is to understand the needs of the decision makers by interacting with them and show them the possibilities and helping them reach the right course of action. It is impossible to remove human touch from decision making because there is always a chance of grey areas in decision making which should be left to decision makers to decide, what Decision Support Systems can do is to help decision makers reach those easily, proactively and effectively.

2. **Interaction:** Decision Support Systems are meant to interact with the decision makers to know the needs of the users and then prepare and present the outputs accordingly. Decision makers can ask direct questions from Decision Support Systems which can be answered by the system using models based on operations research etc. These are highly scientific and structurally defined models and implementing these helps Decision Support Systems reach the answers to the questions asked by the end users i.e. the decision makers. The interaction with the decision makers is facilitated by a concept called the 'what if analysis' which helps the system understand the query in form of conditions and respond to the decision maker on the basis of those conditions providing the data and information which fulfils those conditions.
3. **Ancillary:** Decision Support Systems support decision makers at every level in the organizations. It is not necessary that they may be used at only upper levels of management. They may be used for everyday operational tasks but it all depends on how the Decision Support System has been designed. The requirements for the different levels may be different so there might be provisions of different kinds of tools which may fulfill the needs of all the levels or may be in the form of different modules which may be used by decision makers at different levels in the organizations. A Decision Support Systems is always ancillary to the decision makers and can in no way be made to replace them no matter the level of management the decision makers belong to.
4. **Repeated use:** Decision Support Systems are made for long term use and there are extremely good chances that they are used for routine tasks of repeated use along with the ad hoc queries that they may need to fulfill. As already discussed they can be

utilized to every level in the organization, therefore it can be noted that there is a good possibility that the decision makers from the lower levels of management may use them for routine and repeated tasks where as the upper management may need to use them for ad hoc decision support tasks.

5. **Task/decision oriented:** The ultimate aim of Decision Support Systems is specifically and precisely denoted in the name itself, it categorically says 'decision support', and so there is no doubt that Decision Support Systems are decision oriented. They facilitate this by providing certain capabilities that support one or more tasks related to decision making which may include intelligence and data analysis; identification and design of alternatives, choice among alternatives and decision implementations.
6. **Tailor made:** Every information system is made to order. It is not possible to have a standard decision support system for every organization because organizational needs and requirements are different. Decision Support Systems are tailor made according to the needs of the organization keeping in consideration the various factors such as the data sources for the organization, expected usage, some specific requests of the management etc.
7. **Future oriented:** Decision Support systems designed for the organizations should be so designed that they keep the future considerations of the business in mind. Decision support systems are not easy to design and are a rather cumbersome and time consuming process; therefore once designed they are supposed to serve the organization for a fairly long amount of time. As they are there in the organizations to stay they should be designed keeping in mind the future considerations of the organization so that they do not become useless in just a few years without even returning the investment in terms of time efforts and money incurred on them.
8. **Expansion capabilities:** As Decision Support Systems are a long term asset for the organization, they should be built keeping in mind the future plans and objectives of the organization, in addition to that Decision Support Systems should be such that they have flexibility to adjust any changes that may come in their way. They should be easily expandable to adjust additional functionalities that may be required of them in the future.
9. **Decision impact:** Decision Support Systems we know are decision oriented but their ultimate aim is to impact the decisions taken by the decision makers in the organizations. They have to aid the decision makers such that effectiveness of

decision making process can be increased in an organization. Decision Support Systems are meant to increase the accuracy, timelines, quality and overall efficiency of the decision making process in the organization.

6.3 TYPES OF DECISION SUPPORT SYSTEMS

Decision Support Systems may be different types on the basis of their application, applicability etc. These types are:

1. **Data-Driven Decision Support Systems:** The first types of Decision support systems are the Data driven Decision Support Systems. These types of systems work on massive amounts of data available from the traditional information systems in the organizations for example manual systems or Transaction Processing Systems or Management Information Systems. The Data Driven Decision Support Systems extract the data and information from these systems forming a voluminous data storage system which can then be utilized to generate information for the managers to make informed decisions. These systems generally do not rely upon the decision making models but focus more on the free flow of data. Data driven Decision Support Systems emphasize more on access and manipulation of the large data in the structured databases. They use tools such as file drawer and management reporting systems, data warehouses and analysis tools. Simple file systems accessed by query and retrieval tools provide the most elementary level of functionality. Data Driven Decision Support Systems with Online Analytical Processing (OLAP) provide the highest level of functionality and decision support that is linked to analysis of large collections of historical data.
2. **Model-Driven Decision Support Systems:** Model driven Decision Support Systems emphasize access to and manipulation of a model. Model driven Decision Support Systems are not data intensive as was the case in data driven DSS and not very large databases are required for it. Model driven DSS are generally kept in isolation from the rest of the management information systems of the organization and primarily used for the 'what if analysis' where the decision makers make direct what if queries from the systems. These systems rely heavily on the models to help the executives using the systems to understand the impact of their decisions on the organization, the suppliers and the customers etc.

3. **Knowledge-Driven Decision Support Systems:** These decision support systems are information systems with specialized problem solving expertise. The Decision Support System focus on the expertise about a particular domain, understanding the problems in that domain and the skills to solve these problems in the domain. It is very similar to the concept of data mining where large volumes of data is looked into in order to find the relationships between the data content. These are analytical application which search for pattern in the data which help managers decide on the basis of exception etc.
4. **Document-Driven Decision Support Systems:** New types of Decision Support Systems such as the document driven Decision support systems help the mangers retrieve and manage unstructured documents such as web pages etc. The objective of document driven decision support systems is complete document retrieval and analysis and Document driven decision support system integrate a variety of storage and processing technologies to facilitate this. The internet provides large rather infinite resources in this context. We can have access to large document databases including databases of hypertext documents, images and sounds etc. Search engines are another powerful tool used by these systems and are used to access documents such as policies, procedures, product specifications, catalogs, corporate historical documents such a minutes of meetings, corporate records or important correspondence.
5. **Communication-Driven Decision Support Systems/ Group Decision Support Systems:** Group Decision Support Systems came initially but now a variety of these in the broader tem sod groupware or communication based Decision Support Systems can be seen. A Group Decision Support System or GDSS is nothing but a combination of Decision Support Systems and communication and collaboration. A Group Decision Support System is a Decision support system that emphasis on both the use of communication and models. A group Decision Support systems rely more on the groups formed and the way a group can interact and function in order to find solutions to problems. The solution to problems is found by decision makers by interacting and working together as a group. These software support electronic communication, scheduling, document sharing, and other group productivity and decision enhancing activities. Many technologies for sharing and interacting are used as the basis of Communication Decision Support Systems.

6. **Inter-organizational/ Intra-organizational Decision Support Systems:** With the advancements in the prospects of connectivity and communication in the form of technology advancements such as the internet etc. organizational tend to broaden their perspectives in order to share the information with the various stakeholders of the organization. Decision Support Systems targeted for external users are the inter-organizational Decision Support Systems. With the advancements in internet the stakeholders can have access to company's intranet and authority privileges are set by the administrator as to who has the permission to access or update which parts of the system. Companies generally make Data Driven Decision Support Systems or simple Model Driven Decision Support Systems available to the customers to generally provide facilities to customize or design a product or simple to choose it. There can also be Intra-organizational Decision Support Systems which acts as standalone Decision Support Systems to be used by managers belonging to one company in an Enterprise Wide Decision Support System.
7. **Function-Specific or general purpose Decision Support Systems:** Decision Support Systems are designed in order to support some specific business function, types of businesses or a particular industry. These Decision Support Systems are referred to as Function Specific Decision Support Systems. A function specific system such as a Budgeting Decision Support Systems or a Marketing Decision Support Systems can be purchased from a vendor as a readymade product but specific requests of some business specific changes have to be made to them which can be done by in-house developers of the organization. These general purpose products are vendor developed and are used for the basic functional requirements or the organization. Some products may be very specific to industry or business such as a crew scheduling Decision Support Systems for an airliner. Such Task Specific Decision Support Systems have some particular and important task to deal with and something that has repeated or reoccurring use for the organization. These are tailor made for the organization as requirements of every organization in this regard are different. The Functional or Task Specific Decision Support System derives the knowledge related to that specific function that they are supposed to perform from the organizational data stores. They help some particular group perform some specific task where as the general purpose decision support software help perform generally and broad tasks such as production management or decision analysis etc.

EXERCISE I (State whether true or false)

1. Decision Support Systems are highly interactive and respond to direct manager queries.
2. The tailor made approach cannot be used on Decision Support Systems.
3. Decision Support Systems are supposed to replace decision makers in the organizations.
4. Inter and Intra Organizational Decision Support Systems focus on sharing the organizational information with the stakeholders of the organization.
5. Function Specific Decision Support Systems can be both general purpose of specific purpose.

6.4 COMPONENTS OF DECISION SUPPORT SYSTEMS

Decision Support Systems' framework can be studied in various ways depending upon the class of the decision support systems we are talking about, they may differ in their approach on the basis of the ultimate application they are made for and the emphasis of the system on one or another popular data, knowledge, decision management techniques. One of the generic Decision Support System framework can be studied in terms of four interrelated elements i.e. a language system (LS), a presentation system (PS), a knowledge system (KS), and a problem processing system (PPS). Many other approaches similar this may exist in literature and Decision Support Systems are also practically implemented using these as the need may be. The most widely accepted and used approach considers the following four components of Decision Support Systems:

1. Database Management Subsystem (DBMSS)
2. Model base Subsystem (MBSS)
3. User Interface Subsystem (UISS)

Let us discuss each of these in detail.

6.4.1 DATABASE MANAGEMENT SUBSYSTEM

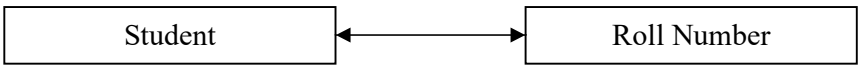
Managers have to store huge amounts of data that the organizations has for future references and it is important for the organizations that this is done in a systematic and accurate way such that the data can be easily stored managed and retrieved. This facility is provided to them by Decision Support Systems in the form the Database Management

Subsystem or the DBMSS. Data bases are the centralized data stores that hold the data about each and every part of data source of the organization. Organizations need to store data which can be internal or external to the organization i.e. the volume of data to be handled is vast. The storage retrieval and management has to fast accurate and easy. This is only possible by computer driven software and this is therefore done by Database Management Systems.

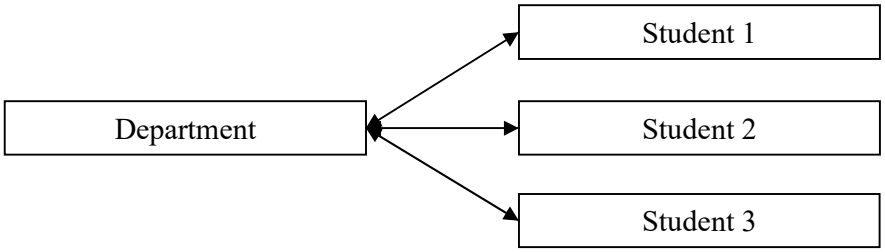
The data in the Database Management Software is stored and managed in a highly structured and organized manner and this is done through various rules and concepts that are directly used in them. The associations that may exist between the data members in a database can be of three types given below:

1. One to One Association
2. One to Many association
3. Many to Many Association

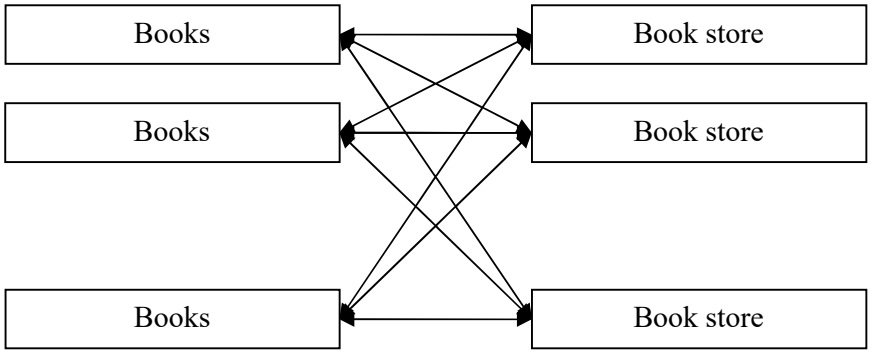
One to One Association: The one to on relationship is such that one entity has only one direct relationship. These relationships can be directly understood by understand the basic example of IDs. Say in a class, a student is given a roll number then there is only one student that has been uniquely assigned that roll numbers. No two students in that class can have the roll number as that is a means of identification of that student. Two students can have other similar attributes such as name or city of birth or the date of birth but cannot have the same roll numbers.



One to Many Association: In the one to Many Association on entity can have many relationships for example one department can have many students.



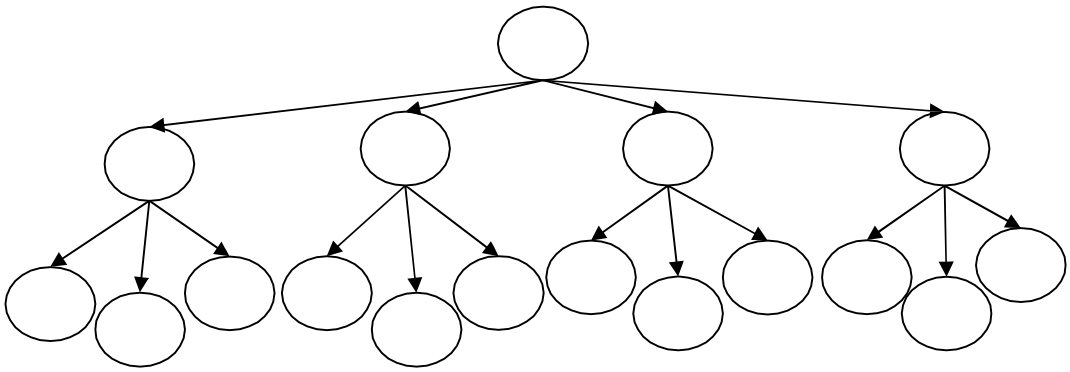
Many to Many Association: In such relationships multiple entities can have multiple relationships for example a book can be available in many bookstores and a bookstore can have many books.



DATABASE MODELS: On the basis of the relationship the entities and attributes hold with each other, the following types of types of database models can be there:

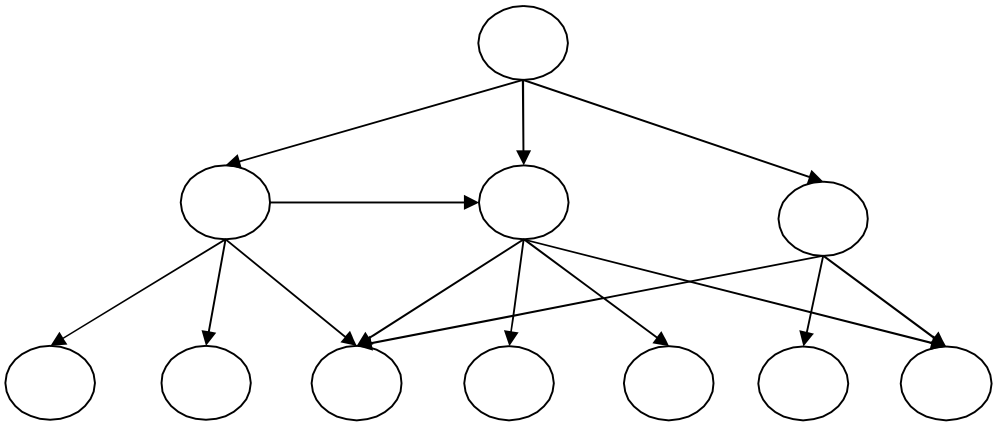
1. Hierarchical model
2. Network model
3. Relational model

Hierarchical model: As the name suggests the data in hierarchal structures follows hierarchies. The relationships that exist in the data are in the form of tree like structures. The records are dependent on each other and are present in a multi level structure. The top node of the tree is called a root and many branches may emerge from one root and being multilevel in nature, multiple sub branches may emerge from the braches and so on forming a complex and dense tree like structure. A parent and child relationship exists between the records related to one another. The highest level in the relationship is the parent and the records lower to it in the hierarchy are the children.



The relationships that exist here are all one to many. This model is simple and easy to design but does not represent many real life relationships that may exist between the records. It cannot represent many to one relationship and can also not represent data where one entity may be present at various levels in the organization.

Network model: As already discussed the hierarchical model does not allow complex relationships but simply expects that of data can be represented in one to many functions. The Network model allows more complex relationships such as many to many or many to 1 relationship. These relationships are stored in the form a linked structure as was the case with hierarchal model.



Relational model: The relational model was given by DR. E F Codd in 1970 and is based on the mathematical theories of sets and relations. Data in the relational model is stored in the form of two dimensional tables called relations. In this model every column denotes an attribute of the entity that the table stores the information about. Every row is a Tuple which denotes the entire data set about a single entity.

Primary key

EmpNO.	Name	Dob	Dept	Designation
1	Preet Kaur	25/12	HR	M
2	Ankit Singla	21/04	HR	M
3	Ruapli Goyal	12/05	OR	O

Tuple

Record

Attribute

The relational model is based on the Codd's 12 relational database rules. These rules are:

1. Information Rule
2. Rule of Guaranteed Access
3. Systematic treatment of Null Values
4. Database Description Rule
5. Comprehensive Data Sublanguage Rule
6. View Update Rule
7. Insert Rule
8. Physical independence Rule
9. Logical data independence Rule
10. Integrity independence Rule
11. Distribution Independence Rule
12. No Subversion Rule

6.4.2 MODEL BASE SUBSYSTEM

Managers face complex situations wherein it is necessary but extremely difficult to take rational decisions. Decision Support Systems help the decision makers in such situation and it is the model base subsystem of the DSS that helps the managers to do that. The problems are solved using the decision making models which analyze the problem on basis of the information available about it and decide the result on basis of scientific models present in field like operations research to get solutions.

A manager may face variety of problems which may vary with the type and kind of information available about the situation. On basis of this decision making can be done in three ways

1. Decision making under Certainty
2. Decision making under Risk
3. Decision making under Uncertainty

Decision making under certainty as the name suggests is when we have extensive knowledge about the situation at hand for which we have to take a decision. We know with certainty the various variables in the situation and the relationship that exists in them which would easily help us generate a specific model in order to reach the decision.

In this type of decision making the exact outcome of every alternative that the decision maker has is known beforehand. There is generally only one outcome for every alternative making it even more specific and the decision maker has to decide that which outcome or alternative is optimal for the situation. Various optimization techniques are used for that. The problems are generally maximization of minimization problems. Such problems are generally solved using the linear programming models extensively defined in operations research. As the variables and alternative are definite, definitive solutions for the problems can be reached easily.

Decision making under risk involves the presence of a level of probability that is associated with each outcome that can be reached. There is always a possibility of multiple outcomes for each alternative and for each outcome we do have a level of probability that can be attached to each of the alternatives and the outcomes associated with them. Here there is a trade-off between the expected outcome and the probability that that outcome. The decision maker id thought to be rational and decisions are made such that the decision maker considers both the expected output value and the associated probability. Models such as PERT (Project Evaluation and Review Technique) and CPM (Critical Path Method) are widely used in scheduling problems faced by the management.

Decision making under uncertainty is the case as the name suggests where there are multiple outcomes possible for the different outcomes that can be reached and even the probabilities are not known as was the case in the decision making under risk. As there is no knowledge of the probabilities therefore the criteria for optimization cannot be applied. In such situation concepts such as Game theory and the Minimax and Maximin operations are used depending upon the problem that the manager faces.

6.4.3 USER INTERFACE SUBSYSTEM

User Interface subsystem id one of the most important subsystems of the Decision Support Systems. This may often be ignored by the organization when the system is being developed but is of high importance because Decision Support systems are always supposed to be interactive systems with the ability to interact with the decision makers and directly respond to their queries. The users of the Decision Support Systems are generally managers in the organizations, they may or may not be from a background such that they can understand the intricate details of the software present in front of

them, therefore it becomes pivotal that a good user interface which can be easily understood by any user id provided with the system. The interface has to facilitate the interaction of the managers with the decision making models. It is the face of the Decision Support system and should be user friendly and easy to use. A UISS can have various types of interfaces i.e.:

1. Command based interface
2. Q&A type interface
3. Menu based interface
4. Icon based interface
5. Speech/Dialogue based interface

The type of interface to be implemented can be decided according to the type of users who have to use the software in the future.

6.5 ROLE AND APPLICATIONS OF DECISION SUPPORT SYSTEMS

Role of Decision Support Systems as has been extensively discussed in the chapter is facilitating the decision making in the organization given the present day business environment. This can be discussed in terms of area of applications in context to the types of decision support systems that exist and have been discussed in the chapter. The applicability of each of them is different and is situation based. Every organization resides and interacts with a different set of environmental factors making the application of Decision support Systems different for each of them. The role of the Decision Support systems remains the same in every context but how it is applied at practical level is different in every situation, scenario, and organization.

EXERCISE II (State whether true or false)

1. A DSS is typically divided into DBMSS, MBSS and UISS.
2. The Database Subsystems is hidden or abstracted from the end users of the organization
3. In Model base Subsystem the model chosen is static and cannot be changed.
4. Decision making can only be done under conditions such that all the alternatives and their attributes are distinctively known.
5. UISS stands for User interface Subsystem.

6.6 REVIEW QUESTIONS

1. What are Decision Support Systems and why did a need for them arise?
2. How are Decision Support Systems different from traditional information systems?
3. Discuss the characteristics of Decision Support Systems.
4. What are the various types of Decision Support Systems?
5. Write in detail about the various components of Decision Support Systems.

Answers to Exercise I

1. True
2. False
3. False
4. True
5. True

Answers to Exercise II

1. True
2. True
3. False
4. False
5. True

6.7 SUGGESTED READINGS

1. Sahil Raj : Management Information Systems
2. D. P. Goyal : Management Information Systems Managerial Perspectives
3. K. Laudon, J. Laudon : Management Information Systems Managing the Digital Firm
4. G.B. Davis, M.H. Olson : Management Information Systems
5. B. Ravindranath : Decision Support Systems and Data warehouses

CHAPTER 7: DESIGN METHODOLOGY & TECHNIQUES

STRUCTURE

7.0 OBJECTIVES

After reading thus chapter, the students must understand:

- System development as a life cycle approach
- The stages of System Development
- Various System Development Models

7.1 DEVELOPMENT OF MANAGEMENT INFORMATION SYSTEMS

Management Information Systems store and manage large volumes of data for organizations along with providing the support in key business functions, aiding decision making, helping in everyday operations, increase business functionalities and other such innumerable applications. This can clearly help us understand that Management Information Systems are

extremely complex systems or software with wide areas of application in the organizations. A lot of organizational resources such as time, money, efforts etc go in making of a Management Information System and when a system is built and is functioning, it is expected to function impeccably and according to the requirements of the organization producing results which are helpful to the organizations. Therefore we know that valuable resources go into making a Management Information System and that input id expected to produce some very specific results. Therefore the development of a Management Information System is done with utter caution and care in order to reach the results desired by the organizations.

Developing a Management Information System is a very complex task as it very large task to accomplish. A whole team of developers, system analysts, experts, representatives from the organizations engage in combined efforts for long period of time to develop Management Information systems. As it is a complex task which sometimes covers organization wide areas of application, therefore it has to be done in a very systematic, structured and organized fashion. Development of the system has to go through a variety of stages in a stepwise manner to reach the ultimate objectives. In this chapter and the chapters that follow we would discuss these stages in detail.

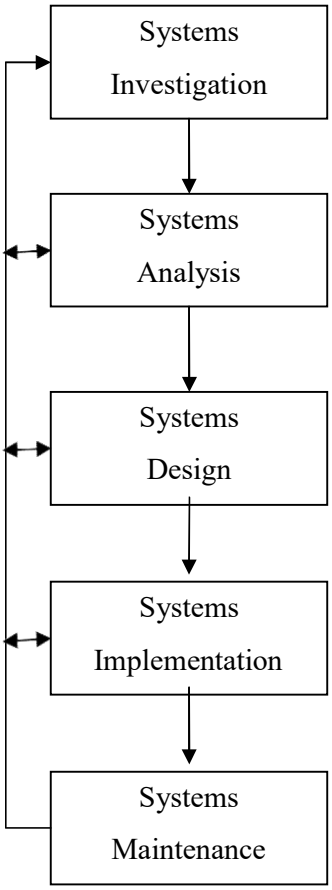
7.2 SYSTEM DEVELOPMENT LIFE CYCLE

System Development is a complex and humungous task; therefore in order to develop the system successfully the total development process goes through many smaller phases or stages such as planning, creating, testing, and deploying an information system. This is referred to as the System development Life cycle or SDLC.

SDLC is a process consisting of a series of planned activities to develop or alter any software products to be made for some organizations. The stages of System Development Life Cycle are:

- Systems Investigation
- Systems Analysis
- Systems Design
- Systems Implementation
- Systems Maintenance

It should be noted that all these stages are highly related and interdependent on each other. There is a great level of overlapping that exists as far as practical application is concerned. The developers and analysts many times go back and forward in the process in order to get the best results in view of constant review and monitoring that keeps on going when the process is going on. In order to understand them better let us discuss each of them in detail:



7.5.1 SYSTEMS INVESTIGATION

Do we have business opportunities? What are our business priorities? How can information technologies provide information system solutions that address our business priorities? These are the questions that have to be answered in the systems investigation stage— the first step in the systems development process according to O'Brien.

The Investigation stage is the first stage of the development process and it is a way to handling the users request for a new system or for changes, improvements or enhancements in an existing system. The objective of the stage is to determine if the requests made by the users are valid and feasible before proceeding on performing any implementation work to

change the existing systems or altogether build new ones. The investigation stage includes completion of two tasks i.e.

1. Objectives definition
2. Feasibility Studies

OBJECTIVES DEFINITION: this forms the starting point of the development process of the system. This helps in developing a direction to the whole process and increasing the clarity of the way to proceed toward the objectives. This task is sometimes neglected but it the first responsibility of the analysts to prepare a written statement of the objectives that the system wants to fulfill. It should be based on the descriptions of the various people belonging to different groups i.e. analysts, experts, functional area members, developers etc. Proper understanding of the definitions helps bring a sense of cohesion and direction ensuring that everyone involved understands the situation in the same way and is moving in the same direction.

FEASIBILTY STUDIES: Feasibility of the systems to be implemented and the objectives to be fulfilled is then to be checked. The team analyses the scenario from different aspects in order to reach the conclusion as to whether the system is viable to implement of not. It accesses alternate systems and proposes the most feasible and desired system for development. This study further provides an overview of the problem and acts as a checkpoint that should be completed before committing and resources to the system. Feasibility study is conducted in these major categories:

A. Organizational Feasibility: This takes the whole organization into consideration considering if the system that is proposed is actually trying to help the organizational objectives that it is supposed to fulfill. The system and the objectives it wants to accomplish should also match with the overall strategic plan of the organization; also the organization should be able to provide the resources and factor necessary for the system.
B. Economic Feasibility: This part of the feasibility study tries to study the economies of the project. The costs to be incurred and the returns that may come out of the project in the long term are clearly evaluated. Minute details such as the cost of conducting investigations, cost of hardware, software, cost of employee training etc. are considered. In addition to this all the benefits that can be sought such as the benefits of reduced costs, improved customer service, better resource utilization etc.

C. Technical Feasibility: As the name suggests, it looks at the technical viability of the system under consideration. Whether the hardware and software are capable of meeting the organizational needs and if the support needed in terms of hardware and software and the skills required for implementing that are available with the organization. What kind of technology is available with the organization and what kinds needs to be acquired and if something has to be acquired if the organization has the ability to of the resources and most importantly the time to acquire it.
D. Operational Feasibility: The operational feasibility checks the kind of support or reaction the system may face at the operational or functional levels. The ability of the management, employees, customers, suppliers etc to operate, use and support the proposed system, all this is considered in operational feasibility.
E. Legal Feasibility: if the system that is proposed adheres to the legal structure and framework of the land the organization resides in. It is very important to find out because later on the organization does not want any kinks related to legal restrictions changing the course of action that we wished to take.

Methods of preliminary investigation can be reviewing organization documents and conducting interviews.

7.5.2 SYSTEMS ANALYSIS

System analysis is the detailed study of the various levels of business activity that we wish to target and the boundaries that we wish to maintain while doing that. System analysis looks at where the present system and present working of the organization is and where and what we want for it in the future i.e. after the system is implemented in the organization. The objective of this phase is to determine exactly what needs to be done to achieve the set objectives. Generally the technical people involved in the process of developing the system tend to jump to the next phase of directly designing the system. It is temptation that the developers should try and avoid because analysis and its output is extremely important for the formation of an effective system.

System analysis involves a study of:

- The information needs of the users and the organization on the whole
- The activities, resources and the products involved.

- The results expected from the system in terms of the information needs of the organization

The product that arises from the system analysis phase is the document of system requirements which enlists and structurally documents the set of required system requirements of the proposed systems. It provides the analysts with the exact understanding of the design and the next step is to decide how the problem might be solved.

7.5.3 SYSTEMS DESIGN

The next phase that comes after the system analysis is the system design phase in which the 'how' of the implementation is discussed in comparisons to the 'what' in the analysis phase. The technical specification come into picture here and how the requirements that came into picture from the system analysis phase need to be implemented is designed here. The overall design of the system is divided into two parts:

- Conceptual design
- Detail design

More focus is given to the detail design phase because the conceptual design is more or less derived from the system analysis phase. This phase deals with the specificities of how the things would be done at practical level and the performances of the phases that come depend on this. The actually implementation of the system begins with the stage of coding and coding is entirely dependent upon the design which is prepared in this phase. Especially in very big projects in big organization, work cannot directly begin with programmers to begin coding what they feel are the requirements of the organizations are. They need to have fixed designs which each of them have to follow. This design or framework for the whole team is provided by the system design phase.

There are many tools and techniques that are used in the systems design phase such as the usage of structured charts, structure designs, usage of approaches such a s three schema approach, transactional approach, coupling and cohesion , the HIPO (Hierarchical Input Process Output) approach, NS charts or the Warnier Orr diagrams which may be followed. The choice of the tool or technique used directly depends on the requirements i.e. the kind of the system we wish to develop. These tools are not necessarily used in isolation, a combination of more than one can be used by the designers, or usage of different tools and

techniques for different parts of the same system can be done by the designers. Especially in larger systems as are developed for organizations usage of all tools and techniques at both systems analysis and systems design phases are done.

7.5.4 SYSTEMS IMPLEMENTATION

Implementation is a very wide term and engulfs many smaller stages and terms which happen after the design phase in system development. These stages can be those of

- Coding
- Testing
- Documentation
- Site preparation
- Training and installation
- Physical implementation

One the system requirements are clearly understood and a detailed and structured design is prepared for how the things need to be done, the process of the physical or actual creation of the system begins. This is done in the implementation phase. The required programs are coded and debugged by the programmers and the developers. This is entirely a technical work and developers who are experts of programming make this happen. Followed by the task of testing and debugging is the extremely important work of testing the system in test conditions created by the programmers. This is done to check the accuracy and reliability of the system. All these processes are directly made according to the system designs produced by the previous phase. Along with these processes a constant process of documentation keeps on going because e have to build a formal system with proper documentation in form of help guides and detailed reports.

The more core implementation is done in the form of tasks like site preparation before installation of the system into the organization. This may be done by checking the hardware and software present in the organizations and fulfilling the needs of the organization in hardware and software terms in accordance to the system to be implemented. Then the task of physical installation of the system developed is performed followed by the skill presence in the organization and filling up of the gaps of skills with the help of training and development programs once the system has been implemented us also done.

7.5.5 SYSTEMS MAINTENANCE

Once the system is implemented in the organizations we might get the idea that out work at the organization in terms of system development is complete but this is a huge misconception. The process of maintenance is a huge part of the whole process and cannot be neglected. It is a continuous and a long term process which the team has to do no matter what. These days when information systems are developed by third party vendors with the coloration with the organizations, the vendors have to provide lifetime maintenance services to the organization for that system.

System maintenance includes the processes such a monitoring, evaluation and in some cases modifications if required in the system to make any desirable or necessary changes in the system. Software developed always need to be maintained not just because they may need improvements or advancements in the future which have to be implemented but also because there are always some chances of residual errors or troubleshooting that may be required at all times which come into picture on prolonged usage or real-time practical usage of the systems. This is an on-going process and does not end on one specific day, it goes on and on till the system stabilizes for the task and the environment it was built for. The wear out of the software can be another reason that maintenance is required.

EXERCISE I (State whether true or false)

1. Development of an Information system is an extremely complex task and should be done in an extremely structured manner.
2. The system development process starts from designing the system.
3. The feasibility of the system is check in order to see its viability before committing and resources.
4. System implementation refers to the physical installation of the software in to the organization.
5. System maintenance is a long term process often going on for the lifetime of the product.

7.3 SOFTWARE DEVELOPMENT MODELS

Development of software or as we say a system for the organizations is a enormous task and is carried out in specified tasks in order to get the desired results. These steps or phases have

been discussed in the preceding parts of the chapter and will be discussed in much greater detail in the coming chapters. The goal of the system development process is to produce a high quality end product. Therefore an understanding of the models as to which one would suit the system that we are trying to develop is very important. The following are the most popularly used software or system development model. Let us discuss each one in detail:

7.3.1 WATERFALL MODEL

According to the waterfall model, the development of information systems follows a waterfall like pattern. This model presents stepwise falling water like structure. Waterfall model was developed in the 1970s. The stages according to model are:

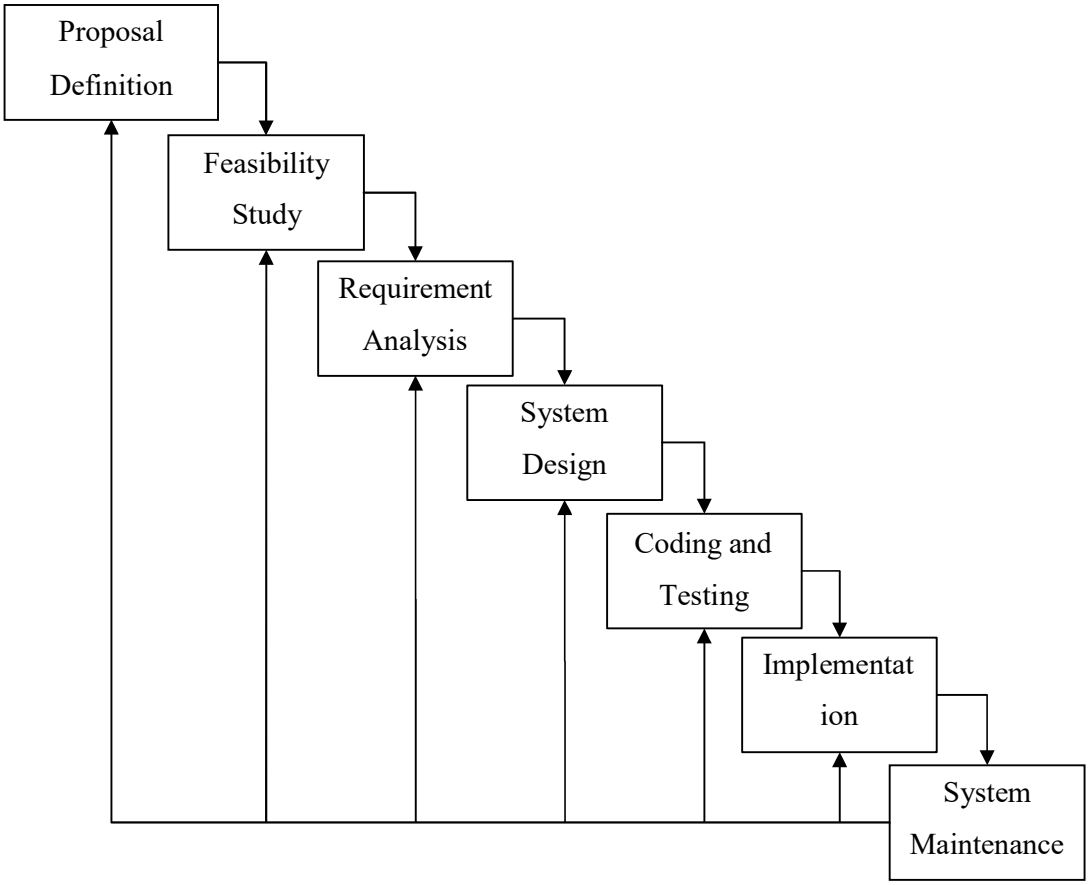
- Proposal Definition
- Feasibility Study
- Requirement Analysis
- System Design
- Coding and Testing
- Implementation
- System Maintenance

The model states that these stages are organized in a linear fashion. This model says that output of one stage becomes the input of the next stage. The stages are very similar to the system development life cycle and are defined in similar terms. The system is said to operate as a living organism i.e. it takes birth, grows and becomes adolescent and then matures to ultimately grow old and then die. Waterfall model is one of the most widely discussed models and is said to be based on the System Development Life Cycle. It is said that it just gives a dependence relationship between the stages of the system development life cycle.

Limitations of waterfall model:

1. In the waterfall model, every phase is considered as distinct phase which happens in isolation from the others which is not the case in practical implementation of the model. In the real world these stages are extremely overlapping and the developers keep on going back and forward while making decisions for the organization and on the basis of feedback.

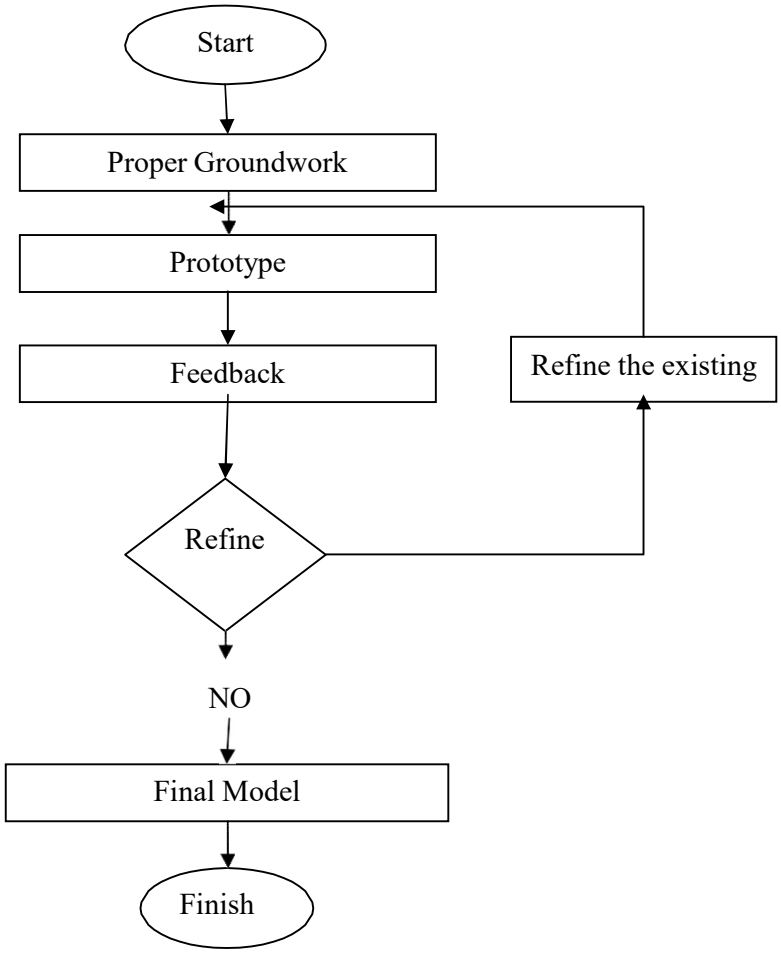
2. The model proposes that the next stage in the model relies on the output from the previous phase which may not be the case in reality. The analysts may work in order to enhance the system in steps in a progressive manner.



7.3.2 PROTOTYPING MODEL

In this model a prototype for the system is developed instead of building the whole system for the user at once. The prototype so made is evaluated and reviewed by the team members. Opinions and reviews are sought on each and every aspect of the model so built and on basis of the opinions and suggestions the prototype that was earlier built is improved. An initial prototype is not that comprehensive in nature and does not necessarily have all the functionalities desired by the user. This model is more of an evolutionary model of system development that is built as it goes and is improved over a period of review and change. This is generally done in the systems where it is difficult to easily list the requirements or in case that they are likely to change in a short span of time. The first prototype is generally provided and made in order to start the development and also aids the users to actually understand their

requirements. On the basis of the reviews and feedback provided by the user the required changes are brought by the developers in order to actually develop the model.



The following steps are followed in this model:

- Groundwork: The analysis of needs and requirements in the form of outputs required from the system. The information analyst on the basis of user expectations prepares the information in a comparatively shorter span of time. It is similar to the information gathering and the feasibility analysis phases in the other models only that because the prototype model is made in the cases where the requirements are not easily determined therefore a more exploratory approach is undertaken.
- Development of model: After gathering the relevant information, the analyst makes the initial prototype. This prototype so built has limited functionality and is not necessarily fulfils all the requirements of clients. The prototype is build such that it is

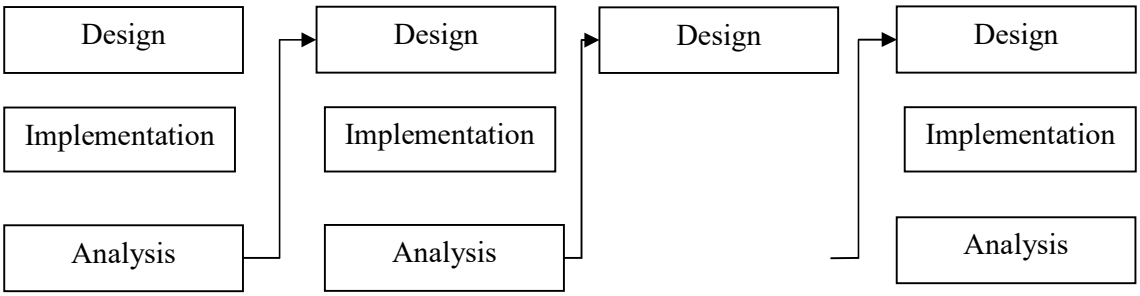
provides a basic structure which can be enhanced in the coming models. It should be built in minimum possible time. In building a prototype the most important consideration is that of efficiency and speed rather than of the detail with which it is built.

- Guidance and Feedback: Once the system is developed it is provided to the user or the client who is supposed to be using the system in the future. The user gets hands on approach on the system and tries and understands the further refinements or improvements which need to be made to the system.
- Refinement: In this stage, based on the changes and improvements which were suggested by the clients are incorporated into the design and the system is refined to meet those requirements. This stage may be keep on going with the client checking the prototypes and the developers making the required making the changes in the functionality of the system.

Prototyping approach is not generally used by small organizations because it is not that cost effective but is used by the organization where cost is not a big issue but the task or identification of requirements can prove to be a rather complex issue. The prototype model helps generating of new ideas as compared to normal designing process and is rather successful in businesses which require regular updates or enhancements. The only criticism this model faces is that of the usage of resources such as time effort and money that need to be incurred on the system. At least two iterations of the process of feedback and refinements are required therefore the costs incurred are high.

7.3.3 ITERATIVE MODEL

The iterative enhancement model, as the name suggests the development of the system develops over a number of enhancements spanned over the iterations of the model. Every increment or the enhancement adds a new functionality to the system.



Modifications that can be required can be made at each and every step of the iterations. The overall problem statement of the development of the present system is never used; generally a subset of all these things may be used. The selected subset though must have the core functionalities of the system so that there can be an agreement on what is most commonly required. This model is understood in form of three steps as shown in the given diagram. The three phases are Analysis, Implementation and Design. The testing portion of the whole process of development is easily and instinctively done in these types of models. The testing is considered to be better because it is done at incremental level and that is always easier than testing the entire system together, as in the waterfall model of how the system development life cycle defines it. This model is further considered a better model than many other s because it combines the best features of both prototyping and the waterfall model which are both individually applicable in different scenarios.

The model however also faces from critics in some aspects. It is not a model which gives the complete system as a there is a possibility that some parts the system could have forced on; also as was the case with the prototyping model there is a modify it again approach and they can prove to be cost effective and time consuming.

7.3.4 SPIRAL MODEL

The spiral model was given by Boehm and is one of the recent models of development this model denotes that all the activities in the system. The spiral model combines the idea of iterative development with the systematic, controlled aspects of the waterfall model.

Spiral model is a combination of iterative development process model and sequential linear development model i.e. waterfall model with very high emphasis on risk analysis. It allows for incremental releases of the product, or incremental refinement using every iteration around the spiral. The spiral model has four phases. A software project repeatedly passes through these phases in iterations called Spirals.

Identification: This phase starts with gathering the business requirements in the baseline spiral. In the subsequent spirals as the product matures, identification of system requirements, subsystem requirements and unit requirements are all done in this phase.

This also includes understanding the system requirements by continuous communication between the customer and the system analyst. At the end of the spiral the product is deployed in the identified market.

Design: Design phase starts with the conceptual design in the baseline spiral and involves architectural design, logical design of modules, physical product design and final design in the subsequent spirals.

Construct or Build**:** Construct phase refers to production of the actual software product at every spiral. In the baseline spiral when the product is just thought of and the design is being developed a POC (Proof of Concept) is developed in this phase to get customer feedback.

Then in the subsequent spirals with higher clarity on requirements and design details a working model of the software called build is produced with a version number. These builds are sent to customer for feedback.

Evaluation and Risk Analysis: Risk Analysis includes identifying, estimating, and monitoring technical feasibility and management risks, such as schedule slippage and cost overrun. After testing the build, at the end of first iteration, the customer evaluates the software and provides feedback.

7.3.5 V MODEL

The V - model is SDLC model where execution of processes happens in a sequential manner in V-shape. It is also known as Verification and Validation model. V - Model is an extension of the waterfall model and is based on association of a testing phase for each corresponding development stage. This means that for every single phase in the development cycle there is a directly associated testing phase. This is a highly disciplined model and next phase starts only after completion of the previous phase.

V- MODELDESIGN: Under V-Model, the corresponding testing phase of the development phase is planned in parallel. So there are Verification phases on one side of the .V. and Validation phases on the other side. Coding phase joins the two sides of the V-Model.

The below figure illustrates the different phases in V-Model of SDLC.

VERIFICATIONPHASES

Following are the Verification phases in V-Model:

- Business Requirement Analysis: This is the first phase in the development cycle where the product requirements are understood from the customer perspective. This phase involves detailed communication with the customer to understand his expectations and exact requirement. This is a very important activity and need to be managed well, as most of the customers are not sure about what exactly they need. The acceptance test design planning is done at this stage as business requirements can be used as an input for acceptance testing.

- System Design: Once you have the clear and detailed product requirements, it's time to design the complete system. System design would comprise of understanding and detailing the complete hardware and communication setup for the product under development. System test plan is developed based on the system design. Doing this at an earlier stage leaves more time for actual test execution later.

- Architectural Design**:** Architectural specifications are understood and designed in this phase. Usually more than one technical approach is proposed and based on the technical and financial feasibility the final decision is taken. System design is broken down further into modules taking up different functionality. This is also referred to as High Level Design (HLD).

  The data transfer and communication between the internal modules and with the outside world (other systems) is clearly understood and defined in this stage. With this information, integration tests can be designed and documented during this stage.

- Module Design: In this phase the detailed internal design for all the system modules is specified, referred to as Low Level Design (LLD). It is important that the design is compatible with the other modules in the system architecture and the other external systems. Unit tests are an essential part of any development process and helps eliminate the maximum faults and errors at a very early stage. Unit tests can be designed at this stage based on the internal module designs.

CODINGPHASE

The actual coding of the system modules designed in the design phase is taken up in the Coding phase. The best suitable programming language is decided based on the system and architectural requirements. The coding is performed based on the coding guidelines and

standards. The code goes through numerous code reviews and is optimized for best performance before the final build is checked into the repository.

VALIDATIONPHASES

Following are the Validation phases in V-Model:

- Unit Testing: Unit tests designed in the module design phase are executed on the code during this validation phase. Unit testing is the testing at code level and helps eliminate bugs at an early stage, though all defects cannot be uncovered by unit testing.

- Integration Testing: Integration testing is associated with the architectural design phase. Integration tests are performed to test the coexistence and communication of the internal modules within the system.

- System Testing: System testing is directly associated with the System design phase. System tests check the entire system functionality and the communication of the system under development with external systems. Most of the software and hardware compatibility issues can be uncovered during system test execution.

- Acceptance Testing: Acceptance testing is associated with the business requirement analysis phase and involves testing the product in user environment. Acceptance tests uncover the compatibility issues with the other systems available in the user environment. It also discovers the non functional issues such as load and performance defects in the actual user environment.

The advantage of V-Model is that it is very easy to understand and apply. The simplicity of this model also makes it easier to manage. The disadvantage is that the model is not flexible to changes and just in case there is a requirement change, which is very common in today's dynamic world, it becomes very expensive to make the change.

EXERCISE II (State whether true or false)

1. The waterfall model compartmentalizes the various stages or phases involved in the process.
2. The iterative and prototype models are used interchangeably.
3. Spiral model is considerate to have the properties of both the waterfall model.

4. Iterative model explores the new things and ideas
5. The usage of the model has nothing to do with where the model is to be implemented.

Answers to Exercise I

1. True
2. False
3. True
4. False
5. True

Answers to Exercise II

1. True
2. False
3. True
4. True
5. False

7.4 REVIEW QUESTIONS

1. What are the various stages of System Development Life cycle?
2. Discuss the systems analysis and Systems design in the development of the organizational.
3. Explain the waterfall model in detail.
4. What is the difference between iterative and prototype models?
5. Explain the v model of systems development in detail.

7.5 SUGGESTED READINGS

1. Sahil Raj : Management Information Systems
2. D. P. Goyal : Management Information Systems Managerial Perspectives
3. O'Brien : Introduction to Information Systems
4. K. Laudon, J. Laudon : Management Information Systems Managing the Digital Firm
5. G.B. Davis, M.H. Olson : Management Information Systems

CHAPTER 8: SYSTEM ANALYSIS

STRUCTURE

8.0 OBJECTIVES

After reading this chapter, the students must understand:

- Concepts of System Analysis phase
- System Requirement Specifications
- Data Flow Diagrams
- Structured English
- Decision tables

8.1 INTRODUCTION

System analysis is the phase of collecting the information, interpreting facts, and identifying problems about the system presently working in the organization and what the system that needs to be developed. It is more like an investigation of the system in the organization and exploration of the current processes in the organization. It studies the present flow of information in the organization in order to get a better understanding of what has to be developed in the future.

An organization always has an information system or some information channels running for the system for which we are proposing the information systems. It is not necessary that these systems must be automated systems or management information systems. These may be the manual systems in the organization or simply the processes for the flow of information in the formal or informal channels in the organization, in case the system we propose is going to work for an entirely new purpose which has in no way been implemented in the organization, even then we have a basic framework or what has to be done from organizational point of view and that how information flow will take place. Generally when existing systems are not giving appropriate results, the need to upgrade the system arises. In such a case it is imperative that the analysts study the existing system in detail and find out all the imperfections and work around the existing system to understand how the new changes can be incorporated in the system. So the analysis phase helps the analysts to accurately define the present system and the problems making the work easier for the next phase i.e. accurately designing the information system.

It should be noted that though the new system or the software has to be developed by the programmers or the developers, and the majority work is done by the system analysts but the management and the organization for which the system is being built has to be actively involved in the processes especially in the system analysis and design phases. The managers play a vital role in explaining the needs goals objectives mission vision of the organization because it is keeping these in mind that the new system has to be made. The analysts and programmers are not aiming to build a system just with the objective of automating the system but the underlying intention is always for providing a solution to a problem or to improve the systems and all the decisions and processes should have active involvement of the organization in them.

This phase basically helps the analyst prepare a logical model of the whole system. This is done with a detailed study of the business processes along with the help of the managers various tools such as data flow diagrams, data dictionary, decision chats etc. are used in order to make that. The final product of the phase is a set of system requirements which are documented in the System Requirement Specification Document.

8.2 SOFTWARE REQUIREMENTS SPECIFICATIONS

The System Requirement Specification Document is a formal document which is considered the end product of the Systems Analysis phase. It is considered the most important and the

most difficult phase of the development process, important because the designing of the whole system and then its implementation is all dependent on the system requirements generated by the analysts and it is considered difficult and error prone because the process has to be such that a perfect collaboration between the analysts and the managers has to be present for this step to be executed properly. There always exists some communication gap between the managers and the analysts. This may be due to the differences in the backgrounds of the people involved in the process, the users or the mangers generally do not understand the software development processes and the analysts may not be that aware of the business processes in the organization so the tuning between the two worlds can be difficult to achieve.

The System Requirement Specification Document should extensively discuss the:

- System Requirements
- Functional Requirements
- Technical Requirements

System requirements refer to the overall organizational requirements. The final objectives of the organization for building the new system should always be kept in mind. The vision and mission of the company, the strategies they wish to implement are of main importance and the system has to be implemented them, therefore the analysts have to look into the details but always keeping the overall bigger picture in mind.

Functional are a sub-set of the overall system requirements. These requirements are used to consider things like system behavior, redundancy and human aspects. Trade-offs may be there between hardware and software issues, benefits coming from the each of them, the costs associated. As well as describing how the system will operate under normal operation should also consider the consequences and response due to software failure or invalid inputs to the system etc.

Technical requirements specifically refer to the support needed in order to make the system operation. This can include the decided hardware and software requirements of the system. The skills that the employee s need to posses, whether they already have the skills or will they have to be trained for the same.

Also the analysts have to keep in mind the information system would be used at different levels and by different types of people and that needs of each one of them have to be kept in

mind while designing the system. It is imperative for the analysts to acknowledge these categories because depending upon the type of stake holders the requirements of the system are bound to change. The stakeholders of the information system can be:

- The Users
- The Clients
- The Technical Staff

The users are the end users whose functional requirements the system is going to address, the client is the one for which the system is being built i.e. the people who have funded the development of the system and the technical staff may be the in house operators or the developers who may have to maintain the system in the long run.

A good System Requirement Specification Document should provide the following benefits:

1. It should bridge the gaps in communication between the user and the developers of the system by acting as a basis of agreement between the two parties.
2. It removes the errors and misunderstanding in the early stages of development because consultation between the developers and mangers for the organization.
3. It also acts as a benchmark for the future processes; act as a reference for validation of the final product that would be developed in the future.

Requirement determination is to learn and collect the information about:

- The basic processes
- Data which is used or produced during the processes
- Various constraints in terms of the time and the volume of work
- Performance controls used in the system

UNDERSTANDING THE BASIC PROCESSS: Understanding the processes is the basis of systems analysis phase. Process understanding can be acquired if the information regarding the following aspects id collected:

- Purpose of the business activity
- The steps in the activity which and where they are performed
- The people involved in performing them
- The frequency time and users of the resultant information.

IDENTIFYING DATA USED AND INFORMATION GENERATED: Apart from understanding what processes are the analysts should what the processes are for. The information that is generated from the processes and what data is required to generate that information is of prime importance because it is ultimate the information generation that is the objective of the information systems. The decision making in the organizations would depend on the information systems therefore a good knowledge about the basis of that decision making is required.

DETERMINING FREQUENCY TIMMING AND VOLUME: The information about the details of the information as to how often does activity is repeated and the volume of items to be handled. The timing frequency and volume of activities are important facts to collect.

KNOWING THE PERFORMANCE CONTROLS: The performance controls or the metrics are the centre point of development of the new system and the system has to incorporate these or rather we should say focus on them.

8.3 STRATEGIES FOR REQUIREMENT DETERMINATION

There can be number of ways of collection of information about the system requirements. These strategies are discussed in detail below:

1. INTERVIEW: The interview method is a form of face to face conversation used for collecting first hand information. The interviews conducted can be structured or unstructured or informal in nature. The people interviewed are generally the existing users of the system or the users of the proposed system. Although one of the first choices for collection of data is interview method but the time resources required for that are huge and sometimes it is not possible for the users to explain the systems in detail.

   Interviewing is considered an art and the quality of the information collected is always influenced by the interviewer taking the interviews. So if the task is to be undertaken the analyst should be trained in the art of interviewing because if the communication is not proper between the users and the analysts then the requirements could be wrongly recorded.
2. Questionnaire: In the Questionnaire method individual responses are stored using a set of statements of questions which the respondents need to answer. Questionnaires allow information to be collected from a large number of respondents. It may contain

open ended questions or close ended questions to be answered by the respondents. The questionnaires should be designed such that they extract maximum information from the respondents. For designing such a questionnaire it is necessary that the analyst has proper information about the organization and the system t6o be developed. The concerned manager also has to coordinate effectively to enable that.

3. Observation: Another method of information gathering is by observation. The process of recognizing recording and generating information from the various occurrences, activities people and processes in the organization at work. The analyst actually observes the processes taking place, the documents being handled etc. As an observer the analysts follows a set of rules. As an observer he is most likely to silently listen than participate actively. The exercise can be extremely time consuming and lengthy and there is even a possibility that due to the passivity the analysts may not be able to extract the information that he wishes to get from the system. Therefore it depends on the judgment of the analysts as to in which situations this method can be used.
4. Record Review: Review of the documentation present in the organization is done. It generally stresses on quantitative aspects such as ratios trends percentages frequencies etc. already existing documentation such as manuals, forms, operating procedures etc. the information that has been already recorded about the system and its users is studied by the analysts. Records /documents may include the standard operating procedures used by the organization as a guide for the managers and the analysts. The one problem that rises from this method is that the documentation present with the organization may not be up to date or complete or in some case may not be present at all.

All these methods have their own pros and cons and it is the situation which guides their usage. The analysts generally use their judgment and use all these methods at different time as and when they may be required.

EXERCISE I (State whether true or false)

1. The information generated in System Analysis forms the basis for System Design Phase.
2. System Analysis tries to get more information about the present system in order to make out the requirements for the proposed system.

3. The Analysis of the organization should always be done only on the point of view of the end users.
4. Observation of the business processes cannot help the analyst understand the requirements of the system.
5. The final product from the system Analysis stage is the SRS document.

8.4 STRUCTURED ANALYSIS TOOLS

The aim of the system analysis is to generate a framework of what has to be designed by the developers. This has to be done with the close coordination between the analysts and the managers because ultimately the software has to be used to fulfill the organizational needs. The managers generally cross check the systems requirements as defined by the analysts so that they can be as close to the reality as possible. Therefore the feedback from the managers is of prime importance. As managers necessarily are not from technical backgrounds, therefore the analysis phase is strictly conceptual in nature and only the logical framework of the situation is build. It is for the same reason that various tools are used to present the data in such a way that they can be used to represent data in the form that they are easily understandable by the non technical managers from the organizations. No technical jargons are used and the business processes and the needs of the system are depicted in a manner that everyone can understand them easily. Also time is a constraint, building a software takes a long process and a lot of effort is incurred on it. The tools used help in this aspect also. Usage of this tools enable faster comprehension of the entire situation, by just looking at the representation the meaning is directly conveyed.

Structured Analysis tools also help the system analysts to document the system which comes in handy in the stages next to come in the system development process.

8.4.1 DATA FLOW DIAGRAM

Data Flow diagram is a graphical representation of the logical flow of data. It helps in expressing the system's requirements in a simple and easily understandable form. Data Flow Diagram is one of the most widely used tools for depicting the flow of information across the various processes in an organization.

The aim of the data flow diagram is to specify clearly all the system requirements and to identify and report the major transformations happening in the organization which

will eventually turn into programs when the designs are actually implemented and takes its practical form. Data Flow Diagrams are also known as bubble chats as they contain a series of bubbles joined together showing relationships between them and showing the data flow in the system.

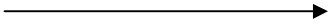
Data Flow Diagrams decompose the activities to smallest possible level thus defining each and every aspect of organization in minute operational details making it easier for the design phase of development. The requirement specifications are broken down to lowest level of detail and decomposed to basics.

Data Flow diagrams as the name indicates are graphical in nature and use symbols for representation of the various components which constitute the information system. These constituents are represented using the following symbols:

a. Square
b. Arrow
c. Circle/ Bubble
d. Open rectangle

The **Square** of the rectangle represents the source of destination of the system data. Generally the starting point of the data is the source and the destination is the final stage of the data.

The **Arrow** indicates the flow of the data in the system i.e. its direction. The arrow shows the direction to and from which the data is flowing in the system. It can be seen as a pipeline through which the data is flowing.



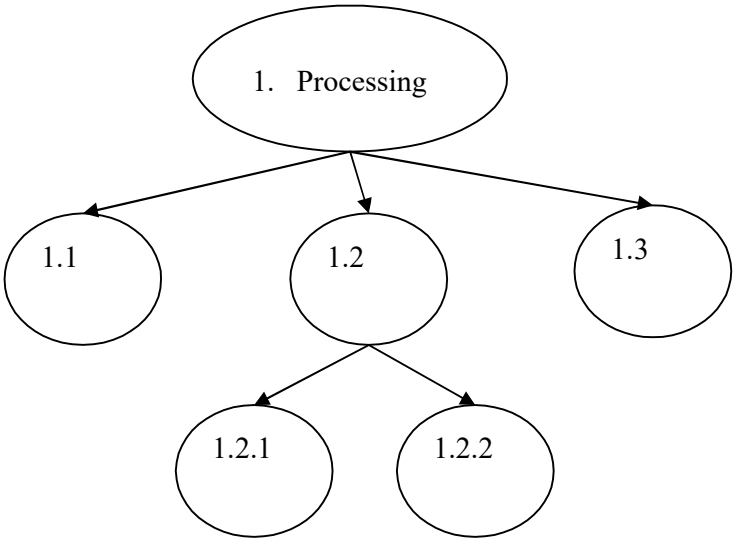
The **Circle/ Bubble** shows a process that transform the incoming data flow into the outgoing data. A process can be shown as an ellipse or a circle. The process converts data into information and it is the product of these processes that is used by the managers in the organization for decision making purposes.

An **open rectangle** is used to represent the data storage in any system. Data storage may represent the physical storage spaces or devises used in the organizations.

With the help of these four symbols Data Flow Diagrams show the whole process of transformation of the organizational data into information. Making a Data Flow Diagram a non a technical task and just the knowledge of these symbols and some very basic rules needs to be observed.

There are a number of rules which have to be followed while making a DFD (Data Flow Diagram). These rules are:

a. Processes should always be named and numbered and the names used should be relative and representative of the process that is actually happening.
b. The direction of flow should always be either from top to bottom or from left to right.
c. When a process is to be further deconstructed and broken down into smaller levels, they must always be numbered properly. For example it the process that has to be broken into sub processes has been numbered 2 then the sub processes should be sub numbered 2.1, 2.2, 2.3 and so on.



d. The names of the data stores, sources and destinations should be written in capitals; also the data flows and processes need to have first words capitalized.

It should be noted that Data Flow Diagrams are made so that the data can be easily understood; therefore Data Flow Diagrams generally do not have more than 8 – 12 processes involved. Even a Data Flow Diagram with 12 processes would be considered a very difficult Data Flow Diagram and would be difficult to understand. Data Flow Diagrams prove to be extremely useful where the required design is not easily available and analysts require some symbolic representation for communication.

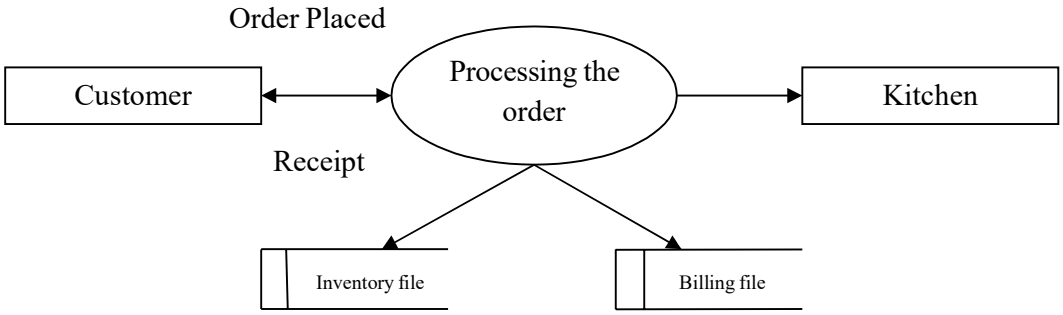
Building a Data Flow Diagram generally requires a top down approach; we generally start by making a macro level Data Flow Diagram and then explore further and add details to reach the micro level Data Flow Diagrams.

The only disadvantage of Data Flow Diagrams is that a lot of iterations are required in order to reach the required result. The level of detail wanted by the Data Flow Diagrams is quite minute and it requires a considerable amount of time and effort to achieve that.

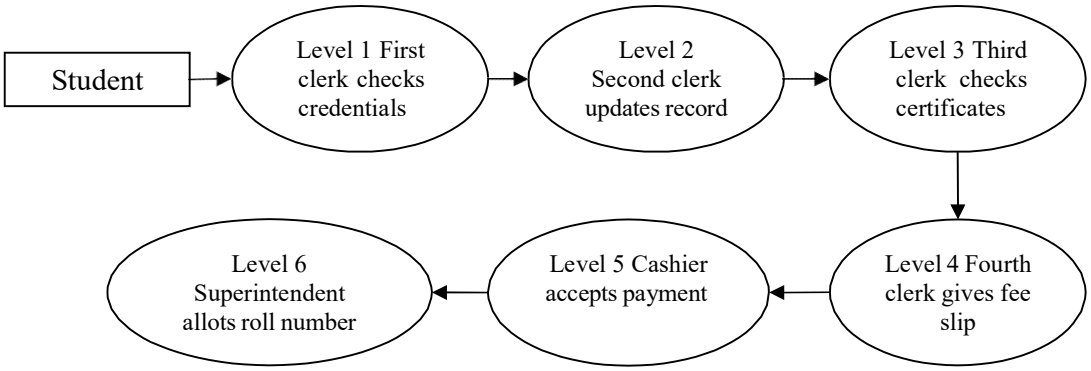
TYPES OF DTA FLOW DIAGRAMS: Data Flow Diagrams can be of two types:

a. Logical Data Flow Diagrams
b. Physical Data Flow Diagrams

Logical Data Flow Diagrams show the flow of data in the organization i.e. the logical framework of the processes in the organization. It shows that which activity generates from which activity; which data is used by it and which information is generated from it. The Logical Data Flow Diagrams however does not depict who is performing the task and actually how it is happening in the organization.



Physical Data Flow Diagrams on the other hand are made such that they depict where the processing is being done and at which physical level data is stored. For example the figure below shows the seat allocation in a university. The diagram not only indicates the task but also who is performing that particular task. As in the diagram the clerk is checking the credentials at the level one and at level 2 a clerk is updating the records and so on.



It should be noted that a Physical Data Flow Diagram is far more informative than a Logical Data Flow Diagram.

8.4.2 DATA DICTIONARY

Data Dictionary is storage of the data about data. It can be seen as an electronic storage of items which constitutes complete information about the data present with the organization. It is a precise and accurate account of all the data constituents, data elements or data structures that exist in the system. It describes in detail each and every data constituent defined in the system analysis or the system design phase. Data dictionary also defines the set of Data Flow Diagrams use in modeling or any other tools which have been used.

A data dictionary is an important point of view that it describes the kind or data we have. For any organization or for that matter any information is built on the foundation of data it has, therefore it is important to describe the data in detail so that it can be used judiciously. Even when systems need to be upgraded the data dictionary can help us get through the process easily for proper designing of any system a systematic and usable data dictionary is required for future references. It supports documentation in a better

way and improves the communication between the user and the analysts. It defines each and every data element, process or procedures occurring in the data stores. It even helps in maintaining uniformity in the data and usage of data as it serves as a common ground for the programmers to refer to while developing the system.

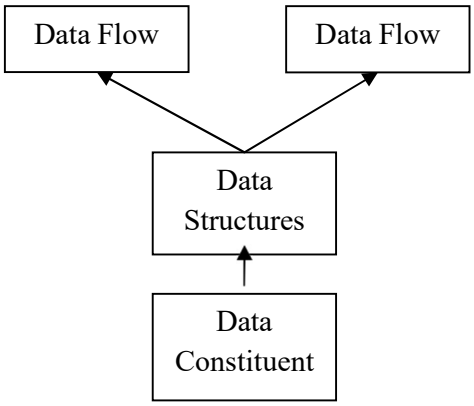
The three main divisions that can be made in data items present in the data dictionary are:

a. Data Constituents
b. Data Structures
c. Data Flow and Data Stores

Data Constituent or a Data Element is the smallest form of data present which cannot be further broken down. For example price of a product, item code, employee id etc.

Data Structures refer to a set of interrelated data elements. When some data constituents are related to one another such that they act as a unit o the whole it is known as a data structure.

Data Flow or Data Stores: Data structures in motion are known as data floes and when they are at rest they are known as data stores.



Data dictionary contains all the information about all the three categories of data. Data Dictionary plays a very important role while the actual designing of coding of the system is taking place. It is especially relevant in the formation of database for the system because it clearly defines the interrelations in between the various data elements in the system.

The following rules are kept in mind while designing a data dictionary:

a. The terms used are directive of the data stored and are used in capital letters,
b. Multiple word names are hyphenated
c. Assigned names should be straight forward and user oriented
d. Every data flow data store data structure or data element should be named.
e. Consistency checks should be performed.
f. Identification numbers should be given and clearly defined in the data dictionary
g. Aliases should be discouraged.
h. Standardization of name formats should be done.

There are various symbols which are used in the data dictionary. These symbols and their meanings are:

=	is equivalent to
+	add
()	optional entry
[Option 1 Option 2 Option 3 Option n]	only one of the options is used at a time

A Data Dictionary for a student file may be as follows

Student Detail = First Name + Last Name + (Middle Name) + (Contact)

8.4.3 STRUCTURED ENGLISH

Structured English is another method of depicting the information flows in the organization. It uses the English language or we can say some standard phrases which help depict the flow of information. These phrases or words can be:

IF

THEN

ELSE

SO

ELSE IF etc.

It is not graphical is nature nor does it use any specific standard symbols to denote any data flows, the information is based on statements which are made using the standard phrases and the data that has to be treated.

The classic example of Structured English can be understood by the grading example. Suppose a student has scored a percentage and a grade A, B or C has to be allotted on the basis of the percentage scored by the student then the following construct of Structured English can be used to depict it.

IF (percentage is above 70)
THEN grade A
ELSE IF (percentage is above 60) AND (percentage is below 70)
THEN grade B
ELSE IF (percentage is above 50) AND (percentage is below 60)
THEN grade C
ELSE (percentage is below 50)
So fail

It is nothing but a logical construction of imperative statements designed to carry out certain actions. Decisions are made on basis of these and are represented using the fixed phrases. Structured English can be quite compact but should be comprehensive enough to convey the right message.

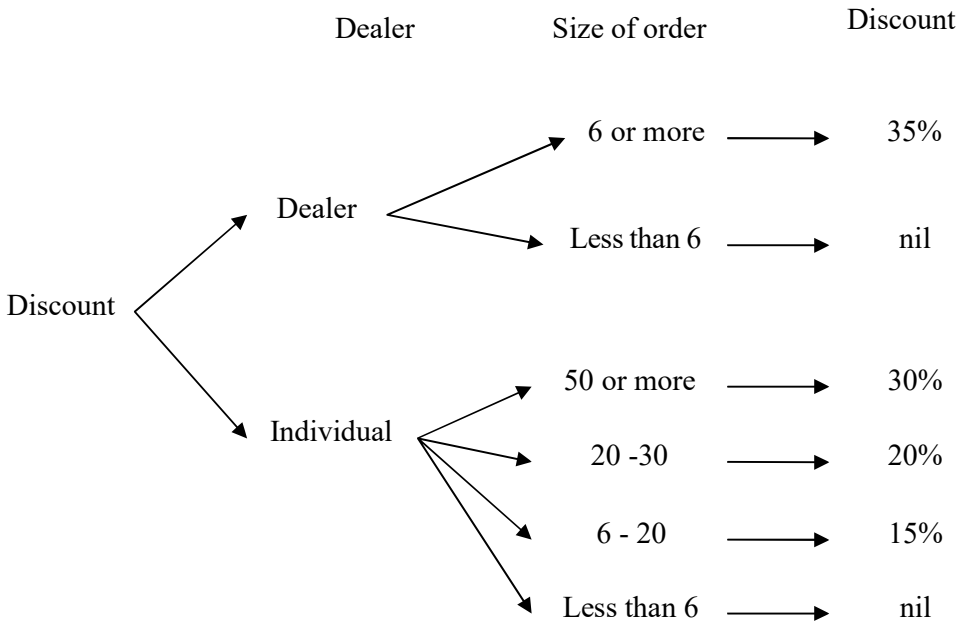
8.4.4 DECISION TREES

Decision trees as the name suggests follows a logical flow to reach a decision. They can be seen as a graphical representation of the Structured English in many ways. The logic of the data flows may not be clearly seen through Data Dictionary but can be easily seen in a Decision tree. The basic essence of a decision can be shown by a decision tree in an extremely easy and readable manner. Data flow diagrams require basic knowledge of the symbols used but in decision tree, no such knowledge is required and it is just a graphical representation of the logic that goes behind taking a decision. It is said to be easily understandable because no technical signs or symbols are used and therefore it is extremely convenient for the non technical managers involved in the making and development of the system.

It is referred to as a tree because graphically the branches of the representation make it look like the branches of a tree. A decision may have many alternatives which can be

chosen and they constitute the branches of the tree. It is extremely easy to read just by looking at it and also can be easily update and construct.

The following example discusses the discount policy of seller and that how the percentage of discount to be given is decided.



Decision trees can be used to verify the logic in problems which involve complex decision. The resultant may be limited number of actions but the biggest limitation a decision tree faces is the lack of information that it provides due to its structure.

8.4.5 DECISION TABLES

Decision tables are a form a charts which indicate a set of conditions and the subsequent actions which can be taken. The set of conditions and the actions which will be taken when a particular set of conditions will be fulfilled is represented in the decision tables. Decision tables are in the form of matrices of rows and columns representing the conditions and actions respectively. The decision conditions are represented in such a way that an action set is invoked when a certain number of conditions are found to be true.

Decision table are generally used when the decision makers are dealing with conditions which include complex branching etc for example certain problems in inventory control.

A Decision table consists of four sections:

a. Condition Checklist
b. Action Checklist
c. Condition Entry
d. Action Entry

Conditions Checklist	Condition entry
Action Checklist	Action Entry

Condition checklist depicts all the conditions that the process has to fulfill so that the subsequent actions can be initiated. All the conditions are written in an order on the left side of the table; the corresponding box is of the **condition entry** and depicts the response to the particular condition.

It is written in as Y or N which means a YES or NO.

The next part of the table is the **action checklist** which indicates the action which would be taken on fulfilling these conditions.

The **action entry** is the fourth part which indicates whether the action has been taken or not.

The action entry is written in the form or X or. X indicates that an action has been taken and . indicates no action

A decision table shows various possibilities which are possible when a set of conditions exist. The numbers of possibilities that arise are an exponential of 2 to the power of n where n is the number of conditions that exist.

The following rules have to be followed while making a decision table:

a. A decision table has to be given a name to be written on the top left of the table
b. The logic of the decision at hand should be independent from the order in which the conditions are written in the table and the actions take place in the order in which the events occur.
c. Standardized and consistent language has to be used.
d. Duplication of terms and scenarios should be avoided as far as possible.

EXERCISE II (State whether true or false)

1. Data flow diagrams can be of two types i.e. logical and physical.
2. Data Dictionary depicts the data about the data.
3. Structured English is graphical representation of the decision trees.
4. Decision trees are made up or various branches depicting the alternatives available for a decision to be taken.
5. Decision tables have four distinct constituents.

Answers to Exercise I

1. True
2. True
3. False
4. False
5. True

Answers to Exercise II

1. True
2. True
3. False
4. True
5. True

8.5 REVIEW QUESTIONS

1. What is meant by system analysis? Discuss the need for data analysis.

2. Understanding the existing system is very important task of system development. Discuss.
3. What are the main methods of getting information for the systems analysis phase?
4. State the main data modeling tools used in system analysis.
5. Write a short note on Data Flow diagrams.

8.6 SUGGESTED READINGS

1. Sahil Raj : Management Information Systems
2. D. P. Goyal : Management Information Systems Managerial Perspectives
3. K. Laudon, J. Laudon : Management Information Systems Managing the Digital Firm
4. G.B. Davis, M.H. Olson : Management Information Systems

CHAPTER 9: SYSTEM DESIGN, IMPLEMENTATION AND TESTING, DOCUMENTATION

STRUCTURE

9.0 OBJECTIVES

After reading this chapter the students must understand:

- Basics of System Design
- Tools and techniques of System Design
- Concepts of Documentation
- Concepts of Coding and Testing

9.1 INTRODUCTION

System Design is the step that we wish to complete after system analysis in the system development process. This phase starts right after the system analysis phase is over and the design phase basically takes its inputs from the outputs of the systems analysis phase. This is where the functionalities required by the organization as identified by the system analysis phases are make functional. The identified functionalities are incorporated into modules and

designed by analysts with expertise in the area. Systems design phase is the phase where the need for technical knowledge i.e. knowledge of the development platform or language increases. There is extremely high involvement of the managers till the system analysis phase but from the design phase forward this involvement decreases as the developers also have the requirements of the people who have to eventually use the system. The managers though remain involved all through in order to oversee that the system is built according to the requirements of the organization but the comparative involvement in analysis and design phase is very different.

9.2 SYSTEM DESIGN

System Design as already discussed is the phase where the system design is prepared keeping in mind the requirements that generated from the system analysis phase. It is a technical process which needs a lot of knowledge of the system to be developed as well as the development platforms to be used. The overall design phase of an information system is divided in to two parts. The first part is the conceptual design and the second part is the detailed design. The conceptual design deals with setting up a framework on the basis of the analysis of the information about the organization where as the detailed design deals with the technical aspects related to the development of the system. This phase lays the basis for the actual formulation of the system as everything is designed in detail in this phase and all the information generated here is used in the actual implementation i.e. in the coding and testing phase.

9.2.1 CONCEPTUAL DESIGN

The conceptual design prepares the blueprint for the detail design to be easily formed. It is not possible for the entire design to be formed in one go as the system to be designed are extremely complex therefore the conceptual design makes the basic framework which can be then be used to develop the detailed design with ease. The analysts here reconcile with the information collected in the analysis phase and on basis of this information define the following aspects:

- The business processes of the organization
- Goals and objectives of the organization
- Critical activities of the system
- Hierarchy of the employees in the organization

- The present state of flow of information
- Precise identification of the problem
- Identification of different stakeholders of the organization and the information requirements of different stakeholders
- System Requirements i.e. comprehensive information about the requirements of the new system to be developed.
- Functional requirements i.e. listing all the important functions that the new system should perform.
- Technical requirements i.e. all the hardware and software requirements that the new system needs.

9.2.2 DETAIL DESIGN

The next step after preparing the conceptual design of the system the next task of the analysts is to prepare the detail design. In the detailed design phase the analysts elaborates the system design to incorporate minute and technical details into the system. In the earlier phase the focus was on the managerial aspects of the system but now the focus shifts from the managerial point of view to technical point of view. The detailed design is formulated such that it provides a complete basic structure for the coding to be done by the programmers in the future. The whole design is divided into parts and subparts in the form of smaller modules and units scaling down to single operation being performed in order to make the work easier and manageable for the next phases that are to be performed. The whole system is segregated into smaller and functional modules and each of them is then studied and defined keeping in view the analysis of the system that was conducted in the previous phases. As programming is nothing more that appropriate formulation of these modules in the language and the platform required therefore a well defined and detailed study of these modules is required for the programming to take place. Also the formulation of the form and report etc. is done on the basis of the input and output requirements based on the user requirements collected in the system analysis phase. These forms are the means of interaction with the users that would be operated by the employees and the user interface is also designed. The following aspects are kept in mind while preparing the detailed design:

- Segregation of the overall structure of the information system into in different schemas
- Detailing the various modules required for providing functionality to the information system
- Hierarchy of different modules in the system
- Relationship between various modules in the system
- Input and output design for the information system
- Design forms for the interface
- Design of the reports that the system may generate
- Designing the user interface

9.3 OBJECTIVES OF SYSTEM DESIGN

A system is designed with the following objectives:

1) Practicality
2) Flexibility
3) Efficiency
4) Security

The design of the system should be practical i.e. should be user oriented. It should focus on the ends i.e. the functionalities that the user expects from it and how can the system fulfill them. The system should be designed in such a way that it can be easy learned and operated by the end users. It should always be kept in mind that the end user sin the organization is not necessarily of the technical background therefore the usability of the product should be high. No technical jargons or technical operating techniques should be used.

The organizations operate in dynamic environments and needs and requirements keep on changing from time to time therefore the system should be designed keeping in view the flexibility requirements of the organization. There should always be a provision o adding additional functionalities or changing the present one with easily without incurring huge costs. It should also be kept in mind that making a information system for a organization is a long and complex process and the whole process takes a long time during which the requirements of the organization may vary slightly therefore the developers should a this in

mind that a rigid system may turn obsolete very quickly not justifying the amount of effort time and money spent on it in the development process.

A system should be efficient and should perform the tasks in specified time. The objective of the information system is to provide the management which accurate and timely information such that the decision making of the organization can be faster than it usually was. The decision makers do not have to spend time on trivial tasks rather the system can be such that it can help managers being proactive in nature. The efficiency of the system may be measured in terms of the following parameters:

a. Throughput: it is the ability to handle a specified number of jobs per unit of time.
b. Response time: The ability to respond to the request made by the user within the given time limit.
c. Run time: It is the ability to undertake the complete job within a given time limit.

The aspect of security is a major concern as the information systems have the duty to handle manage and keep secure one of the most important and strategic resources in the organization i.e. organizational data and information. Therefore the developers have to build in functionalities and modules to incorporate the issues of hardware and soft ware reliability, physical security, security of data, partial access, detection and prevention of fraud and abuse of data.

9.4 METHODS/TOOLS AND TECHNIQUES OF SYSTEM DESIGN

Multiple approaches can be followed while working on System Design. These are the tools and techniques which are used:

1. Three view schema approach
2. Structured Design Methodology
3. Structured Charts
4. Coupling and Cohesion
5. Hierarchy Input Process Output
6. NS Charts
7. Warnier Orr diagram

THREE WAY SCHEMA APPROACH: The Three Way Schema approach is a stepwise approach which helps the designers to develop the system in a systematic and precise manner. For a proper design to be made for implementation of the system, the analysts should have clear understanding of how the data of the organization has to be managed. The inputs and outputs of the system are dependent on how data is accessed. The user is interested only in the inputs and outputs but the analysts have to take care of management of the data i.e. issues like data storage, names of data field, tables etc. The analysts also need to have complete knowledge about the data attributes in order to manage it properly. This approach divides the schemas into three types:

- External Schema
- Conceptual schema
- Internal schema

External schema defines how the system should be designed from the point of view of the user. As the name suggests it relates to the view from an external point of view. As already discussed the user wishes to manage or update or retrieve only small portions of data which are a part of the larger databases present in the system. Therefore database is designed such that the demands of the user can be met and analysts focus on understanding those needs and implementing them. Therefore this level works on the aspect that how the data would be viewed by the user.

Conceptual Schema lays the foundation of the precise relationships that exist between the entities in the databases, the data and the attributes. This is a detailed view and is in a way an implementation of how data is actually related to various entities in organizations. In comparison to the external schema it has far more details for example about the relations i.e. which data item derives its value from whom etc. This information is of no use for the users therefore is hidden from them. It is the duty of the analyst to know all these intricate details and to implement them. Therefore this level works on how the data that is stored would be accessed.

Internal Schema is of the importance for the analysts. These aspects of the system are in a way hidden from the users as the user has no understanding or usage of these aspects. The internal schema uses the knowledge of the external and conceptual schema in order to understand how the data would be actually or we can say physically stored in the

system. To allow easy data access or in order to facilitate the future access of data the analysts decides hoe the data would be stored and also in turn how would it be accessed in order to present the user with the results he/she may want.

As each schema finds application at a different level, the knowledge of the three schemas and an approach to increase the detail as the level increases helps the analysts design the system according to the requirements.

STRUCTURED DESIGN METHEDOLOGY: This approach focuses on the structuring of the designing process. The structured design methodology is also used in the system analysis and development stage but the methodology adopted here is very different. It emphasizes on the fact that designing should happen in a highly structured manner. The inputs to be given and outputs to be received should be listed in detail in order to get the requirements through a structured manner. It advocates building up of modules. The entire design is broken in manageable sub parts of modules which address to one functionality in one single unit. Each of the modules are discussed and looked in to in detail and then work is done on them. The breaking down of the issue into modules and sub modules is done in order to simplify the whole thing. The breakdown helps making the exact units according to which coding is done by the programmers in the next phase while writing code for the system. This also helps in defining and dividing the workload and sharing or assignment of work among the employees of the organization. Three types of modules are prepared when using the structured design approach. These are:

- Base module
- Middle module
- Reasoning module

Base module deals with the main functionality that the system needs to perform

Middle module deals with the various checks and verification processes that need to be performed before the system performs the main function. These are said to deal with the control of the system.

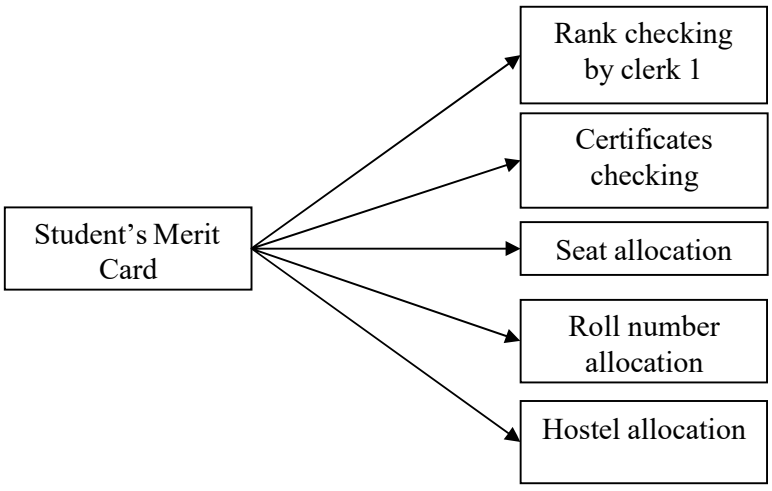
Reasoning module gives the logic of the entire system. Here are the algorithms that need to be followed for the output to come out.

It is important to segregate the module into these parts and in this manner because this helps bring in the functionality of each module when the coding is being done.

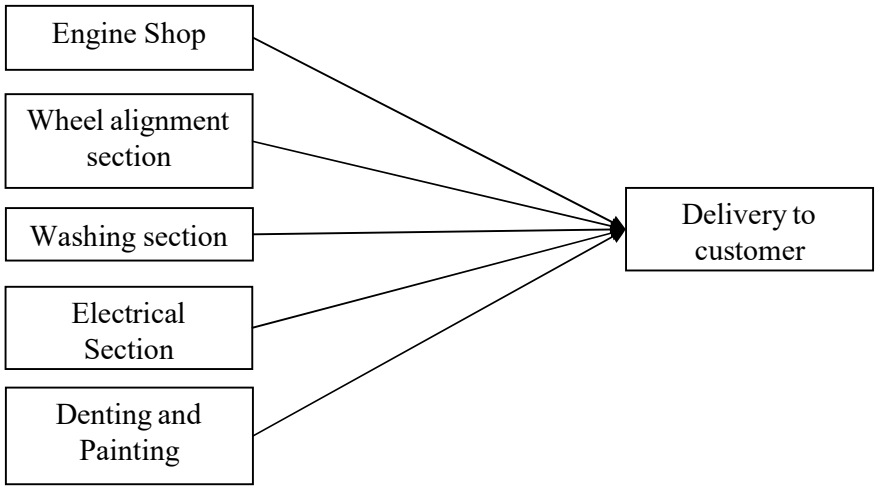
STRUCTURED CHARTS: As already discussed the parts and subparts in the system design are made in the form of modules which are made to perform certain functionalities. The structured chats help the analysts design the hierarchies between the modules. The functionalities of the modules are also made clearer through the hierarchies as a module higher is the hierarchy is the one from which flow transfers to the modules lower in the hierarchy. This also helps get more clarity on how the data flow in the system will take place. The modules of the system and the modes of interaction between them are understood by the analyst using structured chats. The analyst knows the time and situation in which the control would be passed from a higher module to a lower module. Structured chats can be made using two approaches i.e.

- Transaction approach
- Transform approach

In the transaction approach the data or the flow is dispensed from a central place to various destinations where the transaction need to be performed, consider the following example of a student at college counseling.



In the transform approach the data from several places is collected at one place where the processing whatever may be required is done. Consider the following example of a car arriving at a car station for servicing.



EXERCISE I (State whether true or false)

1. System design phase comes after the system analysis phase.
2. System design is of three types i.e. internal design, conceptual design and external design.
3. The system's design should incorporate flexibility in order to provide a provision for adding functionalities.
4. In the Schema approach there are two types of schema i.e. conceptual schema and detailed schema.
5. Structured design methodology identifies three modules i.e. base, middle and reasoning module.

COUPLING AND COHESION: Once the different parts and subparts have been identified and the system is divided into modules and the hierarchies in between them have been developed using the structured chats, the analysts then moves forward to establishing the relationships that exist between the various modules. How each of them is dependent or independent from one another and how change in one affects the others. Business environment as we occasionally discuss is highly dynamic and this has lead to innumerable changes in the ways we make decisions. With the rapid changes in the environment we have to develop a system that is adaptable to the ongoing changes in the business environment. These changes can only be done rightly by the analysts if he/she understands the relationships that exist between the modules, how they affect each other and how changing some attributes in one may bring about changes in others. If these relationships are not known already then

the process of medication would not be as time consuming and difficult as it otherwise would be.

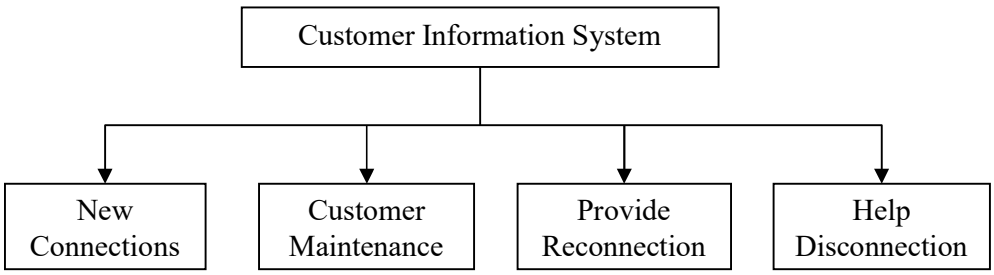
Coupling is the situation when modules are dependent on each other and changes in one brings about changes in others.

Cohesion on the other hand when the modules are not interdependent and changes in one do not bring changes in other the system is said to be cohesive. It should be noted that this type of situation is far more favorable for making modifications I the system as the ripple effect of the change made by the analyst would be less than that in the case of coupled modules, therefore the analysts should try and make the modules cohesive.

HIERARCHY INPUT – PROCESS - OUTPUT: The Hierarchy Input Process Output (HIPO) technique is very good as far as description of the entire system is concerned. It describes the complete system in detail. It is divided into two parts i.e.

- Visual Table of Contents
- Input - Process - Output

The Visual table of contents as the name suggests gives the general outline of the information system. It depicts various modules of the system that is supposed to be implemented. It shows the entire structure of the system, for example a Visual table f contents of a Power corporation is given below



Input - Process – Output elaborates the input, processing and output details for each o the module and sub modules defined in the visual table of contents.

NS CHARTS: Nassi Shneiderman (NS) charts are named after the two developers who developed this technique. These charts enumerate the logic that goes behind a module. It is a

graphical design programming for structured programming. A NS chart has the following three symbols which are used for graphical representation:

- Process Blocks
- Branching Blocks
- Testing loops

Process blocks simply show processes that may occur one after the other. They are simple rectangular boxes that require no analyses. They simple show the movement from one block to the other. When a process block is encountered the process that the box says is performed and then we move to the next block.

Branching Blocks have the option of leading to alternatives on the basis of a condition. The blocks can be in the form of True/False or Yes/ No formats. If the condition is fulfilled one block is executed or else the other. These blocks can also be used for looping procedures or for stopping a program when a condition is fulfilled.

Testing blocks have the ability to loop certain processes unless a specific set of conditions are fulfilled. The process blocks which come under the testing sidebar would be executed as long as the condition stays false. The testing loops can be in the form of test first and test last loops where the processes are executed first and then conditions checked and vice versa.

WARNIER /ORR DIAGRAM: The Warnier Orr Diagram is also named after the two developers Jean Dominique Warnier in France and Kenneth Orr in United States of America. These diagrams also focus on the logic behind the system but are simpler in nature as compared to the NS Charts. This method aids the design of program structures by identifying the output and processing results and then working backwards to determine the steps and combinations of input needed to produce them. The simple graphic method used in Warnier/Orr diagrams makes the levels in the system evident and the movement of the data between them clear and vivid. The inputs are shown in the form of steps and the logical steps are indicated as a block using curly brackets. The process conditions are shown using parenthesis and the output conditions divided by horizontal lines. These diagrams may also be used to depict hierarchical structure of records.

There are four basic constructs used on Warnier/Orr diagrams: hierarchy, sequence, repetition, and alternation. There are also two slightly more advanced concepts that are occasionally needed: concurrency and recursion.

9.5 CODING/ IMPLEMENTATION OF DESIGN

Once the requirements of the system in the form of inputs required and the outputs to be given are well listed and the design of the system has been prepared in detail, the next step that comes into picture is the coding of the proposed system. It is the coding phase that gives a definite shape to the system that we wish to form.

Till the designing phase the requirements of the users have been detailed, the input output requirements are known, a detailed design of how the system should be formed is in front of the analysts but the whole thing is still on paper, no matter the amount of details we have been through about it. Up until the design phase the analysts has made a model of what needs to be done in a structured and completely detailed manner and it is in the coding phase that this design is finally implemented.

In this phase the involvement of the analysts in supported by a team of programmers instead of the managers which were highly involved in the earlier phases of the development but it should be noted that whatever the programmers code is strictly on the basis of the design prepared by the analyst which finds its base in the requirements provided by the managers in the organization. Managers should also have some basic knowledge of this phase and should be involved in order to understand and ensure that the system is ultimately being made to produce the results which they wished it to.

Coding can be done using any platform or language depending upon the requirements of the system and these details are already kept in mind and decided earlier while planning for the system. The analysts should also be extensively involved in the documentation of the coding processes and the code itself because this is the basis of any changes or up gradations which have to be done in the future. Also standards should be used across teams in order to build a uniform system so as to ensure fast and easily understandable access to the code of the system as and when required. The analyst should be actively involved in every aspect of coding should ensure that it adhere to the design standards and requirements that were set in the earlier phases of the development of the system. Documentation should also be done with active participation of the system analyst.

9.6 TESTING

Coding is always followed by the testing f the code that has been developed by the programmers. Testing is a process which starts just as the process of coding is began; this can be said because testing is done at various levels. The programmer as they go might be testing each of the statements that they code into a program and much comprehensive techniques of testing such as testing whole modules or the whole system may be needed later in development. They may also be done from point of view of different stakeholders in order to ensure all round operation ability.

As the application of the information system changes the basic working procedures in the organization, it is necessary to check the results produced against the results expected from the system. At a macro level, first of all, Pilot testing is done, in which certain parts may be tested, or the system may be tested in just one department of the organization. Depending upon the test results subsequent action might be taken.

Testing involves the execution of a software component or system component to evaluate one or more properties of interest. In general, these properties indicate the extent to which the component or system under test:

- Meets the requirements that guided its design and development,
- Responds correctly to all kinds of inputs,
- Performs its functions within an acceptable time,
- Is sufficiently usable,
- Can be installed and run in its intended environments, and
- Achieves the general result its stakeholder's desire.

Testing can be of various types and depending upon the sage and area of application they may be used by the analysts. Some of the widely using software testing techniques are:

- Alpha testing
- Beta testing
- Acceptance testing
- White box testing
- Black box testing
- Grey box testing

- Load testing
- Volume testing
- Usability testing
- Accessibility testing
- Security testing
- Installation testing

The testing technique is totally dependent on the type of the system and the kind of results that we want from it but no matter the testing techniques used the testing whenever it is done should be done considering three perspectives i.e.

- Organizational front
- User front
- Customer front

The system is built for organizational needs and should always work to fulfill them because the ultimate objective of any system is to ensure organizational effectiveness. Also what should be kept in mind the requirements of the users who have to ultimately use and operate it. It should be user friendly and fulfilling all their functional requirements. What should always be kept in mind is that whatever the organization does is eventually meant for the customers of the organization and therefore the system should be considerate of these requirements as well.

9.7 DOCUMENTATION

Documentation is a very important aspect of System Development. Information systems developed for the organizations are extremely large systems performing complex operations and carrying out interrelated tasks for the organizations. These systems are developed as a result of lengthy tasks panning over large periods of time and employing highly structured processes in order to reach the results that the analysts wish to reach i.e. meeting the user requirements. It should also be noted that the end users of the system that is the managers in the organization are not necessarily from very strong computer backgrounds so that they can understand the intricate details that go into development of a computer based information system. There is also a possibility that the system is developed over a long period of time during which the team members involved in the development may have changed as the project may have taken long to complete. Information systems also require live long

maintenance and up gradation or modification requirements which are not necessarily done by the same people by whom the development was done. All these aspects clearly highlight the need for documenting the whole system to the minutest details possible.

The system documentation provides detailed information about each and every critical aspect of the system. The organizations generally have different teams to perform the system requirement analysis phase, the design phase. The system is then coded and tested by the core developers or the programmers. It is necessary to document every important aspect of the system so that it can be referred to whenever the need may arise. The documentation generally focuses on the following parts:

- Introduction
- Processes
- Designing
- Coding
- Installation
- Maintenance
- Handling Issues

The document first gives a general introduction to the entire system in order to gain familiarity with the system. The organization it is build for, the main purpose etc.

The process with which the system is build is elaborated next. It also discusses the various checks and parameters used to develop the system.

The critical issues regarding the designing the system are then discussed in detail. Design specification start with the performance specification given in the conceptual design to the set of design specification given in the detailed design. Design documentation is a rather important part of the documentation and it contains details about

- System objectives
- Design constraints
- Inputs/outputs
- Data files
- Procedures
- Input output specification

- Program/ database specifications
- Test conditions etc.

The next part contains the entire program code which can be referred to whenever there is a need for in depth analysis of the system may be required. These codes lay the basis and the starting point whenever we wish to make and modifications of up gradation in the system.

Next in line is the installation manual which guides and helps every step in the process. Installation methodologies, which were used by the team, or which may be further required when installation has to take place afresh are given. This also shows how this process may have to be carried out in different scenarios as the one adopted by the team.

Maintenance is a long term process and is occasionally not done by the same set of people who developed the system therefore a detailed maintenance guide should be present in order to effectively do the task. In should be noted that along with this section entire documentation document plays an important role in the maintenance of the system.

EXERCISE II (State whether true or false)

1. NS Charts are graphical representation of the logic behind the various modules in a system.
2. Warnier Orr Diagrams are difficult to make as compared to the NS Charts.
3. Coding the system has more involvement of the managers and the analysts.
4. Testing should be done keeping the organizational, user and customer front in mind.
5. Documentation proves extremely valuable in case of modification, up gradation and maintenance of the system.

9.8 REVIEW QUESTIONS

1. Discuss in detail the objectives of System Design Phase of System Development.
2. Write short notes on:
    a. Conceptual design
    b. Detail design
3. What are the various types of methods which are used for System Design?
4. Discuss the importance of system Documentation
5. Write in brief about system Coding and Testing.

Answers to Exercise I

1. True
2. False
3. True
4. False
5. True

Answers to Exercise II

1. True
2. False
3. False
4. True
5. True

9.9 SUGGESTED READINGS

1. D. P. Goyal : Management Information Systems Managerial Perspectives
2. Sahil Raj : Management Information Systems
3. G.B. Davis, M.H. Olson : Management Information Systems
4. K. Laudon, J. Laudon : Management Information Systems Managing the Digital Firm
5. R. Murdick, J. Ross :Management Information System

CHAPTER 10: IMPLEMENTATION AND EVALUATION

STRUCTURE

10.0 OBJECTIVES

After reading this chapter the students must understand:

- Concepts of System Implementation
- The process of Systems Implementation
- Changeover and the approaches used for it.
- System Evaluation
- System maintenance

10.1 INTRODUCTION

Once the process of development of MIS is completed, the system is ready for implementation. Implementation is the process of installing and making operational the MIS developed at the user's premises and continuously getting the output it was designed to generate. It is the process of converting the old system that was used in the organization and

replacing it with the new system which was developed in the system development process in order to fulfill the organizational objectives the new system may have been introduced as a replacement for the manual system or a improvement in the existing information systems which may be present in the organization.

10.2 IMPLEMENTATION PROCESS

Implementation is the process of transformation of the organization using the new system developed by the organization. Implementation of MIS is a process in itself and involves various steps. It is understood here that the major steps are based on the design specifications. All the requirements of the system such as input, processing, output, equipment, personnel etc. are provided by the design specifications. However the steps are not sequentially exclusives, some of the steps overlap. The various steps are as follows:

10.2.1 PLANNING THE IMPLEMENTATION

Pre implementation activities are the first to be performed when thinking of implementation of the developed systems. It is obvious that the first step in the implementation of an MIS is to planning for the implementation to take place. Various activities which need to be carried out and the time schedules and allotments of work to personnel who are responsible to carry them out are all done in this phase of implementation. This can be done using various techniques such as Gantt Charts, Network Diagrams, etc. This becomes especially important in large projects where large scale implementation has to take place, sometimes even in incremental patterns. Therefore in order to keep track of the activities and to ensure that the system is being implemented with precision and that the system ends up performing the functions that they are supposed to.

10.2.2 ACQUISITION OF FACILITIES

Implementation of the system here talks more in terms of physical implementation that needs to be done in the organizations for the system to take its place. The existing system which might be already operational in the organization has already set up resources and tasks associated with it but setting up of a new system need the acquisition of new resources which might not have been required by the existing system. For the implementation the manager requires to make plans on the basis of estimates for the requirements that the system has. Things such as office spaces, computer terminals,

printers, people, storage areas, security issues, utilities etc. have to be managed. The layout for the area of operations and the location that needs to be chosen are also considered.

10.2.3 PROCEDURE DEVELOPMENT

It is also important that the managers guide the implementation of the system as they go there should be complete involvement in the processes to the maximum possible extent and a sense of belongingness should be felt by them. Here the involvement of the managers and analysts who were actually present all through the process of development of the system would help in procedure development greatly. This is because they know the system in and out and also know which functionalities were introduced with what purposes. This also helps the other members of the organization to feel at home with the new system. The resistance to change that the organization may face needs to be addressed and the development of formal procedures and channels should be done such that the change can be brought about easily and with little resistance.

10.2.4 USER TRAINING

User training is one of the most important tasks which need to be performed as a part of implementation of the new system in the organization. Adequate user training is a very important task for successful implementing an information system. The users may be identified and classified differently on the basis of operational/functions performed by them. The information about the training needs required for the system and the competencies of the workforce present with the organizations should already be covered in the planning phase and it is here that this planning is brought to action. This helps bring about the culture which needs to be developed surrounding the new system in the organization ensuring acceptance from the employees. Even the initial stigmas which may have appeared in the minds of the employees are removed and smooth functioning after the employees know how to operate the systems well can begin.

10.2.5 ACQUISITION OF HARDWARE AND SOFTWARE

Acquisition of hardware and software is a process which begins right after the specifications for the system are set. This is a process which can be seen overlapping with a lot of other activities happening right from the development of software. Selection of hardware and software can be long and complex process. It should be ensured that the facilities which are required for installing the hardware such as site preparation work

layouts conditioning etc. is done before the procurement of the hardware for the system. At this point just the consumables are acquired as maybe required.

10.2.6 TESTING

Testing at the site of operations is one essential task which needs to be done in order to ensure the successful working of the system. Tests should be performed in accordance with the test specification at each and every phase of development. However it is more important at implementation phase because testing at this stage is done under real operating conditions, just as it would be done in the long running the organization with factual data from the organization. Testing maybe done with small representational data but it should be checked at various levels such that it ensures operational abilities of the system from different aspects. The tests are mainly conducted for accuracy range of inputs that they may take frequency of inputs, the operating conditions, reliability of the data, validity of the results produced etc.

Testing of the information systems can be undertaken with the help of many software such as Computer Aided Case Tools (CASE) tools. These systems provide the facilities of online debugging for correcting the programs and errors in data which may arise in the system. The changes in design and need for modifications can be suggested in the basis of operational testing conducting on the system.

10.2.7 CHANGEOVER

Changeover is the act of switching over from the old system to the system newly developed for the organization. This changeover is the ultimate aim of the entire implementation process or rather we can that the aim of the process of system development. The act of changeover takes place only after the system has been tested and its reliability and the validity of the results in testing in real life operational conditions. This process of changeover can be implemented using many approaches. It should be noted that the system of changeover would be different for new organizations as compared to the organization which have already running systems in the organizations. Some of these approaches are listed below:

- FOR NEW OPERATIONS: If the organization is a new one or when the old system does not exist, there is only one method for implementing the newly developed system, i.e. install the system. The newly developed system is

implemented as there is no old system in operation and thus no question of replacement of the old or existing system arises.

- FOR EXISTING OPERATIONS: When the old system is in existence, there may be four different strategies, namely:
    - Direct
    - Parallel
    - Modular
    - Phase-in

The Direct approach as the name suggests involves directly replacing the old system with the new in a rather abrupt fashion. It is also named the Cold Turnkey approach where the old system in entirely cut off in instant and new system is introduced in its place. Such measures are only adopted when the old system is considered utterly useless and the beliefs of the entire organization and the stakeholders match on this, or when very small level implementation has to be done such that they do not affect very large amounts of people. This approach is inexpensive in nature but also poses a great chance of failure for the new project to be implemented.

In parallel approach both systems are run simultaneously at the point of introduction of the system. The new system is installed and operated in parallel with the current system until the time it has been thoroughly tested in the actual working environments, the results of the two systems are tested so as to note the consistencies and the inconsistencies involved with the system. This does provide the duplication of the systems but provides a slow change as opposed to the abrupt removal of the old system as was the case with the direct approach.

In the Modular approach as the name suggests the introduction of the system in done on module basis. It is also sometimes referred to as the pilot approach because just as is in the case of pilot surveys the modules are tested before getting the whole system into functioning all at once. This system provides many advantages such as localizing the risk of failure of the system, identification of problems and corrective actions can be taken and employee s can be slowly trained in the live environments in which they have to ultimately work in.

Phase in approach is also known as the cut over by segments approach and is very similar to the modular approach discussed above. The difference lies in the fact that

here the introduction of the system itself is done in phases to the entire organization. The approach is also advantageous as it provides a slow and gradual move towards the new system allowing the system and the organization and the people involved to get adapted to one another. This can also pose some disadvantage such as additional costs incurred and there may be certain temporary operational issues which the system may face during the process of phasing in.

EXERCISE I (State whether true or false)

1. System Implementation is a pivotal task to be done after the development of the system.
2. Collecting information and procurement of the hardware and software starts as soon as setting of system specifications.
3. Operational environment testing checks for reliability of the system in live environment.
4. The changeover of the system can be done following any of the four approaches i.e. direct, internal, external and phased.
5. In the phase in approach the whole system is introduced to some parts of the organization.

10.3 EVALUATION OF MANAGEMENT INFORMATION SYSTEMS

Evaluation of Management Information systems is an integral part of the management control process in which the organizations determine and appraise the quality and the effectiveness of the information systems made for the organization. Evaluation can be said to be directly termed as the process of measuring the performance of the system developed after it has operated in the organization. Various approaches can be employed by the evaluators in order to carry out the performance measurement process. The following are few approaches listed by D P Goyal which can be followed:

1. Quality Assurance Review
2. Compliance Audits
3. Budget performance Reviews
4. MIS Personnel Productivity Measurement
5. Computer Performance Evaluation
6. Service Level Monitoring

7. User Attitude Survey
8. Post Installation Review
9. Cost/ Benefit Analysis.

Quality Assurance Review: Quality assurance reviews or technical reviews focus on assessing the information system's technical quality, e.g. comparison to standards and operations acceptance procedures. Technical evaluation includes variables like data transmission rate, main/secondary storage, CPU capacity, etc. Technical reviews are performed by MIS development/operations personnel or a separate quality assurance group within the MIS function.

Compliance Audits Compliance audits or a location control reviews assess the adequacy and completeness of controls for the system inputs, outputs, processing, security and access. Compliance audits are typically performed by an autonomous internal audit function.

Budget Performance Review: Evaluation of MIS budget performance concentrates on compliance with a predetermined budget expenditure level for the MIS development or operations process. Evaluation of user budget performance has its focus on MIS resource consumption by the user. Both may be supported by a chargeback mechanism.

MIS Personnel Productivity Measurement: The capability of MIS personnel is typically determined in terms of productivity. Examples of productivity measures include lines of code per unit time for the programming (development) personnel and keystrokes per unit time for the data entry (operations) personnel.

Computer Performance Evaluation: The production capability of the computer hardware is typically evaluated in terms of performance efficiencies and bottlenecks that limit production. For example, computer performance evaluation measurements are made on per cent uptime, actual throughput, and I/O channel utilization.

Service Level Monitoring: Service level monitoring focuses on assessing the information and support provided to the user, based on the terms established between the MI5 and the user personnel. Assessment of the information provided includes turnaround time, response time and error rates. Assessment of the support provided includes the time required to respond to the user's problems and requests for changes.

User Attitude Survey: User attitude survey method is used in operational evaluation. Operational considerations refer to whether the input data is adequately provided and the output is usable. These types of attitude surveys are conducted through questionnaires and/or interviews to appraise the user's perceptions of the information and support given by the MIS function. User attitude surveys typically assess such aspects as the quality and timeliness of reports, quality of service and MIS - user communication.

Post-Installation Review: The focus of a Post-Installation Review (PIR) is often on estimating whether the system meets the requirement definition, i.e. 'Does the system do what it is designed to do'? However, the scope of the PIR may include a post—hoc review of the development and operation processes, an examination of the information and support provided, an analysis of the actual use process, and cost/benefit analysis of the system and its effects on the user performance.

Cost/Benefit Analysis: Cost/Benefit analysis is also known as economic evaluation. The analysis quantifies the system's effect on organizational performance in terms of dollars, e.g. direct cost savings or tangible financial benefits. Cost/benefit analysis is often used in capital budgeting to gauge the return on investment.

Evaluation can be done according to two major EVALUATION CLASSES (Davis and Olson, 1985) i.e. effectiveness and efficiency.

- Effectiveness: This refers to the quality of the outputs from the system. Effectiveness means doing the 'right' thing in the right manner so that desired result may be achieved. Information System is said to be effective if its product (i.e. output) is of quality, and the process of producing output is right (effective).
- Efficiency: It is a measure of the amount of resources required to achieve the output, i.e. the use of system resources to get results. Being efficient implies the system is operating the 'right' way. The relationship between effectiveness and efficiency is that effectiveness is a measure of 'goodness' of output, while efficiency is a measure of the resources required achieving the output. There are various dimensions of information systems that should be evaluated. These may include the development process, which, concerns whether the system was developed following set standards; information being provided and the system's performance. Depending upon the dimensions of the information system to be evaluated, an appropriate evaluation approach may be adopted. To understand the concept of MIS evaluation, two types of

evaluation have been discussed in this section. These are product-based evaluation and economic evaluation; where one type of evaluation (economic) focuses on the costs/benefits of MIS, the other type focuses on the product, i.e. information support from the MIS.

COST BENEFIT ANALYSIS: In cost/benefit evaluation, a thorough study of various expected costs, the benefits to be expected from the system and expected savings, if any, is done. It is an economic evaluation of the system, in which costs to be incurred for developing, implementing and operating a system are to be justified against the expected benefits from the system. In other words, cost/benefit analysis determines the cost-effectiveness of the system. For undertaking cost benefit evaluation, various estimates of costs as well as benefits expected from the system are to be made. In developing cost estimates for a system, several cost elements are considered. Among them are initial development costs, capital costs, operating costs, etc. Similarly expected benefits from the system are considered. The benefits may be in terms of reduced cost, better performance/decisions, etc. The various categories of costs and benefits are measured and included in cost/benefit analysis. A brief description of all these cost elements and benefits is given below.

- Initial Development Cost: Initial development cost is the cost incurred in developing an information system. Various elements of development cost include project planning cost, feasibility study cost, design cost, conversion cost, implementation cost (including user training cost, testing costs, etc.). In other words, total development cost is considered one-time cost and is termed as initial development cost.
- Capital Cost: Capital cost is also one-time cost. It is the cost incurred in facilities and in procuring various equipment, including hardware, etc., required for the operation of the system. Facility costs are expenses incurred in the preparation of the physical site where the system will be implemented. It includes wiring, flooring, lighting, acoustics, air-conditioning cost. The cost on space required for office, storage and computer room, if not hired, is also included in the facility cost. Hardware and equipment cost relates to the actual purchase or lease of the computer and peripherals.
- Annual Operating Cost: Annual operating cost is the cost incurred in operating the system. It includes computer and equipment maintenance cost, personnel cost, overheads and supplies cost. Computers and equipment are to be maintained and thus

some cost is incurred, known as Annual Maintenance Cost (AMC).Similarly, personnel are required to operate the system. Personnel cost includes EDP staff salaries and other benefits (provident fund, health insurance, vacation time, pensioners benefits, etc.). Overhead costs include all costs associated with the day-to-day operation of the system; the amount depends on the number of shifts, the nature of the applications and capabilities of the operating staff. Supply costs are variable costs that increase with increased use of paper; ribbons, disks, etc. just as the cost elements, in cost/benefit evaluation, various expected benefits from the system areal so studied. The first task is to identify each benefit and then assign a monetary value to it. Benefits may be tangible or intangible, direct or indirect. There are two major benefits, namely, improving performance and minimizing the cost of processing. The performance part suggests improvement in the accuracy, timeliness, non-duplication, adequacy, usefulness in information and easier access to the system by authorized users; which in turn leads to better decisions and allows more time to managers for planning purposes, etc. Minimizing costs through an efficient system, such as error control, reduced salary and labor cost and reduced inventory cost is a benefit that is to be measured for evaluating cost-effectiveness of a system.

For identification and categorization of various costs and benefits, the following concepts are important.

- Identification of Costs and Benefits: Certain costs and benefits are more easily identifiable than others. For example, direct costs, such as the price of a personal computer, ribbon, etc., are easily identified from invoices or from organizational records. Similarly, direct benefits like reduction in staff because of the new system or fast processing of transactions, may be identified. Other direct costs and benefits, however, may not be well-defined, since they represent estimated costs or benefits that are not very certain or well-defined. An example of such a cost is a reserve for bad debt.
- Classification of Costs and Benefits: The various categories of costs and benefits are important to make costs and benefit analysis. These categories may be tangible or intangible, direct or indirect, fixed or variable.
- Tangibility: Tangibility refers to the ease with which costs and benefits can be identified and measured. Cost incurred or to be incurred on a specific item or activity

is termed as a tangible cost. For example, computer costs, consultancy fee paid to a consultant, employee salary are tangible costs. Whereas intangible costs are those costs that are known to exist but whose monetary value cannot be accurately measured, For example, lowered employee morale because of a new system is an intangible cost. Like costs, benefits may also be categorized as tangible or intangible. Tangible benefits such as reduced salaries, producing reports with no errors are quantifiable. Intangible benefits, such as high morale among employees, improved in the organi image are not easily quantified.

Costs are also categorized as direct or indirect costs. Direct costs are those with which an amount in rupees can be directly associated to any of the items or operations of the system. For example, the purchase of a computer ribbon for Rs 200 is a direct cost. Direct benefits also can be identified which could be attributed to the new system. For example, a 5 per cent reduction in salary expenditure because of the new system can be classified as a direct benefit. Indirect costs are the results of operations that are not directly associated with the system or activity. They are termed as overheads. For example, safety or security of computer room, electricity, air conditioning and maintenance, etc., are included in indirect costs. Similarly, indirect benefits are realized as a by-product of some other activity or system. Fixed costs are constant costs and do not change, regardless of how well a system is used. They are only one-time costs like development cost, capital and insurance cost, etc., whereas variable costs are incurred on a regular basis. They are usually proportional to work volume and continue as long as the system is in operation.

10.4 SYSTEM MAINTENANCE

Software maintenance is an extremely important part of the whole system development process and goes on even after the system has been built and deployed into the organization. It stands for all the modifications and updation done after the delivery of software product. There are number of reasons, why modifications are required, some of them are briefly mentioned below:

- **Market Conditions** - Policies, which changes over the time, such as taxation and newly introduced constraints like, how to maintain bookkeeping, may trigger need for modification.

- **Client Requirements** - Over the time, customer may ask for new features or functions in the software.

- **Host Modifications** - If any of the hardware and/or platform (such as operating system) of the target host changes, software changes are needed to keep adaptability.

- **Organization Changes** - If there is any business level change at client end, such as reduction of organization strength, acquiring another company, organization venturing into new business, need to modify in the original software may arise.

System Maintenance is the modification of a software product after delivery to correct faults, to improve performance or other attributes. A common perception of maintenance is that it merely involves fixing defects. However, one study indicated that over 80% of maintenance effort is used for non-corrective actions. This perception is perpetuated by users submitting problem reports that in reality are functionality enhancements to the system. More recent studies put the bug-fixing proportion closer to 21%. System maintenance and evolution of systems was first addressed by Meir M. Lehman in 1969. Over a period of twenty years, his research led to the formulation of Lehman's Laws (Lehman 1997). Key findings of his research include that maintenance is really evolutionary development and that maintenance decisions are aided by understanding what happens to systems (and software) over time. Lehman demonstrated that systems continue to evolve over time. As they evolve, they grow more complex unless some action such as code refactoring is taken to reduce the complexity. In the late 1970s, a famous and widely cited survey study by Lientz and Swanson, exposed the very high fraction of life-cycle costs that were being expended on maintenance. They categorized maintenance activities into four classes:

- Adaptive – modifying the system to cope with changes in the software environment (DBMS, OS)
- Perfective – implementing new or changed user requirements which concern functional enhancements to the software
- Corrective – diagnosing and fixing errors, possibly ones found by users
- Preventive – increasing software maintainability or reliability to prevent problems in the future

The survey showed that around 75% of the maintenance effort was on the first two types, and error correction consumed about 21%. Many subsequent studies suggest a similar magnitude

of the problem. Studies show that contribution of end user is crucial during the new requirement data gathering and analysis. And this is the main cause of any problem during software evolution and maintenance. So System maintenance is important because it consumes a large part of the overall lifecycle costs and also the inability to change software quickly and reliably means that business opportunities are lost.

IEEE provides a framework for sequential maintenance process activities. It can be used in iterative manner and can be extended so that customized items and processes can be included. These activities go hand-in-hand with each of the following phase:

- **Identification & Tracing** - It involves activities pertaining to identification of requirement of modification or maintenance. It is generated by user or system may itself report via logs or error messages. Here, the maintenance type is classified also.

- **Analysis** - The modification is analyzed for its impact on the system including safety and security implications. If probable impact is severe, alternative solution is looked for. A set of required modifications is then materialized into requirement specifications. The cost of modification/maintenance is analyzed and estimation is concluded.

- **Design** - New modules, which need to be replaced or modified, are designed against requirement specifications set in the previous stage. Test cases are created for validation and verification.

- **Implementation** - The new modules are coded with the help of structured design created in the design step. Every programmer is expected to do unit testing in parallel.

- **System Testing** - Integration testing is done among newly created modules. Integration testing is also carried out between new modules and the system. Finally the system is tested as a whole, following regressive testing procedures.

- **Acceptance Testing** - After testing the system internally, it is tested for acceptance with the help of users. If at this state, user complaints some issues they are addressed or noted to address in next iteration.

- **Delivery** - After acceptance test, the system is deployed all over the organization either by small update package or fresh installation of the system. The final testing takes place at client end after the software is delivered. Training facility is provided if required, in addition to the hard copy of user manual.

- **Maintenance management** - Configuration management is an essential part of system maintenance. It is aided with version control tools to control versions, semi-version or patch management.

10.5 SYSTEM MAINTENANCE PROCESSES

This section describes the six System maintenance processes as:

1. The implementation process contains software preparation and transition activities, such as the conception and creation of the maintenance plan; the preparation for handling problems identified during development; and the follow-up on product configuration management.
2. The problem and modification analysis process, which is executed once the application has become the responsibility of the maintenance group. The maintenance programmer must analyze each request, confirm it and check its validity, investigate it and propose a solution, document the request and the solution proposal, and finally, obtain all the required authorizations to apply the modifications.
3. The process considering the implementation of the modification itself.
4. The process acceptance of the modification, by confirming the modified work with the individual who submitted the request in order to make sure the modification provided a solution.
5. The migration process is exceptional, and is not part of daily maintenance tasks. If the software must be ported to another platform without any change in functionality, this process will be used and a maintenance project team is likely to be assigned to this task.
6. Finally, the last maintenance process, also an event which does not occur on a daily basis, is the retirement of a piece of software.

10.6 TYPES OF SYSTEM MAINTENANCE

In a software lifetime, type of maintenance may vary based on its nature. It may be just a routine maintenance tasks as some bug discovered by some user or it may be a large event in itself based on maintenance size or nature. Following are some types of maintenance based on their characteristics:

- **Corrective Maintenance** - This includes modifications and updations done in order to correct or fix problems, which are either discovered by user or concluded by user error reports.
- **Adaptive Maintenance** - This includes modifications and updations applied to keep the software product up-to date and tuned to the ever changing world of technology and business environment.
- **Perfective Maintenance** - This includes modifications and updates done in order to keep the software usable over long period of time. It includes new features, new user requirements for refining the software and improve its reliability and performance.
- **Preventive Maintenance** - This includes modifications and updations to prevent future problems of the software. It aims to attend problems, which are not significant at this moment but may cause serious issues in future.

10.7 REVIEW QUESTIONS

1. Discuss the System Implementation in detail.
2. Write in detail about the process of system implementation.
3. Explain the significance of changeover and how it is done in an organization.
4. What are the approaches used for System Evaluation? Discuss.
5. Write in detail about System Maintenance in the organizations.

Answers to Exercise I

1. True
2. True
3. True
4. False

5. False

10.8 SUGGESTED READINGS

1. D. P. Goyal : Management Information Systems Managerial Perspectives
2. Sahil Raj : Management Information Systems
3. O'Brien : Introduction to Information Systems
4. K. Laudon, J. Laudon : Management Information Systems Managing the Digital Firm
5. G.B. Davis, M.H. Olson : Management Information Systems

CHAPTER 11: EMERGING ISSUES IN INFORMATION SYSTEMS

STRUCTURE

11.0 OBJECTIVES

After reading this chapter the students must understand:

- Concepts of Supply Chain Management
- Supply Chains as Information Systems
- Concepts of Customer Relationship Management
- Need and scope of Customer Relationship Management
- Advantages and Disadvantages of Customer Relationship Management

11.1 INTRODUCTION TO SUPPLY CHAIN MANAGEMENT

Supply Chain Management is defined as the management and integration of all the strategic partners in the value chain of an organization which includes the suppliers and the customers, the suppliers' suppliers and the customers' customers reaching down to the producers and the

end users. It also involves the management of the flow of products, services and information right from the starting point of production i.e. procurement of the raw materials to the actual delivery of the final product to the customers. As there can be innumerable players involved in this process i.e. the firms supply chain, Supply Chain management considers every intermediary which may be strategically important or seem to be creating value for the organization or the customers. The ultimate aim of the Supply Chain management is to satisfy the customer needs and in turn help the organization increase its profitability.

11.2 BASIC CONCEPTS IN SUPPLY CHAIN MANAGEMENT

11.2.1 THE SUPPLY CHAIN

A firm's supply chain is a network of organizations and business processes for procuring raw materials, transforming these materials into intermediate and finished products, and distributing the finished products to customers. It links suppliers, manufacturing plants, distribution centers, retail outlets, and customers to supply goods and services from source through consumption. Materials, information, and payments flow through the supply chain in both directions Goods start out as raw materials and, as they move through the supply chain, are transformed into intermediate products (also referred to as components or parts), and finally, into finished products. The finished products are shipped to distribution centers and from there to retailers and customers. The returned items flow in the reverse direction from the buyer, back to the seller.

The upstream portion of the supply chain includes the company's suppliers, the suppliers' suppliers, and the processes for managing relationships with them. The downstream portion consists of the organizations and processes for distributing and delivering products to the final customers. Companies doing manufacturing, such as Nike's contract suppliers of sneakers, also manage their own internal supply chain processes for transforming materials, components, and services furnished by their suppliers into finished products or intermediate products (components or parts) for their customers and for managing materials and inventory

A supply chain can be classified into three types based on the degree of complexity that may exist in them. These are:

a. Straight supply chain
b. Comprehensive supply chain

c. Definitive supply chain

A straight supply chain is a simple structure having just the firm supplier and the customer, a comprehensive supply chain caters to the customers' customers and the suppliers' suppliers and the third degree definitive supply chain involves every firm involved from the ultimate supplier to the ultimate customer.

11.2.2 SUPPLY CHAINS AND INFORMATION SYSTEMS

In organizations inefficiencies in the supply chains are inevitable, especially in the traditional management control systems. These inefficiencies in the supply chain, such as parts shortages, underutilized plant capacity, excessive finished goods inventory, or high transportation costs, are caused by inaccurate or untimely information. These supply chain inefficiencies waste as much as 25 percent of a company's operating costs. Everything here is dependent on the information which is or can be available to the decision makers at the right time, if a manufacturer has perfect information about exactly how many units of product customers wanted, when they wanted them, and when they could be produced, it would be possible to implement highly efficient strategies. A system very similar to the just in time model can be achieved where the components would arrive exactly at the moment they were needed and finished goods would be shipped as they leave the assembly line.

This is where information systems find application as this is where the availability of time and accurate information by the information help the organizations achieve such standards.

11.3 BUSINESS PROCESS INTEGRATION

Successful SCM requires a change from managing individual functions to integrating activities into key supply chain processes. In an example scenario, a purchasing department places orders as its requirements become known. The marketing department, responding to customer demand, communicates with several distributors and retailers as it attempts to determine ways to satisfy this demand. Information shared between supply chains partners can only be fully leveraged through process integration. Supply chain business process integration involves collaborative work between buyers and suppliers, joint product development, common systems, and shared information.

The business processes such as those stated below can be said to be integrated using these systems:

1. **Customer service management process:** Customer relationship management concerns the relationship between an organization and its customers. Customer service is the source of customer information. It also provides the customer with real-time information on scheduling and product availability through interfaces with the company's production and distribution operations. Successful organizations use the following steps to build customer relationships:

    - determine mutually satisfying goals for organization and customers
    - establish and maintain customer rapport
    - induce positive feelings in the organization and the customers

2. **Procurement process:** Strategic plans are drawn up with suppliers to support the manufacturing flow management process and the development of new products. In firms whose operations extend globally, sourcing may be managed on a global basis. The desired outcome is a relationship where both parties benefit and a reduction in the time required for the product's design and development. The purchasing function may also develop rapid communication systems, such as electronic data interchange (EDI) and Internet linkage, to convey possible requirements more rapidly. Activities related to obtaining products and materials from outside suppliers involve resource planning, supply sourcing, negotiation, order placement, inbound transportation, storage, handling, and quality assurance, many of which include the responsibility to coordinate with suppliers on matters of scheduling, supply continuity, hedging, and research into new sources or programs.
3. **Product development and commercialization:** Here, customers and suppliers must be integrated into the product development process in order to reduce the time to market. As product life cycles shorten, the appropriate products must be developed and successfully launched with ever-shorter time schedules in order for firms to remain competitive. According to Lambert and Cooper (2000), managers of the product development and commercialization process must:

    a. Coordinate with customer relationship management to identify customer-articulated needs;

b. Select materials and suppliers in conjunction with procurement; and
c. Develop production technology in manufacturing flow to manufacture and integrate into the best supply chain flow for the given combination of product and markets.

4. **Manufacturing flow management process:** The manufacturing process produces and supplies products to the distribution channels based on past forecasts. Manufacturing processes must be flexible in order to respond to market changes and must accommodate mass customization. Orders are processes operating on a just-in-time (JIT) basis in minimum lot sizes. Changes in the manufacturing flow process lead to shorter cycle times, meaning improved responsiveness and efficiency in meeting customer demand. This process manages activities related to planning, scheduling, and supporting manufacturing operations, such as work-in-process storage, handling, transportation, and time phasing of components, inventory at manufacturing sites, and maximum flexibility in the coordination of geographical and final assemblies postponement of physical distribution operations.
5. **Physical distribution:** This concerns the movement of a finished product or service to customers. In physical distribution, the customer is the final destination of a marketing channel, and the availability of the product or service is a vital part of each channel participant's marketing effort. It is also through the physical distribution process that the time and space of customer service become an integral part of marketing. Thus it links a marketing channel with its customers (i.e., it links manufacturers, wholesalers, and retailers).
6. **Outsourcing/partnerships:** This includes not just the outsourcing of the procurement of materials and components, but also the outsourcing of services that traditionally have been provided in-house. The logic of this trend is that the company will increasingly focus on those activities in the value chain in which it has a distinctive advantage and outsource everything else. This movement has been particularly evident in logistics, where the provision of transport, warehousing, and inventory control is increasingly subcontracted to specialists or logistics partners. Also, managing and controlling this network of partners and suppliers requires a blend of central and local involvement: strategic decisions are taken centrally, while the monitoring and control of supplier performance and day-to-day liaison with logistics partners are best managed locally.

7. **Performance measurement:** Experts found a strong relationship from the largest arcs of supplier and customer integration to market share and profitability. Taking advantage of supplier capabilities and emphasizing a long-term supply chain perspective in customer relationships can both be correlated with a firm's performance. As logistics competency becomes a critical factor in creating and maintaining competitive advantage, measuring logistics performance becomes increasingly important, because the difference between profitable and unprofitable operations becomes narrower. A.T. Kearney Consultants noted that firms engaging in comprehensive performance measurement realized improvements in overall productivity. According to experts internal measures are generally collected and analyzed by the firm, including cost, customer service, productivity, asset measurement, and quality. External performance is measured through customer perception measures and "best practice" benchmarking.
8. **Warehousing management:** To reduce a company's cost and expenses, warehousing management is concerned with storage, reducing manpower cost, dispatching authority with on time delivery, loading & unloading facilities with proper area, stock management system etc.
9. **Workflow management:** Integrating suppliers and customers tightly into a workflow (or business process) and thereby achieving an efficient and effective supply chain is a key goal of workflow management.

11.4 INFORMATION SYSTEMS AS FACILITATORS OF SCM

So as discussed above information systems can act as facilitators of Supply Chain Management. Here are some points elaborating how information by Supply Chain Management systems can help firm with:

1. Decide when and what to produce, store, and move: Only the production of products is not enough but making products according to user requirements, when to produce these products on the basis of seasonal, cyclic trends, inventory levels etc., where the storage has to be done, what levels of inventory need to be maintained, for which season, category etc., which choices of logistics can be used, which would be apt to our business model are some of the aspects which the Supply Chain Management applications can help us understand.

2. Rapidly communicate orders: Communication is the key to fulfillment of each and every objective, if the parties involved in fulfillment of the objective do not communicate well the objective is bound to fail. Supply chains may span over a variety of suppliers, distributors and customers, and maintaining communication channels over such a high number of participants can be difficult to maintain. Supply Chain Management systems can help the organizations communicate information faster and also provide instant feedback channels making communication a strong point leading to organizational profitability.
3. Track the status of orders: Another aspect that comes out of instant or real time communication channels is the fact that they provide many functional capabilities such as tracking the customers. Online sales companies these days cash heavily on these capabilities providing additional information to the end users. This can also be used to control production and inventory management dynamics in the organization.
4. Check inventory availability and monitor inventory levels: Inventory levels, the demand for the products and the production of the product are highly interdependent functions in an organization. The restocking of the inventory is done according to the production process. Supply Chain Management systems help us continuously monitor the levels of inventory the organization hold and can prompt the organizations for restocking in case the inventory levels dip.
5. Reduce inventory, transportation, and warehousing costs: with advanced inventory management and monitoring techniques available, the organizations can better manage the inventories thereby reducing considerably the amount of idle inventories they have to maintain in the warehouses, some organizations even manage to establish precise just in time schedules using them, saving them inventory costs. Similarly with better coordination and communication and better strategies and background support to deal with the problems in front of the firms, the overall costs involved in transportation and warehousing also decrease.
6. Track shipments: In addition to tracking of orders which can be done by the customers, in house tracking of the shipments to be received by the suppliers etc. can also be easily done by the organizations.
7. Plan production based on actual customer demand: on major advantage of Supply chain Management Systems can be that they connect the organizations to the customers, no matter the number of intermediaries which may exist in between the organization and the ultimate end users, there is a provision of feedback from the

customers which can be received and analyzed by the organization. This feedback can act as a tool for improvement and organization can work on what they are producing and what they need to produce. Production can be planned directly according to the firsthand knowledge provided by customers who can prove to be highly advantageous for the organizations.

8. Rapidly communicate changes in product design: Changes in the product design can be incorporated on the basis of real-time feedback from the supply chain, which may have generated from the customers or even the suppliers.

EXERCISE I (State whether true or false)

1. Supply chain includes the suppliers, distributers and the customers of an organization.
2. Supply Chain Management involves integration of all strategic partners in the value chain of the organization.
3. Supply chains may be single, comprehensive and definitive in nature.
4. Customer relationship management can be considered a subset of SCM functionality.
5. Other communication channels with the partners also need to be maintained in addition to Supply chain Management Systems

11.5 INTRODUCTION TO CUSTOMER RELATIONSHIP MANAGEMENT

Customer Relationship Management is a strategy by which the companies optimize the profitability of the organizations by enhanced customer service and thus customer satisfaction. Customer Relationship Management is about the customer centric business processes in the organization i.e. sales, Marketing, Service etc. The basic aim here is not just automating these processes but on the whole ensuring that customer satisfaction is a by-product of the front end usage of these systems resulting in adding customer loyalty and the ultimate organizational objective of profitability. The important thing to note here is that the front can only be effective and desirable to the customers if it has good back end support. Therefore the system should be an integration o customer service backed with internal back end systems that provide the basis for customer satisfaction. Therefore the model that would work would be the one with customer centric objectives but a system with integrated front and back end processes providing satisfactory customer experiences.

Parvatiyar and N. Sheth provide an excellent definition for customer relationship management in their work titled - 'Customer Relationship Management: Emerging Practice, Process, and Discipline':

“Customer Relationship Management is a comprehensive strategy and process of acquiring, retaining, and partnering with selective customers to create superior value for the company and the customer. It involves the integration of marketing, sales, customer service, and the supply-chain functions of the organization to achieve greater efficiencies and effectiveness in delivering customer value.”

Customer relationship management is an enterprise application module that manages a company's interactions with current and future customers by organizing and coordinating, sales and marketing, and providing better customer services along with technical support.

The focus in Customer Relationship Management applications is always on the customer. In the present era of business operations, the customer is the king. Organizations want to or we can say need to be in contact with the customers at every stage in the process of sales. The pre sales activity and the post sales activity, both require direct contact with the customers. Moreover, as the size of the organization increases, the information is spread into various departments. For any organization, it is important to have information at one central place in the organization. Centralization in small organization with simple structures is feasible but when the size and operations of organizations increase the size starts to increase the complexity in managing the information. There also needs to be increased co ordination between departments so that delivery of products and services can be timely and according to the satisfaction of the customers.

11.6 TYPES OF CUSTOMER APPLICATION SOFTWARES

1. **Call centers:** As well as tracking, recording and storing customer information, customer relationship management systems in call centers codify the interactions between company and customers by using analytics and key performance indicators to give the users information on where to focus their marketing and customer service. The intention is to maximize average revenue per user, decrease churn rate and decrease idle and unproductive contact with the customers. Customer relationship management software can also be used to identify and reward loyal customers over a period of time. Growing in popularity is the idea of gamifying

customer service environments. The repetitive and tedious act of answering support calls all day can be draining, even for the most enthusiastic customer service representative. When agents are bored with their work, they become less engaged and less motivated to do their jobs well. They are also prone to making mistakes. Gamification tools can motivate agents by tapping into their visceral need for reward, status, achievement, and competition.

2. **Business-to-business:** According to a sweeney group definition, CRM is "all the tools, technologies and procedures to manage, improve, or facilitate sales, support and related interactions with customers, prospects, and business partners throughout the enterprise". It assumes that customer relationship management is involved in every b2b transaction. Despite the general notion that customer relationship management systems were created for the customer-centric businesses, they can also be applied to b2b environments to streamline and improve customer management conditions. For the best level of customer relationship management operation in a b2b environment, the software must be personalized and delivered at individual levels. The main differences between b2c and b2b Customer Relationship Management systems are as follows:

    - B2b companies have smaller contact databases than b2c.
    - The volume of sales in b2b is relatively small.
    - In b2b there are less figure propositions, but in some cases they cost a lot more than b2c items.
    - Relationships in b2b environment are built over a longer period of time.
    - B2b Customer Relationship Management must be easily integrated with products from other companies. Such integration enables the creation of forecasts about customer behavior based on their buying history, bills, business success, etc.
    - An application for a b2b company must have a function to connect all the contacts, processes and deals among the customers segment and then prepare a paper.
    - Automation of sales process is an important requirement for b2b products. It should effectively manage the deal and progress it through all the phases towards signing.

- A crucial point is personalization. It helps the b2b company to create and maintain strong and long-lasting relationship with the customer.

3. **Social media:** Balaram presented evidence of a significant increase in the use of social networking sites, especially among young people. This has caused companies to use these sites to draw attention to their products, services and brands, with the aim of building up customer relationships to increase demand. Some Customer Relationship Management systems integrate social media sites like twitter, LinkedIn and facebook to track and communicate with customers sharing their opinions and experiences with a company, products and services.
4. **Other types:** Some Customer Relationship Management software is available as software as a service, delivered via the internet and accessed via a web browser instead of being installed on a local computer. Businesses using the software do not purchase it, but typically pay a recurring subscription fee to the software vendor. For small businesses a Customer Relationship Management system may consist of a contact manager system which integrates emails, documents, jobs, faxes, and scheduling for individual accounts. Customer Relationship Management systems available for specific markets (legal, finance) frequently focus on event management and relationship tracking as opposed to financial return on investment (ROI). Customer-centric relationship management (Customer Relationship Management) is a nascent sub-discipline that focuses on customer preferences instead of customer leverage. Customer Relationship Management aims to add value by engaging customers in individual, interactive relationships. Systems for non-profit and membership-based organizations help track constituents, fund-raising, sponsors demographics, membership levels, membership directories, volunteering and communication with individuals

11.7 NEED FOR CUSTOMER RELATIONSHIP MANAGEMENT

The popularity of Customer Relationship Management systems is fed by the fact that better understanding of the customers is beneficial for both customers and the enterprises. Better service quality not only provides tremendous value to customer but also in turn to the organizations. Customer Relationship Management arose due to several reasons. Some of them can be:

1. To keep track of all present and future customers:
2. To identify and target the best customers.
3. To let the customers know about the existing as well as the new products and services.
4. To provide real-time and personalized services based on the needs and habits of the existing customers.
5. To provide superior service and consistent customer experience.
6. To implement a feedback system.
7. To try and retain customers by enhanced satisfaction due to high responsiveness of the organization.
8. Identification of most profitable customers and focusing on them and then treating them accordingly.
9. Reduce Marketing costs by developing effective sales campaigns.
10. Increased sales by offering new/ correct products according to customer needs.
11. Improve communications channels and thus the understanding of user needs.
12. Direct qualified leads to appropriate sales channels.

11.8 SCOPE OF CUSTOMER RELATIONSHIP MANAGEMENT

Customer Relationship Management systems find applications in the following areas in management:

1. Marketing and fulfillment: Marketing is always done according to needs and wants of the customers. Everything from the products to be made, the features they would have, the quality levels we wish to maintain, the price we decide for the product, the channels of delivery, everything related to marketing of the product id directly dependent upon the customer requirements. Therefore Customer Relationship Management systems act as a link in between the organization and the customer which help us receive direct feedback from the end users to get to know their tastes and preferences and therefore build our marketing strategies on the basis of this information and therefore allowing fulfillment or the customer needs and wants. These systems can help us implement campaign management, opportunity

management, web based encyclopedias, market segmentation, lead generation/ enhancement and tracking facilities etc.

2. Sales (cross-sell up-sell and telesales): Sales is one of the most important aspects of business, talking in practical and operational terms. In order to get competitive advantage and greater profitability, the sales of the organization have to be high. To ensure this marketers generally engage in selling techniques such as cross selling and up selling etc. Cross selling involves selling of related products along with the sale in which the customer may be interested and up sell means selling extra items or items of greater value to a customer. These techniques can only be applied when the seller has some information about such taste and preferences or trends related to the products and services provided by the organizations therefore enabling the marketers to increase their sales using the information the Customers Relationship Management software provide. This also provides information in the form of details of the prospective customers which may be contacted using tele-services in order to pursue for selling the products.
3. Customer service and support: The focus in the organizations these days is the customer and the Customer Relationship Management Software specifically focuses on customer support and service needs. Customer Relationship Management applications helps the organization achieve these high standard for customer service in addition to the product provided by the organizations. These systems support query handling, complaint registries, tracking of orders, expected delivery schedules, review and rating options etc. which may be provided to the customers to enhance the customer service experience. This can be done by incident assignment, escalation, tracking, reporting, problem management, problem resolution channels, order processing, order recording, warranties and contract management.
4. Retention and loyalty: Customer Relationship Management systems provide better customer experience, therefore generating satisfaction from the side of the customer. When the right products are delivered to the customers along with the correct, timely and desirable customer service experiences this leads to customer retention. As the customers tend to buy again and again from the organization they are said to be loyal to the organization and this can only be made possible due to Customer Relationship Management Systems.
5. Store front and field service: Customer Relationship Management applications sometimes act as the interactive channel from which the customers can directly buy

the products; this can be seen extensively being used in the case of online sales. Various e commerce websites are ruling the sales in volumes and numbers by each passing year. Customer Relationship Management software can produce the virtual store experiences for the customers. Also the task of field service including preparation for work orders, dispatching, real-time information transfer to field personnel via mobile technologies.

6. Data Synchronization: Customer Relationship Management applications being a consolidated system having complete present and past information regarding the data and information that the system posses about the customers of the organizations. This consolidated system can be used in enterprise wide synchronization or implementation of other types of systems in order to produce organization wide applications/ database services.
7. Executive information Source: they provide information which is pivotal for organizations especially the marketing department of the organization. They provide executive level support by the extensive reporting tools etc.

11.9 ADVANTAGES OF CUSTOMER RELATIONSHIP MANAGEMENT

Some of the advantages of Customer relationship Management Software can be:

1. Provides better customer service and increases customer revenues: Customer Relationship Management software focus on the customers of the business and collect assimilate and refine information about the customers thereby providing better services to the customers.

2. Discovers new customers: with the innumerable functionalities that can be incorporated into the Customer Relationship Management applications, the organizations can get detailed information in the form of customers reviews and feedback stored in the systems which can be utilized in order to form new products of services which they thinks the customer desires or needs in the future.

3. Cross-sells and up-sells products more effectively: Having enough information about the prospective customers helps the organizations know customer needs in details and use techniques such as up-sell of cross sell in order to increase sales and thus profitability of the system.

4. Helps sales staff to close deals faster: With availability of large amounts of information, and with the details about the person or the customer are known already about the organizations customers, it is possible to ensure higher sales. This helps the staff sell the product very easily and more effectively using various techniques such as details which help the organizational executives to close calls much easier.

5. Makes call centers more efficient: one of the major applications of Customer Relationship Management Systems is working in customer satisfaction, therefore as cal centre play important roles in query or problem solving which is the major concern in the case of call centers etc.

6. Simplifies marketing and sales processes: availability of information can prove to be rather helpful in the decision making related to sales and marketing operations in the organizations.

11.10 DISADVANTAGES OF CUSTOMER RELATIONSHIP MANAGEMENT

Some of the disadvantages of customer relationship management:

1. Sometimes record loss is a major problem: Data is one of the most important and strategic resource for the organizations and data loss or data corruption is two problems that organizations may face in this context. Therefore when an organization faces data loss or corruption this can be major issue for the organization.

2. Overhead costs: There may be many additional costs to implement Customer Relationship Management Systems other than the direct costs incurred on the resources used for development or implementation of these systems.

3. Giving training to employees is an issue in small organizations: Giving training to the employees given the mindset of the employees in small organizations is a big task. Generally big business organizations have already set formals channels etc. through which changes can be easily incorporated which may sometimes prove tricky in small organizations.

4. Differential treatment of some Customers while different for others may generate a felling of favoritism.

EXERCISE II (State whether true or false)

1. CRM applications provide a comprehensive approach to making new, retaining old and maintaining customers.
2. CRM applications can be call centre applications, B2B and social media applications.
3. CRM applications help increase customer loyalty and retention
4. The need for CRM arises in case of need for higher customer satisfaction.
5. CRM applications can in no case act disadvantageous for the organizations.

11.11 REVIEW QUESTIONS

1. Write in detail about Supply Chain Management and the need for SCM applications.
2. What is a Supply Chain? Explain different types of Supply Chains.
3. Which business processes are facilitated by Supply Chain Management Systems?
4. What are Customer Relationship Management Systems?
5. Where do CUSTOMER RELATIONSHIP MANAGEMENT applications find scope in organizations?

Answers to Exercise I

1. True
2. True
3. True
4. True
5. False

Answers to Exercise II

1. True
2. True
3. True
4. True
5. False

11.12 SUGGESTED READINGS

1. Sahil Raj : Management Information Systems
2. D. P. Goyal : Management Information Systems Managerial Perspectives
3. O'Brien : Introduction to Information Systems
4. K. Laudon, J. Laudon : Management Information Systems Managing the Digital Firm
5. G.B. Davis, M.H. Olson : Management Information Systems

CHAPTER 12: ENTERPRISE RESOURCE PLANNING

STRUCTURE

12.0 OBJECTIVES

After reading this chapter the students must understand:

- Concepts of Enterprise Resource Planning
- Enterprise Resource Planning Implementation
- Role of manager and issues in Enterprise Resource Planning Implementation
- Need for Enterprise Resource Planning
- Concepts of Data Warehousing
- Characteristics of Data Warehouses
- Concepts of Data mining

12.1 INTRODUCTION TO ENTERPRISE RESOURCE PLANNING

Enterprise Resource Planning software is build for enterprise wide effectiveness and coordination in order to bring about improvement in the functional areas of the organization.

Enterprise Resource Planning can be defined as a platform for integrating; standardizing and optimizing the business processed for effective functioning of an organization and enables the firm to gain competitive advantage.

The main aim of Enterprise Resource Planning is to integrate the various functional areas of an enterprise. It can be notes that when enterprises grow in size, individual functional areas or units start acting as more or less individual units with their own sets of aims and objectives. With relatively more complex organizational structures in play these days such as the strategic Business Units etc., we see that the SBUs are entirely independent units handling their own goals and in fact their own profits and losses. In such a business sense and environment it is possible that the organizational objectives may suffer in the face of individual unit's objectives. But when organization wide effectiveness has to be seen it is necessary that there is subordination of individual goals to organizational goals. This can be achieved through coordination and Enterprise Resource Planning helps organizations achieve that.

The tools of the Enterprise Resource Planning are used to access data from the whole organization and can be applied to the whole organization as well. Enterprise Resource Planning applications can be viewed from tree aspects in an organization namely

- Standardization of processes
- Optimum business performance in terms of cost and efficiency
- A manifesto of novelty

Resources in organization are always limited and Enterprise Resource Planning helps the organizations to help achieve optimization in usage such that the functional areas act in unison with each other keeping in mind the central goals of the organization.

12.2 CHARACTERISTICS OF ENTERPRISE RESOURCE PLANNING

An Enterprise Resource Planning application can be characterized as follows:

1. REAL TIME OPERATIONS: Enterprise Resource Planning applications find their meaning in real time operations only, this is because every functional unit has to be sensitive to the changes made in one system and has to respond to those changes eventually and this cannot happen with lags because lags would create inconsistency in the system data.

2. INTEGRATION OF ALL BUSINESS ACTIVITIES: One of the main functions of Enterprise Resource Planning is to plan control and optimize resources in the organization. This can only be done by integrating the business activities happening in the organization which would lead to increased coordination and collaborative actions by the various business units in the organization. The ultimate aim of coordination is it for resource allocation or for any other purpose is increasing the efficiency and effectiveness of the organization which would lead to profitability for the organization.
3. PROCESS VIEW RATHER THAN FUNCTIONAL VIEW: The focus in Enterprise Resource Planning is not on the various business functions in the organizations but rather on the business processes that they perform. The Enterprise Resource Planning applications focus on the processes being performed because of the sole reason that the data generated from various business processes can be utilized by many business functions at different points in time for different purposes.
4. FLOW OF INFORMATION: the coordination and integration that the Enterprise Resource Planning work upon is based upon the sharing of data and information resources of the organization and the flow of information that can be achieved when these data and information sources are shared by the various functional units. Enterprise Resource Planning applications ensure the flow of information not only within the organization but also beyond the organizational boundaries i.e. with the customers suppliers, distributors etc. data once entered in a Enterprise Resource Planning system can then be accessed anytime anywhere using the technological communication channels by the various stakeholders to wish to do so on the basis of the privileges they have received from the organizations.
5. BEST PRACTICES: The best practices which the organization can utilize for the optimization of business prices are used in the Enterprise Resource Planning applications. This would ultimately ensure that the performance that the system needs to achieve for the organization can be achieved.

12.3 ENTERPRISE RESOURCE PLANNING IMPLEMENTATION

Enterprise Resource Planning implementation needs to be taken care of at both hardware and software levels. Many software for development of Enterprise Resource Planning applications are available which can be used as and when required on the basis of area of

application in the organization. On the hardware and software synchronization, a centralized databases capability is required to be implemented in the organization. There is a high level of complexity involved in implementation of such systems in the organizations, the level of complexity also increases with the size of the organization , the level of operation, the larger the organization the process of development of the system for such a organization become even more complex. Sometimes reaching out extreme technological teams for development of custom made application organizations do go for existing standard Enterprise Resource Planning application software.

In the turbulent environment the organizations today work in , even organization needs to strive for competitive advantages and this even small players in the markets tends to go Enterprise Resource Planning systems which ultimately become the backbone for these businesses. As these systems are highly complex and sometimes built from scratch and they aim to change the way organization operate, they sometimes bring about large changes in the way organizations work, their work practices and processes sometime leading to Business process reengineering. As the complexity and the aftermath of such implementation if huge the firms providing Enterprise Resource Planning solutions provide consultancy, implementation and maintenance services to the organizations. The solutions provided can be on the basis of the size of the organization, scope of the change required and the willingness of the firm to take ownership.

12.3.1 ROLE OF MANAGER IN IMPLEMENTING ENTERPRISE RESOURCE PLANNING

Managers at all levels in the organizations play an important or rather pivotal role in implementation of Enterprise Resource Planning application. The systems require immense participation from the managers, starting from the conception of the ideas to complete physical implementation in the organizations. All the three levels have to be actively involved in making these systems actually work for the organizations the way they are expected to. The following are some roles played by managers in implementation Enterprise Resource Planning:

1. COMMITMENT AND SUPPORT: The idea conception of building the Enterprise Resource Planning projects generally comes from the top management in the organizations because these are generally strategic decisions having very long term implications for the organizations. Even at lower levels the management the

managers have to remain committed to this idea or vision of the top management. They have to work and support the process at every stage providing the support which may be required from their side.

2. CHANGE MANAGEMENT: As Enterprise Resource Planning brings about drastic changes in the process of increase effectiveness and efficiency of the systems it is the duty of the managers at all levels to help implement these changes smoothly and at a pace acceptable to the organization. The change can be implemented in three ways i.e.
    - Dismantling,
    - Changeover and
    - Winding up.

    Dismantling involves the setting up the ground for change to smoothly take place in the organization. The employee in most situations are hesitant to change, sometimes even opposing it, therefore it is the duty of managers to create a mindset by dismantling the previous views and processes. This can be done by telling the disadvantages of the present systems, or by giving benefits of the change to be incorporated, providing examples of some role models or of similar firm who have successfully implemented such changes. Then comes the changeover where a lot of confusion about roles, formal channels, or formal process standard may prevail, this can be sorted out by discussions, counseling on what needs to be done and what has to happen in the future. Then comes the process of winding up, here the process has fallen into place and the users have adapted to the change that has taken place in the organization, but even then it is important to keep the users motivated regarding the present system so that long term benefit of the Enterprise Resource Planning applications can be availed by the organization.

3. COST CONSIDERATIONS: Developing a Enterprise Resource Planning application for an organization can be a costly affair, also it is a lengthy affair so the outputs come after a considerable amount of time and in some cases are abstract in nature which cannot be easily quantified, therefore cost considerations have to be taken into account before deciding on the type of the level to which the organization wants Enterprise Resource Planning to be implemented in the organization. Costs to

be incurred depend upon the size of the firm or the degree to which implementation id done and the methodology applied for doing that.

4. COMMUNICATION: The first step for the top management once the idea is conceived is to communicate the idea of Enterprise Resource Planning to the organization and in a manner such that it can be implemented in the way they envision it. Then effective communication also forms the basis is the process of change management. A communication plan should be made in the following manner:
    - Create awareness and justify the need of Enterprise Resource Planning implementation
    - Provide step by step demonstration of software modules as applicable to the departments of the firm and the business processes
    - Explain strategies used by the firm to bring in changes
    - Decide communication points to address queries and grievances
    - Provide periodic updates
5. RISK MANAGEMENT: Risk management is necessary for the organizations because Enterprise Resource Planning is a long term decision involving a lot of resources in the form of time effort and money. The organizations use risk management to deal with unexpected crisis arising from Enterprise Resource Planning. The organizations use contingency plans and system which may provide the organizations with signals or warning in case of any deviation from the plans. The managements should note down these deviations and should suggest some corrective actions or alternate plans which can be executed in case the deviation occur.
6. TRAINING: Enterprise Resource Planning are extremely complex and contain various parts which are implemented enterprise wide. These systems even though made for the user have a basic level of technical difficulty when it comes to operations. Many Enterprise Resource Planning systems implemented by the organizations fail because of lack of training inadequate skills with the employees to operate these systems. The end users of the organizations should be trained and imparted skills as required by the system. The management should ensure that the training provided in apt and is fulfilling the objectives that it needs to. Even though Enterprise Resource Planning systems are made to order and are made such that

they fir the requirements of the end users, even then some basic training to use and adapt to the systems is required. Some vendors provide training with the implementation of the systems in the organization which is provided right after the systems are implemented in the organization which also decreased the reliance of the organizations on external contractors for maintenance etc.

7. PROJECT TEAM COMPETENCE: This role is quite obvious but is often ignored just because it is not that explicitly focused on by the management. Team which has to manage and implement the transition that the organization has to go through, the team should be competent enough that the process of change can be done and also that the ERP is able to implement the vision of the top management and that the resultant system is able to perform the functions that it is supposed to.
8. IT INFRASTRUCTURE: all Enterprise Resource Planning solutions that we discuss are IT enabled and need hardware and software support that the organization should provide for the Enterprise Resource Planning application to be implemented. Data in the organization should be compatible with the system that is being used for implementation. Management should also have in mind the kind of system that they want to implement and the kind of monetary resources that have to be committed to the system to provide the hardware and software support required for the system.
9. VENDOR RELATIONSHIP: Successful implementation of system in the organization is directly related to the relationship and the support provided by the vendors in the development of the Enterprise Resource Planning software. The time and money spent by the vendor would directly depend on the choice of tools and techniques used for implementing them. The management should choose the vendor very carefully as it is a long term affair and the entire process of the system implementation right from the idea conception is a rather long process and cannot be fruitful if the relationship with the team implementing it is not cordial.

12.3.2 ISSUES IN IMPLEMENTING ENTERPRISE RESOURCE PLANNING

Some major issues that an organization may face when implementing Enterprise Resource Planning solution are listed below:

1. PRE-IMPLEMENTATION ISSUES: system implementation may have the following three stages i.e.
    a. Pre-implementation

b. During implementation and
c. Post-implementation

The activities performed during the pre implementation phase are done in an environment where not much information is available with the implementation team. The major focus of the teams is to work with whatever they have and in turn generate the information which would be used in the future. Also what needs to be noted that the processes done in the pre-implementation phases are of larger importance because once the planning for the system is done in a faulty manner, they ultimate product is sure to fail. Due to lack of knowledge in the planning phase, the task of collection and generating of the relevant knowledge can prove to a daunting task for the team. This can reduce the efficiency and effectiveness of the proposed system. Some of the pre implementation strategies that can be incorporated to overcome the implementation issues are incorporation of risk and quality managements plans in the change management plans phased rather than gradual implementation and strategic plans for recruitment, selection and training. Communication is the basis for effective implementation so the organizations should formulate networks to collect user requirements and feedback, carry out client consultation, and develop staff familiarity with the proposed change and technology transfer. The last and the most important task is to draft strategies and to adopt these strategies for the new Enterprise Resource Planning system.

2. COMPLEXITY OF ENTERPRISE RESOURCE PLANNING SYSTEMS: Enterprise Resource Planning applications are enterprise wide application and vary from organization to organization because or different nature, size, structure etc of the organizations. There are hardly any standard Enterprise Resource Planning applications which may apply to each and every kind of organization. Such standardization is not yet achieved by the vendors providing these solutions to the organizations. Another aspect where the complexity of these systems lay in the aspect of integration that these systems wish to provide to the organization. They wish to work on the principle of subordination of individual goals to organizational goals which can be very difficult to incorporate where different units act and behave independently in organizations. There can be conflicting goals and objectives which the system may have to deal with in order to endure optimization of processes. The next point of Business Process Reengineering especially if it is radical or massive.

The stakeholder affected by the change have to be actively involved in the change processes so that the disagreements which may arise from the customers, suppliers, distributers can be checked before they arise by considering the viewpoint of those who would eventually deal with the systems that we are there to develop for the organizations. The communication of the process should be done well in advance taking the considerations of various concerned functional employee taking them into confidence.

3. HIRING AND MANAGING CONSULTING FIRM: Enterprise Resource Planning implementation implies significant changes to organizational processes and structures, to implement such changes generally organizations take the help of a third party vendor that offers services consultation customization and support. Due to rapid expansion of Enterprise Resource Planning markets there is a shortage of standardize competent vendors and there is s dearth of consultants with specified knowledge and skills, the consultants should be skilled in Enterprise Resource Planning technology and business practices. They should also be aware of the micro business environment such as government regulations. This awareness is very important because the firms are unaware of the Enterprise Resource Planning systems complexity hence the consulting firma re required to fill the knowledge gaps. The vendors should also provide quality time to clients throughout the life cycle of the Enterprise Resource Planning. Lack of support is a major source of conflict between the client and the consulting firm.
4. KNOWLEDGE CONSTRAINTS: Enterprise Resource Planning systems and implementation is not dependent on factors such as cost or scale of operations. Even successful Enterprise Resource Planning implementations can be done with smaller firms with limited scale of operations by choosing the right system that has to be implemented. The failure may arise due to wrongful implementation misjudging the present scenario of the organization, there may also be lack of resources to commit with the organization and they may have been focusing to implement something much beyond they should have. Therefore the organization should have proper knowledge of the organization, the constraints they may have and which system would be able to fulfill their need given the constraints which apply to that particular organization.

12.4 NEED FOR ENTERPRISE RESOURCE PLANNING

Competition is inescapable in today's globalised business environment and competitive advantage over the others we are competing against is the only way of organizational success. Companies implement information systems in order to achieve the completive advantage. Enterprise Resource Planning systems have become necessary owing to the cross functional nature of the businesses today. They are imperative to implement considering the amount of redundancy and duplication that is prevalent due to the independent functional systems present in every unit in the organization. They also are the reason of the ill co ordinate units working for their individual benefits sometimes compromising the organizational gains on the whole.

Certain manufacturing firms which use Enterprise Resource Planning are best in class performers because of reduced inventory levels, accuracy and schedule and delivery compliance. These firms take timely strategic actions owing to the implementation of the Enterprise Resource Planning systems. These systems enable the firms to standardize and streamline business processes, optimize the use of the current capacities of the organization, use the latest technology, eliminate redundant process, provide global linkages, and integrate all business activities. Other than financial benefits the Enterprise Resource Planning packages also help the firm in order to avoid duplication and the effort and time wastage done for the same. They also cross functional alignment and optimized spending and improved communication and greater process flexibility. The major impact is on the Management information systems as with Enterprise Resource Planning solutions the information is now available across the organization as whole rather than scattered information as was before. They may even help the organizations to adhere to government regulations.

EXERCISE I (State whether true or false)

1. Enterprise Resource planning is used to standardize processes and optimize enterprise wide business performance.
2. Real Time operations are not necessary in Enterprise resource Planning.
3. Change Management has to go through process of dismantling, changeover and winding up.
4. Complexity of the Enterprise Resource planning software is one of the major issues in implementing ERPs in organizations.
5. The need for ERPs arose due to the increased efforts required to gain competitive advantage in today's business scenario.

12.5 INTRODUCTION TO DATA WAREHOUSING

Data warehouse is a large collection of an organizations electronically stored data. In computing, a data warehouse (DW or DWH), also known as an enterprise data warehouse (EDW), is a system used for reporting and data analysis. Data Warehouses are central repositories of integrated data from one or more disparate sources. They store current and historical data and are used for creating analytical reports for knowledge workers throughout the enterprise. Examples of reports could range from annual and quarterly comparisons and trends to detailed daily sales analyses. The data stored in the warehouse is uploaded from the operational systems (such as marketing, sales, etc., shown in the figure to the right). The data may pass through an operational data store for additional operations before it is used in the DW for reporting.

Data bases can be implemented three ways in an organization, theses are:

- OFFLINE OPERATIONAL DATABASE: Data warehouses in their initial stage are just offline systems. These are developed by simply copying the database of an operational system in the organization to an offline server where the processing load of reporting does not impact on the operational system's performance.
- OFFLINE DATA WAREHOUSE: Data Warehouse in this stage of evolutions are updated on a regular time cycle from the operational systems in the organizations and the data is stored in an integrated reporting oriented data structure.
- REALTIME DATA WAREHOUSEL Data warehouses at this stage in evolution are updated on a transaction of event basis. Every time an operational system performs a transaction for example an order or a delivery or a booking etc the warehouse gets data from that operational system.

12.6 TYPES OF SYSTEMS

The types of Data Warehouse systems which can be implemented are:

1. **Data mart:** A data mart is a simple form of a data warehouse that is focused on a single subject (or functional area), such as sales, finance or marketing. Data marts are often built and controlled by a single department within an organization. Given their

single-subject focus, data marts usually draw data from only a few sources. The sources could be internal operational systems, a central data warehouse, or external data. De-normalization is the norm for data modeling techniques in this system.

2. **Online Transaction Processing (OLTP)**

   OLTP is characterized by a large number of short on-line transactions (INSERT, UPDATE, and DELETE). OLTP systems emphasize very fast query processing and maintaining data integrity in multi-access environments. For OLTP systems, effectiveness is measured by the number of transactions per second. OLTP databases contain detailed and current data. The schema used to store transactional databases is the entity model. Normalization is the norm for data modeling techniques in this system.

3. **Online analytical processing (OLAP):** OLAP is characterized by a relatively low volume of transactions. Queries are often very complex and involve aggregations. For OLAP systems, response time is an effectiveness measure. OLAP applications are widely used by Data Mining techniques. OLAP databases store aggregated historical data in multi-dimensional schemas (usually star schemas). OLAP systems typically have data latency of a few hours, as opposed to data marts, where latency is expected to be closer to one day.

4. **Predictive analysis:** Predictive analysis is about finding and quantifying hidden patterns in the data using complex mathematical models that can be used to predict future outcomes. Predictive analysis is different from OLAP in that OLAP focuses on historical data analysis and is reactive in nature, while predictive analysis focuses on the future. These systems are also used for CRM (Customer Relationship Management)

Generally a data warehouses adopts three-tier architecture. Following are the three tiers of the data warehouse architecture.

- **Bottom Tier** - The bottom tier of the architecture is the data warehouse database server. It is the relational database system. We use the back end tools and utilities to feed data into the bottom tier. These back end tools and utilities perform the Extract, Clean, Load, and refresh functions.

- **Middle Tier** - In the middle tier, we have the OLAP Server that can be implemented in either of the following ways.

- By Relational OLAP (ROLAP), this is an extended relational database management system. The ROLAP maps the operations on multidimensional data to standard relational operations.

- By Multidimensional OLAP (MOLAP) model, this directly implements the multidimensional data and operations.

- **Top-Tier** - This tier is the front-end client layer. This layer holds the query tools and reporting tools, analysis tools and data mining tools.

12.7 CHARACTERISTICS OF DATA WAREHOUSES

Data warehouses can be characterized as follows:

1. AREA SPECIFIC: Earlier when automation came into organizations, the organizations just used simple Transaction Processing Systems in the various functional areas of the organization. Then came the era of Management information systems and they were also implemented in order to get functional outputs. Functional systems such as Human Resource Information systems, Marketing Information systems, production Information Systems were used. The application and the requirements of these systems are very function specific; therefore just dumping the data given to and generated by these systems in a common ground would serve no purpose. The Data warehouses therefore segregate the data and then store it very diligently so that the objectives that need to be fulfilled at these functional levels can be done effectively.
2. DETAILED APPROCH: Data warehouses utilize detailed past and historical data to help the management in the operations in the organizations. The earlier approaches relied more on the summarized reporting based on just certain attributes of data but that is not the case in the present scenario given the competitive world that the businesses reside in.
3. HISTORICAL: if beyond the data and information concepts, the decision making these days wants to rely on knowledge that can be generated out of the organizational data and information. This kind of knowledge which is used in the present day expert

systems is generated from huge amounts of historical data which is provided by data warehouses.

4. SECURED: Data is one of the most strategic resources that the organizations posses these days. Given the age of technology we live in, data theft and corruption are some real and dangerous problems that organizations deal with. Keeping this in mind data warehouses provide platforms with high stability security and privacy for the historical data of the organizations

12.8 INTRODUCTION TO DATA MINING

Data mining is the process of getting the relevant data out of the data warehouse that an organization may possess. The process may sound simple and easy to do but the key here is to provide precisely the output which is expected by the user. By definition data warehouses are storage spaces with extremely large amounts of data spanning over entire enterprises over very large periods of time. Therefore getting the relevant information out of these data warehouses can be a rather daunting task. Data mining tools and techniques provide critical information to the organization which may have forecasting or predictive abilities.

12.9 BENEFITS OF DATA MINING

Data mining tools can be beneficial for the organizations in several ways:

1. PREDICT THE TRENDS: Predicting the relevant trend which may happen in the future on the basis of the past information is one huge application that gets out of mining relevant information on some specific issue.
2. IDENTIFY PATTERNS: Data mining may help identify specific reoccurring data patterns; this can find application in areas such as marketing in order to know customer behavior and buying patterns etc. on the basis of this data the future strategies can be applied. For example in case of the patterns of buying, the customers can be given discounts etc.
3. DECIPHER HIDDEN INFORMATION: data present with the organizations can provide volumes of information if looked into from the right aspects. Organizations need to decipher this information in order to gain competitive advantage and this is what data mining capabilities can help them achieve. The reading between the lines, correlation different types of data, looking at the same data from different perspective does the trick and helps organizations achieve what they wish to through data mining.

4. BE PROACTIVE: in contrast to conventional information systems, these systems with data mining abilities help organization be proactive in solving problems using capabilities such a s trend analysis, forecasting, pattern identification as discusses above.

EXERCISE II (State whether true or false)

1. Data Warehouse is a large collection of electronically stored data.
2. Data warehouses store extremely large amounts of historical data.
3. Data Warehouses can be implemented in the form of offline or real-time systems.
4. Data mining means mining for relevant data from the organizations data warehouses storing historical organizational data.
5. Data mining has predictive and forecasting abilities.

12.10 REVIEW QUESTIONS

1. What are ERP systems? Explain the characteristics in detail.
2. Discuss in detail the issues faced in Enterprise Resource Planning implementation.
3. What is the need for ERP systems?
4. What is Data Warehousing? What are the different ways in which they can be implemented?
5. What is data mining? What are the benefits that an organization can get from it?

Answers to Exercise I

1. True
2. False
3. True
4. True
5. True

Answers to Exercise II

1. True
2. True
3. True

4. True
5. True

12.11 SUGGESTED READINGS

1. Sahil Raj : Management Information Systems
2. D. P. Goyal : Management Information Systems Managerial Perspectives
3. O'Brien : Introduction to Information Systems
4. K. Laudon, J. Laudon : Management Information Systems Managing the Digital Firm
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