Management Information System (MIS): Elements, Objectives and Limitations

Management information system is a system, which is designed to provide information to various organizational levels, to assist them in decision-making. This is certainly not a new system. Many firms have customer information system, accounting information system; marketing information system. These levels use the information for the purpose of decision-making. As the business organizations grow in complexity, managers depend more heavily upon various external and internal sources of information. The growing complexity of the business organizations also increases the quantum of points at which decision must be made, ranging from individual decision-maker at the lowest operating levels to strategic decision-maker at the top.

“Management information system is a system of people, equipment, procedures, documents and communications, that collects, validates, operates, transformers, stores, retrieves, and presents data for use in planning, budgeting, accounting, controlling and other management process”. — SCHWARTZ

“MIS is structured to provide the information needed, when needed and where needed”. Further the system represents the internal communication network of the business providing the necessary intelligence to plan, execute and control. — F.B. CORNISH

“Management Information system is an approach to information system design that conceives the business enterprise as an entity composed of interdependent system and sub-systems, which with the use of automated data processing systems attempts to provide timely and accurate management information which will permit optimum management decision making.” — Dickey

“MIS is an approach that visualize the business organisation as a single entity composed of various inter-related and inter-dependent sub-systems looking together to provide timely and accurate information for management decision making, which leads to the optimization of overall enterprise goals”. — Canth

“Management information system is a comprehensive and coordinated set of information sub-systems which are rationally integrated and which transform data into information in a variety of ways to enhance productivity in conformance with managers’ styles and characteristics on the basis of established criteria”. — George M. Scott

“MIS is a computer based network containing one or more operating systems, provides relevant data to management for decision-making purposes and also contains the necessary mechanism for implementing changes of responses made by management in this decision making”. — Thomas. R. Prince

“MIS is a system that aids management in making, carrying out, and controlling decisions”. — Jerome Ranter

“Management information system is an integrated man I machine system for providing information to support the operations, management and decision making function in an organisation”. — G.B. Davis

Elements of Management Information System:

Managing with information involve gathering the necessary data (crude input or raw material) and processing these data into meaningful information. To understand MIS clearly, it is very much required to define these three words management, information, and system. It can be described with the help of figure 1.1.

Objectives of Management Information System:

1. To provide information for planning, organizing and controlling purposes.
2. To store and manage data efficiently from all the functional areas of the business.
3. To process the collected data and derive information out of them.
4. To provide information quickly as and when required.
5. To reduce the risk and uncertainties in the managerial decision-making.
6. To collect and store the data for the purpose of internal research.
7. To assist in identifying the managerial problems and their solution.
8. To provide information regarding work force planning.
9. To provide the information regarding the financial health of the business organization.
10. To provide information regarding production and inventory.
11. To provide information regarding sales and other marketing aspects i.e. product, price, promotion, market, physical distribution, payment collection, market segmentation etc.
12. To speed up the execution of the results with the reliable data available.
13. To smooth up the flow of data through various levels of the organization.
14. To provide information regarding work force planning.
15. To provide the information regarding the financial health of the business organization.
16. To speed up the execution of the results with the reliable data available.
17. To smooth up the flow of data through various levels of the organization.

Importance of Management Information System:

1. It helps in minimizing risk in decision making.
2. It processes the data and derives information out of them.
Management Information System (MIS): Meaning, Types and Installation

The Business at present operates under an environment which is more difficult and complex, as compared to earlier times. The size of business has necessitated the delegation of authority at various levels of management. There are problems of control, co-ordination and communication. The decision-making has become a difficult task.

The decisions have wider ramifications for the business and a wrong decision may then lead to its closure. Management needs full information before taking any decisions. Good decisions can minimize costs and optimize returns. Management Information System (MIS) can be helpful to the management in undertaking managerial functions smoothly and effectively.

It is an approach of providing timely, adequate and accurate information to the right person in the organisation which helps him in taking decisions. So, management information system is a planned and organized approach to the transferring intelligence within an organisation for the organisation of management. The information is furnished into useful quantum’s of knowledge in the form of reports.

Elements of Management Information System:
An effective system of MIS collects data from all possible sources. The information is properly processed and stored for use in future.

The following are the elements of MIS:
1. The first element of MIS is the determining of informational needs. What type of information will be required and what will be its sources etc.? When these questions are decided then it will be possible to decide the modus opened for collecting the required data, etc.
2. The collected information should be properly processed, sorted and stored.
3. Another element of MIS is to determine the time and quantum of information needed. The information is sent to the desired managerial levels within the specified time.
4. MIS also involves the process of measuring the adequacy of purpose served. If the information has not been sufficient and desired purpose has not been served then the base of collecting it should be enlarged or modified.

Types of Management Information System:
1. Management Operating System:
This system is meant for meeting the information needs of lower and middle level managements. The information supplied generally relates to operations of the business. The figures about finance, raw materials, labour, production, sales, etc.; are supplied to the concerned persons. The operational information is required to see the pace of work and make necessary changes, if needed. The supply of information is quick and regular. The use of electronic devices is made for processing and analyzing data.

2. Management Reporting System:
This system is designed to supply information to top level management for decision-taking. The information is presented in a way which enables the management to take quick decisions. Sometimes, comparative information is presented to see the present performance in relation to past one. The purpose of this information is to present before management the real position of the enterprise. The supply of this information is slow because information from various sources is first complied. Decision-making requires full information about all important areas of the enterprise.

Objectives/Goals of Management Information System:
1. MIS should be designed in such a way that it enhances communication between employees.
2. MIS should deliver complicated and complex materials throughout the enterprise.
3. MIS should provide an objective system for recording, gathering and aggregating the information.
4. MIS should be designed in such a way that it reduces the expenses in connection with labour related and manual activities.
5. MIS should be helpful to the enterprise’s goals and directions.

Installing Management Information System:

1. Preliminaries: The introduction of MIS requires a proper study of business objective, plans, policies, etc. It will enable in deciding the type of data required, its sources and the levels at which required. The organisational structure should be able to supply the required information. The organisational levels, authorities, responsibilities, etc. should be studied for this purpose. The success of MIS will depend upon the support of top level management. The management should also be able to supply the requisite finances.

2. Planning: The informational needs of top, middle and lower levels of management should be studied so that the system is planned accordingly. The functions of each level of management should also be studied. The questions like, what data is needed? When is it needed? Who needs it and; in what form is it needed? should be studied for making the system effective.

3. Implementation: MIS can effectively be applied only when every person in the organisation is involved in it. The persons should also be given training for implementing this system. Information system manuals should be prepared to devise procedure for it. The manual and mechanical devices necessary for processing data should also be selected. Standard proformas, etc. should also be decided for collecting information. The main emphasis should be on the involvement of all persons in the organisation.

4. Review: The review of the system is very essential. The problems and difficulties faced in the system and additional requirements should be pointed out. The review of MIS will enable us to spot the week spots and corrective action will make the system more effective. It should be determined whether the information supplied was sufficient or not? Was the information relevant and critical? Was the frequency of reporting justified? The answers to these questions will help in making changes in the system. Without a proper review, the system will cease to be effective and useful after some time. It should constantly be reviewed with the change in situation in the business.

Management information system (MIS) must be designed in an organisation in such a way as nervous system works in a human body. The foremost task of the MIS is to provide information to the management but the scope of MIS covers number of functions to be performed simultaneously.

1. MIS has to aim at identifying the management’s informational needs.
2. MIS has to aim at in satisfying informational needs of management.
3. MIS has to help the management in processing information for decision making process.
4. MIS has to aim at providing regular formal information gathered from routine commercial data.
5. MIS has to be flexible enough to help management to incorporate informal and unstructured information into process of decision-making.
6. MIS may grow up in an informal or unplanned way which are not designed but can be helpful to the management in decision making process.

An Effective Management Information System (9 Characteristics)

1. MIS is management oriented: - The design of MIS starts with an appraisal of the information needs of the management. The system is usually designed from top to bottom. However, this does not mean that MIS fulfils the information needs of top management only. It only implies that information needs of the top management will serve as a basis for assessment of information needs of lower level managers. In every case the system should be designed to cater to the information needs of all levels of management.

2. MIS is developed under the direction of management: - Because of management orientation of MIS, it is imperative that, management of an organisation actively directs the development and establishment of the MIS in an organisation. It is rare to find an MIS where the manager himself, or a high level representative of his department, is not spending a good deal of time in the system design.

It is not a one time involvement, because continued review and participation are necessary to ensure that the implemented system meets the specifications of the system that was designed. Therefore, management of the organisation should not only take active part in the development of MIS but also play a major role in effecting subsequent changes in the system so that it serves the information needs of the management.

3. MIS is an integrated system: - MIS is an integrated system which blends information from several operational areas to serve the information needs of the management more effectively. It takes a comprehensive view of the interlocking sub-systems which operate within an organisation. For example, in order to develop an effective production scheduling system, the management must balance such factors as (a) production capacity, (b) work force (c) inventory levels (d) nature of the product (e) demand pattern of the product (f) capital requirements and (g) marketing network. A system that ignores one of these elements will not provide an efficient production schedule.

4. Common data flows: - MIS seeks to avoid duplication and redundancy in data collection, storage and dissemination of information. The designers of MIS are aware that a few key source documents account for much of the information flow and affect many functional areas. The concept of common data flow requires building and using master files, for recording and reporting information. This concept supports several of the basic principles of system analysis avoiding duplication, combining similar functions and simplifying operations wherever possible.

5. MIS is based upon future needs of the business: - MIS is designed to serve the objectives and needs of the business in an effective manner. The MIS designer must avoid the possibility of system obsolescence before the system gets into operation. If MIS is designed after taking care of future information needs of the business, there remains little chance of its becoming obsolete.

6. MIS is composed of sub-systems: - MIS although viewed as a single entity, must be broken down into sub-systems. The breakdown of MIS into meaningful sub-systems sets the stage for a prioritized implementation. It also enables the MIS designer to focus on manageable entities that can be assigned and computerised by selected systems and programming teams.

7. MIS requires flexibility: - MIS is designed to fulfill the information needs of management for future decision making. Despite a careful analysis of future information needs of the management, it is impossible to predict accurately all the events of three to five years ahead. This is true in most industries and especially in those industries with rapid changing patterns. Therefore, the MIS should be designed in such a manner so as to permit appropriate changes in future, if the MIS does not allow any modification, it is bound to become obsolete very soon.
8. Distributed data processing: In case of companies having geographical network of sales offices, distribution points, manufacturing plants, divisions and subdivisions, some form of distributed data processing is necessary, since some of these units may be operated in a completely independent fashion.

The purpose of distributed data processing is to ensure that information is placed in the hands of those who need it at the time when they need it. However, the sub-systems designed for distributed data processing should be considered as the integral parts of the MIS of the company.

9. MIS is mostly computerized: Now-a-days, all activities of MIS viz., data collection, data processing and data retrieval are accomplished through electronic media. The use of computer assures accuracy and consistency in processing data and speeds up dissemination of information.

System Approach to Management: Definition, Features and Evaluation

In the 1960, an approach to management appeared which try to unify the prior schools of thought. This approach is commonly known as ‘Systems Approach’. Its early contributors include Ludwing Von Bertalanfty, Lawrence J. Henderson, W.G. Scott, Deniel Katz, Robert L. Kahn, W. Buckley and J.D. Thompson.

They viewed organisation as an organic and open system, which is composed of interacting and interdependent parts, called subsystems. The system approach is top took upon management as a system or as “an organised whole” made up of sub-systems integrated into a unity or orderly totality.

Systems approach is based on the generalization that everything is inter-related and interdependent. A system is composed of related and dependent element which when in interaction, forms a unitary whole. A system is simply an assemblage or combination of things or parts forming a complex whole.

One its most important characteristic is that it is composed of hierarchy of sub-systems. That is the parts forming the major system and so on. For example, the world can be considered-to-be a system in which various national economies are sub-systems.

In turn, each national economy is composed of its various industries, each industry is composed of firms’ and of course a firm can be considered a system composed of sub-systems such as production, marketing, finance, accounting and so on.

Features of Systems Approach:

(i) A system consists of interacting elements. It is set of inter-related and inter-dependent parts arranged in a manner that produces a unified whole.

(ii) The various sub-systems should be studied in their inter-relationships rather than in isolation from each other.

(iii) An organisational system has a boundary that determines which parts are internal and which are external.

(iv) A system does not exist in a vacuum. It receives information, material and energy from other systems as inputs. These inputs undergo a transformation process within a system and leave the system as output to other systems.

(v) An organisation is a dynamic system as it is responsive to its environment. It is vulnerable to change in its environment.

In the systems approach, attention is paid towards the overall effectiveness of the system rather than the effectiveness of the sub-systems. The interdependence of the sub-systems is taken into account. The idea of systems can be applied at an organisational level. In applying system concepts, organisations are taken into account and not only the objectives and performances of different departments (sub-systems).

The systems approach is considered both general and specialised systems. The general systems approach to management is mainly concerned with formal organisations and the concepts are relating to technique of sociology, psychology and philosophy. The specific management system includes the analysis of organisational structure, information, planning and control mechanism and job design, etc.

As discussed earlier, system approach has immense possibilities, “A system view point may provide the impetus to unify management theory. By definitions, it could treat the various approaches such as the process of quantitative and behavioural ones as sub-systems in an overall theory of management. Thus, the systems approach may succeed where the process approach has failed to lead management out of the theory of jungle.”

Systems theory is useful to management because it aims at achieving the objectives and it views organisation as an open system. Chester Barnard was the first person to utilize the systems approach in the field of management. He feete that the executive must steer through by keeping a balance between conflicting forces and events. A high order of responsible leadership makes the executives effective. H. Simon viewed organisation as a complex system of decision-making process.

Evaluation of System Approach:

The systems approach assists in studying the functions of complex organisations and has been utilized as the base for the new kinds of organisations like project management organisation. It is possible to bring out the inter-relations in various functions like planning, organizing, directing and controlling. This approach has an edge over the other approaches because it is very close to reality. This approach is called abstract and vague. It cannot be easily applied to large and complex organisations. Moreover, it does not provide any tool and technique for managers.

What is Systems Approach? Definition and Meaning

The systems approach is an old concept. The approach stands on the assumption that breaking down of a complex concept into simple easy to understand units helps in better understanding of the complexity. Ludwig von Bertalanffy first proposed the systems approach under the name of ‘General System Theory’.

Even though he had orally created the notion of the general systems theory in the 1940’s he formally published it in 1968 (Ludwig von Bertalanffy 1968). He introduced system as a new scientific philosophy and defined it in a formal manner. He noted that most systems (biological or physical) of any practical relevance are open as they interact with the environment. Therefore, to understand the system it has to be differentiated from the environment, i.e., the boundary of the system has to be clearly defined along with its interaction with the environment from with in this boundary.

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

Major concepts of the systems approach are:

2. Specialization: A whole system can be divided into granular (smaller easy to understand), components so that the specialized role of each component is appreciated.

3. Non-summational: Every component (subsystem/partial system) is of importance to the whole. It is therefore essential to understand the actions of each component to get the holistic perspective (Boulding 1985, Litterer 1973).

4. Grouping: The process of specialization can create its own complexity by proliferating components with increasing specialization. To avoid this it becomes essential to group related disciplines or sub-disciplines.

5. Coordination: The grouped components and sub components need coordination. Without coordination the components will not be able to work in a concerted manner and will lead to chaos. Coordination and control is a very important concept in the study of systems as without this we will not be a unified holistic concept.

6. Emergent properties: This is an important concept of systems approach. It means that the group of interrelated entities (components) has properties as a group that is not present in any individual component. This is the holistic view of a system. For example, multicellular organisms exhibit characteristics as a whole which are not present in individual constituent parts like cells.

System Views of Management and Organization

System views of management associates with the Management division of the organization and it assumes that all of the organizations are systems, whereas all of the systems are sub-systems of larger systems. Here the the question is how a sub-system adjusts and meets the needs of the larger system. It clearly defines whether the sub-system is going to gain the prosperity or hit the ground. Before talking about the system views of management, lets see the some basic concepts of management and system.

Managing Systems

Managing System is another way to overview the job responsibilities of a manager such as how the manager performs certain actions for the betterment of management systems and the organization.

System - A set of interdependent and interconnected objects ordered as a compilation is called as System, a concept taken from physical science that is applied to the organizations. There are two basic types of system that are closed system and opened system.

Closed System - The system that cannot be interacted or influenced by the environment is called as the closed system.

Open System - The system, which is dependent on the outer effects of atmosphere, is known as open system.

Nowadays, Open System has been widely used across a great range of organizations, because of its continuous interaction with the outer environment. Actually, when the organization is connected with the environment, then it helps in having a deep insight into needs, approaches, manners and new trends of the environment. At some point, these things help the organization build a new innovative goal that would be beneficial for both, i.e. the organization and the environment.

System Views of Management Theory

The system views of management theory is a technique based upon the idea that the organization are imagined as the systems of correlated parts or subsystems to be operated as a whole for the achievement of common and similar targets and goals.

Major Components

1. Inputs - Variety of manpower, raw material, equipment and information resources required for production of goods and services.

2. Transformation process - Technological and Managerial abilities of an organization, applied to change input into the output is called as Transformation process.

3. Output - Final production and by-production resulted through the transformation process in the form of product or services of the organization are called as Output.

4. Feedback - Feedback always determines the reaction of final users. Here the feedback will be the response of final consumers of the products or services.

Open v/s Closed System - The interaction of the system with its environment in related degree is indicated through these terms. There are only few systems that are completely open or completely closed ones. Open systems have continuous interaction with its environment for feedback and closed systems have a very low degree of interaction regarding feedback to its environment. Two major specifications of the open systems are described as:

1. Negative Entropy - The ability of an open system that brings the innovation and energy in the way of feedback mechanism and input is called as Negative Entropy.

2. Synergy - It is the ability of the organization that is the sum of all parts of working areas.

Systems Viewpoint

It provides the suggestion to the managers that they can be more successful, if they try to operate their units and areas under the open systems than closed ones.

A Systems View of Business Analytics, Part 1 Introduction to Systems Thinking

Many of today's business intelligence programs focus intensely on analytics. The business wants scorecards, dashboards and analytic applications, and the technology to deliver them is mature. Still we struggle to deliver high-impact analytics that are purposeful, insightful and actionable. The key to high-impact analytics is a strong connection with cause and effect – the essence of understanding why and deciding what next. Systems thinking offers the cause-and-effect connection. It holds the key to real analytic value that is derived through insight, understanding, reasoning, forecasting, innovation and learning.

Systems Theory

So let's look beyond analytics and think about systems. I don't mean computer systems here, although computer systems are one type to which systems theory can be applied. But it applies just as readily to human, organizational and business systems.

Fundamental truths for all systems, regardless of their type, include the following assertions:

- A system is a collection of interacting parts.
- Behavior of any part is influenced by interaction with other parts.
- A system boundary defines the set of parts that comprise a system.
- A system may interact with things outside of its boundary.
• External interaction is less influential on system behaviour than internal interaction.
• Behavior is understood by examining the entire system, not individual parts.

**Systems Thinking – Applied Systems Theory**

Systems thinking applies systems theory to create desired outcomes or change. It offers a unique approach to problem solving that views problems as part of an overall system. Traditional problem-solving approaches tend to focus on one or a few parts of a system, believing that changes to those parts offer a solution. The systems-thinking approach focuses less on the parts and more on interactions and influences among them as the core elements of solving problems.

Understanding of systems is achieved through identification, modeling and analysis of relationships and interactions among parts of a system—a distinctly different and more in-depth analysis than is possible with structural models of a system. Systems modeling is performed by representing the parts of a system and the interactions among those parts.

The most basic concept of systems theory is that a system is a collection of interacting things. I use the word “thing” to avoid the context-based connotations that might occur with terms such as entity, object or component.

Things in a system are of many types. They may include (but are not limited to) entities that are familiar to data modelers, objects that are familiar to object-oriented systems analysts and components as they are understood by software developers. Things in a business system encompass artifacts such as resources, capacities, limits, gaps, goals, desires, actions, results, plans, processes, rules, standards and much more.

Influence is a behavioral characteristic of interaction. Interaction between two things in a system is directional—one thing has influence on another thing. System behavior is important to understand why things happen in a system and to predict what may happen in the future. Analysis of influences is the key to understanding system behavior.

**Systems Thinking Models – Causal Loop Diagramming**

Visually representing system behavior is widely practiced in systems thinking with a causal loop diagram (CLD). Causal loop diagramming is a form of cause-and-effect modelling. The diagrams represent systems and their behaviors as a collection of nodes and links. Nodes represent the things in a system and links illustrate interactions and influences.

Influences are of two types—same direction and opposite direction. A same-direction influence means that the values of two things move in the same direction when change occurs: When employee morale increases, employee productivity goes up. An opposite direction influence means that the values move in opposite directions: When employee stress increases, employee productivity decreases. Figure 1 illustrates how these two examples are modeled. Note that a plus (+) indicates same direction and a minus (-) is used for opposite direction.

The diagramming technique is called causal loop diagramming because real understanding comes from understanding the system as a whole. Cause-and-effect is typically not linear. It is circular with a sequence of influences producing a feedback loop. Loops are closed structures that represent a sequence of system interactions without a beginning or an end. A loop may contain any number of interactions greater than one. Feedback is a characteristic of loops in systems.

Feedback is a process by which the results of an activity or action are returned to the actor in a way that influences the behavior of that actor. Positive feedback occurs when the cumulative effect of all interactions in the loop is one of growth, amplification or acceleration. Positive feedback loops are often called reinforcing loops. Negative feedback occurs when the cumulative effect of all of the interactions is stabilization or equilibrium. Negative feedback loops are also known as balancing loops or goal-seeking loops.

Figure 2 illustrates both kinds of feedback loops. Note that the kind of feedback loop – positive or negative – is indicated using a polarity symbol at the center of the loop. Polarity describes the positive or negative feedback property of a loop. Determining loop polarity is relatively easy. Simply count the number of subtractive interactions in the loop. An odd number indicates negative polarity, and an even number indicates positive polarity. Individual feedback loops are a step toward understanding cause and effect, but they only scratch the surface. It is often the interactions among loops that provide real insight into system behaviors by breaking down stovepipe views of the parts of a system. Figure 3 illustrates this principle with only one minor change to the diagrams shown in Figure 2. The new model shows a connection between the two feedback loops. Finding these kinds of connections is the first step to developing a holistic view of a system.

In reality, a system consists of many loops and many interactions among those loops. It is that total system view that helps to achieve depth of understanding and real insight into the behaviors of complex systems. The intersection nodes—those that participate in two or
more loops are the core of system complexity, and they provide the greatest opportunity to discover side effects, hidden influences and unintended consequences.

Determining the boundaries of a system model can be challenging. Every system is a part of some larger system. Therefore, it is possible to continue modeling infinitely. Stop modeling when you have acquired the knowledge and information that satisfies the purpose of the model. Stopping too quickly, however, brings the risk that you'll overlook side effects and unintended consequences. Figure 4 illustrates the nature of this challenge.

**Systems Thinking and Business Analytics**

This article provides only a brief introduction to systems thinking, a subject that is deep, complex and very much related to business analytics. Only by understanding system dynamics can we provide the most meaningful measures and deliver analytics that are purposeful, insightful and actionable. Sometimes that means measuring things, but more often it means measuring interactions and influences. The discipline of systems thinking includes several archetypes — generic models that represent recurrent patterns in systems. The names of the archetypes are fascinating in themselves: accidental adversaries, fixes that fail, drifting goals, tragedy of the commons, etc. But even more interesting is the clear and certain relationship that exists between these archetypes and the patterns seen in time-series analysis. The systems thinking approach also includes other modeling techniques. Causal loop diagrams illustrate influences. Another technique called stock-and-flow provides the means to quantify influences. Quantification enables simulation, and simulation is at the heart of "what if" analysis and predictive analytics.

**Energy — From Physics to Organizations**

The First Law of Thermodynamics states that energy cannot be created or destroyed. All energy present in the universe (the largest system we know) simply changes forms throughout the cycles and phases of the system. When we observe a component of the system losing energy, we are observing a displacement of the energy’s location. The energy that was once localized to a specific entity, group, business or person will eventually disperse into the surrounding system.

**Example:** A hammer is swung with kinetic energy to drive a nail into a piece of wood. When the nail is struck, the hammer’s energy is transferred to the nail. The nail then uses its kinetic energy to move into the wood. The wood uses its potential energy to push back against the nail until the nail no longer continues to move. Excess energy produces heat and sound during the hammering.

In this small system, energy only changes form and location, but is never created or destroyed. If we were to expand the system, we would see that the kinetic energy in the hammer came from the kinetic energy in the hammerer’s arm. This kinetic energy came from the chemical energy gained from ingesting food. The food’s chemical energy came from the chemical bonds formed in the presence of solar energy. In physics, the changes in the location and form of energy is the mechanism that connects the universe as a very large system. Energy flows through other systems as well. In social organizations, energy is often described in various other terms (people, money, products, information or capital) but still flows in a similar manner.

**Example:** A company’s success in bill collecting is declining because the amount of collection calls per week has diminished. The bill collector has been searching for a new job during their working hours. The energy that the collector normally put into calling clients is now being used to conduct personal business. In this example, the energy inputs (40 hours per week from the collector) have remained the same, however, the energy is being dispersed from the company’s system to the collector and other businesses’ systems.

**Entropy Defined**

Entropy is a tendency for a systems’ outputs to decline when the inputs have remained the same. Most often associated with the Second Law of Thermodynamics, entropy measures the changes in the type and dispersion of energy within an observable system. We measure entropy in a systems thinking by the change in outputs when the inputs have remained the same. Thus, entropy is a direct function of time (temporal).

**Closed Systems and Scope**

Entropy occurs in closed systems where only the outputs decline. The system appears closed because the observed scope of the system displays no changes in the normal processes or actions that continue to take place.

**Example:** An organization manufactures ocean-worthy sailing ships for transportation. The organization has reported fewer revenues every year since the late 1800’s. The inputs (labor, skill, tools and capital) have remained the same throughout the years, however, sales have dropped (no pun intended) due to entropy. Without changes in inputs (creativity, modernism, or market observance) the system is considered closed, and entropy becomes inevitable.

In this example, the success of the transportation industry is not declining, only the success of one organization. Through more convenient transportation, the success of large sailing ships is being transferred from the local environment to the global market. The trans-oceanic travel is still needed, but due to a closed and entropic system, the sailing boat organization will no longer be successful. This organization failed to consider that they are part of a larger system, and must evolve over time. The scope of the system and the complexity greatly effect the length of time in which entropy typically occurs.

**Example:** A neighborhood child opens a lemonade stand. The lemonade remains the same, and after one month, the sales of lemonade decline as the neighborhood consumers want variety. Entropy within this system sets in quickly. An international soft-drink company that chooses to no longer manufacture more than one type of beverage could similarly fall victim to entropy.

**Combating Entropy**

Living organisms are often affected by diseases. These diseases represent external and internal threats that degenerate the organism until it no longer can sustain life. We challenge this form of organic entropy by adding inputs (white blood cells, medications, nutrients, etc.). Thus, organisms continue to exist through a spontaneous changes in the inputs and structures of the processes.

Once social organizations reach a state of static equilibrium, entropy begins to occur. The degradation of the system unit of entire system is then only a function of time. This unintended process occurs until the system is thrown out of its static state with new inputs or process changes, or the system fails. To challenge the onslaught of entropy, system thinkers are required to continuously expand their knowledge of the scope and complexity of their system. Once they can identify a way for the component or process to evolve, the risk of entropy is
lessened. After new actions are taken or inputs are changed, the process to avoid system decline due to entropy begins again. Once growth has stopped, the decline of the system is inevitable.

Although the concepts of people, money, products, information, or capital can be created and destroyed, the flow, organization, and displacements of these components are treated like energy for the discussion of organizational entropy.

Not to confuse physics and systems science: In systems science, entropy is measured by change in outputs over time. In physics, entropy is measured by change in temperature over time.

Nobel laureate Ilya Prigogine first described that living systems continuously renew themselves through a process of "spontaneous structuration" which occurs when they are jarred out of a state of equilibrium.

### Synergy

In general, synergy (pronounced SIN-ur-je , from Greek sunergia , meaning "cooperation," and also sunergos , meaning "working together") is the combined working together of two or more parts of a system so that the combined effect is greater than the sum of the efforts of the parts. In business and technology, the term describes a hoped-for or real effect resulting from different individuals, departments, or companies working together and stimulating new ideas that result in greater productivity.

The process of synergy as a way of originating new ideas or making new discoveries can be contrasted to serendipity , in which ideas and discoveries emerge seemingly by accident.

### Synergy, Entropy and Change

The concept of synergy has become very popular in business in recent times. In particular one hears of companies merging in order to gain synergies. Dominating the South African business headlines at the moment is the entry of Walmart into the local economy. Apart from the controversy over trade-unions resisting (alleging unfair labour practices) and the group claiming positive effects on prices to the consumer, the architects of the take-over cite the natural "synergies" that exist between the two entities as a key factor. Synergy (from the Greek for "working together") is often taken to mean efficiencies and savings brought about by eliminating duplicated capacities and services. In my view this should be defined as restructuring and re-organising and not synergy.

Am I being pedantic over a word? I think not, because we are losing the essence of synergy which refers to the working together of people to "create a whole that is greater than the sum of its parts". In other words, it is the state in which people work co-operatively in a way that 1 + 1 > 2. I may have been influenced by my studies in Engineering, but I am convinced that the Second Law of Thermodynamics applies to the way people tend to work in groups as well - the Entropy will increase or the state of disorder will grow!

Building synergy therefore has less to do with the efficient use of assets and resources and more to do with the ability of people to work together effectively and creatively. So the challenge for the members of Massmart to change as they merge with Walmart should begin by establishing a "synergistic environment" to avoid an inevitable state of "growing entropy in the workplace".

### Management, Organisation, Theory and systems Approach

#### Exhibit 1: Organization theories

- **CLASSICAL ORGANIZATION THEORY**
  - Scientific Management approach
  - Weber's Bureaucratic approach
  - Administrative theory.

- **NEOCLASSICAL THEORY**
  - Systems approach
  - Socio-technical approach
  - Contingency or Situational approach

#### Exhibit 2: Taylor's principles of scientific management

- Science, not rule-of-thumb;
- Scientific selection of the worker
- Management and labour cooperation rather than conflict
- Scientific training of workers

#### Exhibit 3: Weber's bureaucratic approach

- Structure
- Specialization
- Predictability and stability
- Rationality
- Democracy

#### Exhibit 4: Fayol's principles of management: Administrative theory

- Division of work (specialization)
- Authority and responsibility
- Discipline
- Unity of command
- Unity of direction
- Subordination of individual interest
- Remuneration of personnel
- Centralization

#### Exhibit 5: Principles of the neoclassical approach

- INDIVIDUAL
- WORK GROUP
- PARTICIPATIVE MANAGEMENT

#### Exhibit 6: Characteristics of modern approaches to the organization

- Systems viewpoint
- Dynamic process of interaction
- Multilevelled and multidimensional
- Multimotivated
- Probabilistic
- Multidisciplinary
- Descriptive
- Multivariable
- Adaptive
Exhibit 7: Modern approaches to organization: The systems approach

COMPONENTS
☐ The individual
☐ The formal and informal organization
☐ Patterns of behaviour
☐ Role perception
☐ The physical environment

LINKING PROCESSES
☐ Communication
☐ Balance
☐ Decision analysis

GOALS OF ORGANIZATION
☐ Growth
☐ Stability
☐ Interaction

Exhibit 8: The research organization as a social system

Characteristics of the research organization
☐ Complexity
☐ Degree of inter-dependence between sub-systems
☐ Openness of the social organization
☐ Balance in the social organization
☐ Multiplicity of purposes, functions and objectives

Exhibit 9: The importance of goal settings
☐ Clarified what people have to do
☐ Identifies problems and facilitates solution
☐ Reduces ambiguity in work
☐ Establishes a relationship between work and organizational achievements
☐ Assists individuals to allocate time, efforts and personal resources
☐ Provides a sense of accomplishment and contentment
☐ Provide control over the people in the organization

EXPERT POWER
CHARISMATIC POWER

Exhibit 10: The process of goal setting (management by objectives)

1. Setting overall organizational objectives and action plan
2. Identifying key result areas
3. Identifying measures of performance
4. Stating objectives
5. Agreement on objectives and goals
6. Develop the organization
7. Set individual objectives
8. Periodic appraisal and feedback
9. Appraisal by results

Exhibit 11: The need for integration
☐ Environmental complexity, diversity and change
☐ Increase in structural dimensions
☐ Specialization
☐ Across various specialized units - each pursuing individual objectives - to ensure that organizational goals are being pursued
☐ Conflict resolution
☐ Better performance and productivity

Exhibit 12: Methods of integration

COORDINATING VERTICALLY THROUGH THE HIERARCHY
DETERMINING THE DECISION MAKING LEVEL
DECIDING THE SPAN OF CONTROL

Exhibit 13: Organization-based power
REWARD POWER
COERCIVE POWER

Exhibit 14: Communication in the organization

UPWARD
HORIZONTAL
DOWNWARD

Exhibit 15: The process of decision making

SETTING ORGANIZATIONAL GOALS

ESTABLISHING PERFORMANCE CRITERIA

CLASSIFYING AND DEFINING THE PROBLEM

DEVELOPING CRITERIA FOR A SUCCESSFUL SOLUTION

The systems approach

The systems approach views organization as a system composed of interconnected and thus mutually dependent sub-systems. These sub-systems can have their own sub-sub-systems. A system can be perceived as composed of some components, functions and processes (Albrecht, 1983). Thus, the organization consists of the following three basic elements (Bakke, 1959):

(i) Components There are five basic, interdependent parts of the organizing system, namely:
- the individual,
- the formal and informal organization,
- patterns of behaviour emerging from role demands of the organization,
- role comprehension of the individual, and
- the physical environment in which individuals work.

(ii) Linking processes The different components of an organization are required to operate in an organized and correlated manner. The interaction between them is contingent upon the linking processes, which consist of communication, balance and decision making.
**Communication** is a means for eliciting action, exerting control and effecting coordination to link decision centres in the system in a composite form.

**Balance** is the equilibrium between different parts of the system so that they keep a harmoniously structured relationship with one another.

**Decision analysis** is also considered to be a linking process in the systems approach. Decisions may be to produce or participate in the system. Decision to produce depends upon the attitude of the individual and the demands of the organization. Decision to participate refers to the individual’s decisions to engross themselves in the organization process. That depends on what they get and what they are expected to do in participative decision making.

(iii) **Goals of organization** The goals of an organization may be growth, stability and interaction. Interaction implies how best the members of an organization can interact with one another to their mutual advantage.

**Socio-technical approach**

It is not just job enlargement and enrichment which is important, but also transforming technology into a meaningful tool in the hands of the users. The socio-technical systems approach is based on the premise that every organization consists of the people, the technical system and the environment (Pasmor, 1988). People (the social system) use tools, techniques and knowledge (the technical system) to produce goods or services valued by consumers or users (who are part of the organization’s external environment). Therefore, an equilibrium among the social system, the technical system and the environment is necessary to make the organization more effective.

**The contingency or situational approach**

The situational approach (Selznick, 1949; Burns and Stalker, 1961; Woodward, 1965; Lawrence and Lorsch, 1967) is based on the belief that there cannot be universal guidelines which are suitable for all situations. Organizational systems are inter-related with the environment. The contingency approach (Hellriegel and Slocum, 1973) suggests that different environments require different organizational relationships for optimum effectiveness, taking into consideration various social, legal, political, technical and economic factors.

### What are Conceptual, Logical and Physical Data Models?

My uses of **conceptual, logical, and physical** come from the Information Engineering (IE) methods of data modeling. Other uses and definitions arise from the database schema and academic world. Neither is wrong; it’s just that they are different. The industry as a whole tends to use the IE definitions, so I tend to stick to them because they are used by the vast majority of practitioner data modelers and other team members.

**Conceptual Data Model**

A **conceptual data model** is a summary-level data model that is most often used on strategic data projects. It typically describes an entire enterprise. Due to its highly abstract nature, it may be referred to as a **conceptual model**.

Common characteristics of a conceptual data model:

- **Enterprise-wide coverage of the business concepts.** Think Customer, Product, Store, Location, Asset.
- **Designed and developed primarily for a business audience.**
- **Contains around 20-50 entities (or concepts) with no or extremely limited number of attributes described.** Sometimes architects try to limit it to printing on one page.
- **Contains relationships between entities, but may or may not include cardinality and nullability.**
- **Entities will have definitions.**
- **Designed and developed to be independent of DBMS, data storage locations or technologies.** In fact, it would address digital and non-digital concepts. This means it would model paper records and artifacts as well as database artifacts.

**Logical Data Model**

A **logical data model** is a fully-attributed data model that is independent of DBMS, technology, data storage or organizational constraints. It typically describes data requirements from the business point of view. While common data modeling techniques use a relational model notation, there is no requirement that resulting data implementations must be created using relational technologies.

Common characteristics of a logical data model:

- **Typically describes data requirements for a single project or major subject area.**
- **May be integrated with other logical data models via a repository of shared entities.**
- **Typically contains 100-1000 entities, although these numbers are highly variable depending on the scope of the data model.**
- **Contains relationships between entities that address cardinality and nullability (optionality) of the relationships.**
- **Designed and developed to be independent of DBMS, data storage locations or technologies.** In fact, it may address digital and non-digital concepts.
- **Data attributes will typically have datatypes with precisions and lengths assigned.**
- **Data attributes will have nullability (optionality) assigned.**
- **Entities and attributes will have definitions.**
- **All kinds of other meta data may be included (retention rules, privacy indicators, volumetrics, data lineage, etc.)** In fact, the diagram of a logical data model may show only a tiny percentage of the meta data contained within the model.

A logical data model will normally be derived from and or linked back to objects in a conceptual data model.

**Physical Data Model**

A **physical data model** is a fully-attributed data model that is dependent upon a specific version of a data persistence technology. The target implementation technology may be a relational DBMS, an XML document, a NoSQL data storage component, a spreadsheet or any other data implementation option.

**Common characteristics of a physical data model:**

- **Typically describes data requirements for a single project or application.** Sometimes even a portion of an application.
- **May be integrated with other physical data models via a repository of shared entities.**
- **Typically contains 10-1000 tables, although these numbers are highly variable depending on the scope of the data model.**
- **Contains relationships between tables that address cardinality and nullability (optionality) of the relationships.**
Conceptual, Logical and Physical Data Model

Conceptual, logical and physical model or ERD are three different ways of modeling data in a domain. While they all contain entities and relationships, they differ in the purposes they are created for and audiences they are meant to target. A general understanding to the three models is that, business analyst uses conceptual and logical model for modeling the data required and produced by system from a business perspective, whereas database designer refines the early design to produce the physical model for presenting physical database structure ready for database construction.

With Visual Paradigm, you can draw the three types of model, plus to progress through models through the use of Model Transitor. A conceptual model would answer questions such as this: at what point do we consider a lead a customer? is it when he actually buys a product or earlier, when we have identified him as a lead and are in the process of marketing and selling to him?

In a large organization there can be different viewpoints. The risk management people would not consider a lead a customer fx marketing and sales departments would.

The logical model implements the concept model in, typically, tables and fields, attributes and relationships. Here you would decide which concepts you want to implement in your database. Usually most of them but there could be concepts that are merely definitions of terms but not persisted as data. Here you would think about de normalizing, indexes and performance considerations.

The physical model is often similar or identical to the LDM but can be different based on the technical platform. This means that an accurate use of data type is needed for entity columns and the use of reserved words has to be avoided in naming entities and columns. Besides, database designers may also add primary keys, foreign keys and constraints to the design.

What is the difference between conceptual, logical and physical data models?

They are in descending levels of abstraction where the conceptual model is the most abstract and the physical data model the least abstract or most concrete.

A conceptual model describes the business area in business terms and natural language. For instance you might have concepts such as customer or product and define them precisely. A conceptual model would answer questions such as this: at what point do we consider a customer a customer? is it when he actually buys a product or earlier, when we have identified him as a lead and are in the process of marketing and selling to him?

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The physical model is often similar or identical to the LDM but can be different based on the technical platform. A common, and in my opinion costly mistake is to confuse the conceptual and logical models. Both are important. If you forego the conceptual model you often define terms based on how it makes sense to persist data instead of defining the terms from a business perspective.
Program - Data Independence - Insulation between programs and data: Allows changing data storage structures and operations without having to change the DBMS access programs.

Efficient Data Access - DBMS uses a variety of techniques to store & retrieve data efficiently

Data Integrity & Security - Before inserting salary of an employee, the DBMS can check that the dept. budget is not exceeded

Data Administration - When several users share data, centralizing the administration offers significant improvement

Concurrent Access & Crash Recovery - DBMS schedules concurrent access to the data in such a manner that users think of the data as being accessed by only one user at a time. DBMS protects users from the ill-effects of system failures

Reduced Application Development Time - Many important tasks are handled by the DBMS

Models of Database Architecture: Hierarchical, Network and Relational Models

The process of defining the conceptual design of data elements and their inter-relationships is called data modeling. The traditional applications approach to data organisation built different models for each data file. Such a diversity of ways in which different data elements are linked and stored in data files make these files suitable only for the applications that they were originally created for. In fact, the details regarding the exact placement of different data elements in a file have to be documented very carefully.

Any change in the order in which various data elements are placed results in changes in the application programs using the data file. The database approach uses a common data model for the entire database and the user program is not concerned with the placement of a particular data element. The database management system (DBMS) acts as an interface between the database and the user programs. The DBMS fetches the data from the database and makes it available to the user program. This feature offers the advantage of data independence in the database approach.

Conceptually, there are three broad options with regard to database models. These are:

a. Hierarchical model
b. Network model
c. Relational model

(a) Hierarchical model:

This model presents data to users in a hierarchy of data elements that can be represented in a sort of inverted tree. In a sales order processing system, a customer may have many invoices raised to him and each invoice may have different data elements. Thus, the root level of data is customer, the second level is invoice and the last level is line items such as invoice number, date, product, quantity, etc.

This structure is quite natural when seen from the event point of view. However, the lower levels are owned by higher level data elements, and elements at the same level have no linkage at all. As a result, the query such as what products are purchased by which customer, in the above example, shall be difficult to carry out in the hierarchical structure.

The query as to which customer purchased which product would be convenient. Thus, where there are many-to-many relationships between two entities, this model would not be appropriate. Figure 9.4 shows the hierarchical model of data for a sales order processing application.

(b) Network model:

In the network model of database, there are no levels and a record can have any number of owners and also can have ownership of several records. Thus, the problem raised above in the sales order processing will not arise in the network model.

As there is no definite path defined for retrieval of data, the number of links is very large and thus network databases are complex, slow and difficult to implement. In view of the difficulty in implementation, network model is used only when all other options are closed.

The typical example of a network database may be the employee and the department he/she has worked or can work with in future. Figure 9.5 shows the network model of data for an employee information system.

(c) Relational model:

The most recent and popular model of database design is the relational database model. This model was developed to overcome the problems of complexity and inflexibility of the earlier two models in handling databases with many-to-many relationships between entities.

These models are not only simple but also powerful. In the relational database, each file is perceived as a flat file (a two dimensional table) consisting of many lines (records), each record having key and non-key data.
ach record shall in my change example, an organization might store information about an employee, except the key item. So, the data redundancy can be avoided example, an "orders" base the data order, position or relationships are only specified at retrieval time, good relational database as following:

- Each R
- Values Are Atomic
- Each Row Has a Unique Name
- The Sequence of Columns is Insignificant
- Each Column Has a Unique Name
- The Sequence of Rows is Insignificant
- Column Values Are of the Same Kind
- The Sequence of Columns is Insignificant
- Each Column Has a Unique Name

Certain fields may be designated as keys, which means that searches for specific values of that field will use indexing to speed them up. Where fields in two different tables take values from the same set, a join operation can be performed to select related records in the two tables by matching values in those fields. Often, but not always, the fields will have the same name in both tables. For example, an "orders" table might contain (customer-ID, product-code) pairs and a "products" table might contain (product-code, price) pairs so to calculate a given customer’s bill you would sum the prices of all products ordered by that customer by joining on the product-code fields of the two tables. This can be extended to joining multiple tables on multiple fields. Because these relationships are only specified at retrieval time, relational databases are classed as dynamic database management system. The RELATIONAL database model is based on the Relatio

Hierarchical Model
The hierarchical data model organizes data in a tree structure. There is a hierarchy of parent and child data segments. This structure implies that a record can have repeating information, generally in the child data segments. Data in a series of records, which have a set of field values attached to it. It collects all the instances of a specific record together as a record type. These record types are the equivalent of tables in the relational model, and with the individual records being the equivalent of rows. To create links between these record types, the hierarchical model uses Parent Child Relationships. These are a 1:N mapping between record types. This is done by using trees, like set theory used in the relational model, “borrowed” from maths. For example, an organization might store information about an employee, such as name, employee number, department, salary. The organization might also store information about an employee’s children, such as name and date of birth. The employee and children data forms a hierarchy, where the employee data represents the parent segment and the children data represents the child segment. If an employee has three children, then there would be three child segments associated with one employee segment. In a hierarchical database the parent-child relationship is one to many. This restricts a child segment to having only one parent segment. Hierarchical DBMSs were popular from the late 1960s, with the introduction of IBM’s Information Management System (IMS) DBMS, through the 1970s.

Network Model
The popularity of the network data model coincided with the popularity of the hierarchical data model. Some data were more naturally modeled with more than one parent per child. So, the network model permitted the modeling of many-to-many relationships in data. In 1971, the Conference on Data Systems Languages (CODASYL) formally defined the network model. The basic data modeling construct in the network model is the set construct. A set consists of an owner record type, a set name, and a member record type. A member record type can have that role in more than one set, hence the multiparent concept is supported. An owner record type can also be a member or owner in another set. The data model is a simple network, and link and intersection record types (called junction records by IDMS) may exist, as well as sets between them. Thus, the complete network of relationships is represented by several pairwise sets; in each set some (one) record type is owner (at the tail of the network arrow) and one or more record types are members (at the head of the relationship arrow). Usually, a set defines a 1:M relationship, although 1:1 is permitted. The CODASYL network model is based on mathematical set theory.

Relational Model
(RDBMS - relational database management system) A database based on the relational model developed by E.F. Codd. A relational database allows the definition of data structures, storage and retrieval operations and integrity constraints. In such a database the data and relations between them are organised in tables. A table is a collection of records and each record in a table contains the same fields. Properties of Relational Tables:

- Values Are Atomic
- Each Row Is Unique
- Column Values Are of the Same Kind
- The Sequence of Columns is Insignificant
- Each Column Has a Unique Name
- The Sequence of Rows is Insignificant

In this model. For this purpose, a process of data normalisation is undertaken while designing the structure of a database.
and geospatial data and diverse binary media such as audio, video, images, and applets. By encapsulating methods with database structures, an ORDBMS server can execute complex analytical and data manipulation operations to search and transform multimedia and other complex objects.

As an evolutionary technology, the object/relational (OR) approach has inherited the robust transaction- and performance-management features of its relational ancestor and the flexibility of its object-oriented cousin. Database designers can work with familiar tabular structures and data definition languages (DDLs) while assimilating new object-management possibilities. Query and procedural languages and call interfaces in ORDBMSs are familiar: SQL3, vendor procedural languages, and ODBC, JDBC, and propriety call interfaces are all extensions of RDBMS languages and interfaces. And the leading vendors are, of course, quite well known: IBM, Informix, and Oracle.

**Object-Oriented Model**

Object DBMSs add database functionality to object programming languages. They bring much more than persistent storage of programming language objects. Object DBMSs extend the semantics of the C++, Smalltalk and Java object programming languages to provide full-featured database programming capability, while retaining native language compatibility. A major benefit of this approach is the unification of the application and database development into a seamless data model and language environment. As a result, applications require less code, use more natural data modeling, and code bases are easier to maintain. Object developers can write complete database applications with a modest amount of additional effort.

According to Rao (1994), "The object-oriented database (OODB) paradigm is the combination of object-oriented programming language (OOPL) systems and persistent systems. The power of the OODB comes from the seamless treatment of both persistent data, as found in databases, and transient data, as found in executing programs."

In contrast to a relational DBMS where a complex data structure must be flattened out to fit into tables or joined together from those tables to form the in-memory structure, object DBMSs have no performance overhead to store or retrieve a web or hierarchy of interrelated objects. This one-to-one mapping of object programming language objects to database objects has two benefits over other storage approaches: it provides higher performance management of objects, and it enables better management of the complex interrelationships between objects. This makes object DBMSs better suited to support applications such as financial portfolio risk analysis systems, telecommunications service applications, world wide web document structures, design and manufacturing systems, and hospital patient record systems, which have complex relationships between objects.

Semistructured data has recently emerged as an important topic of study for a variety of reasons. First, there are data sources such as the Web, which we would like to treat as databases but which cannot be constrained by a schema. Second, it may be desirable to have an extremely flexible format for data exchange between disparate databases. Third, even when dealing with structured data, it may be helpful to view it as semistructured for the purposes of browsing.

**Semistructured Model**

In semistructured data model, the information that is normally associated with a schema is contained within the data, which is sometimes called "self-describing". In such database there is no clear separation between the data and the schema, and the degree to which it is structured depends on the application. In some forms of semistructured data there is no separate schema, in others it exists but only places loose constraints on the data. Semi-structured data is naturally modelled in terms of graphs which contain labels which give semantics to its underlying structure. Such databases subsume the modelling power of recent extensions of flat relational databases, to nested databases which allow the nesting (or encapsulation) of entities, and to object databases which, in addition, allow cyclic references between objects.

**Associative Model**

The associative model divides the real-world things about which data is to be recorded into two sorts: Entities are things that have discrete, independent existence. An entity's existence does not depend on any other thing. Associations are things whose existence depends on one or more other things, such that if any of those things ceases to exist, then the thing itself ceases to exist or becomes meaningless.

An associative database comprises two data structures:
1. A set of items, each of which has a unique identifier, a name and a type.
2. A set of links, each of which has a unique identifier, together with the unique identifiers of three other things, that represent the source, verb and target of a fact that is recorded about the source in the database. Each of the three things identified by the source, verb and target may be either a link or an item.

**Entity-Attribute-Value (EAV) data model**

The best way to understand the rationale of EAV design is to understand row modeling (of which EAV is a generalized form). Consider a supermarket database that must manage thousands of products and brands, many of which have a transitory existence. Here, it is intuitively obvious that product names should not be hard-coded as names of columns in tables. Instead, one stores product descriptions in a Products table: purchases/sales of individual items are recorded in other tables as separate rows with a product ID referencing this table. Conceptually an EAV design involves a single table with three columns, an entity (such as an olfactory receptor ID), an attribute (such as species, which is actually a pointer into the metadata table) and a value for the attribute (e.g., rat). In EAV design, one row stores a single fact. In a conventional table that has one column per attribute, by contrast, one row stores a set of facts. EAV design is appropriate when the number of parameters that potentially apply to an entity is vastly more than those that actually apply to an individual entity.

For more information see: The EAV/CR Model of Data

**Context Model**

The context data model combines features of all the above models. It can be considered as a collection of object-oriented, network and semistructured models or as some kind of object database. In other words this is a flexible model, you can use any type of database structure depending on task. Such data model has been implemented in DBMS ConteXt. The fundamental unit of information storage of ConteXt is a CLASS. Class contains METHODS and describes OBJECT. The Object contains FIELDS and PROPERTY. The field may be composite, in this case the field contains SubFields etc. The property is a set of fields that belongs to particular Object. (similar to AVL database). In other words, fields are permanent part of Object but Property is its variable part.
The header of Class contains the definition of the internal structure of the Object, which includes the description of each field, such as their type, length, attributes and name. Context data model has a set of predefined types as well as user defined types. The predefined types include not only character strings, texts and digits but also pointers (references) and aggregate types (structures).

Types of Fields
A context model comprises three main data types: REGULAR, VIRTUAL and REFERENCE. A regular (local) field can be ATOMIC or COMPOSITE. The atomic field has no inner structure. In contrast, a composite field may have a complex structure, and its type is described in the header of Class. The composite fields are divided into STATIC and DYNAMIC. The type of a static composite field is stored in the header and is permanent. Description of the type of a dynamic composite field is stored within the Object and can vary from Object to Object.

Like a NETWORK database, apart from the fields containing the information directly, context database has fields storing a place where this information can be found, i.e. POINTER (link, reference) which can point to an Object in this or another Class. Because main addressed unit of context database is an Object, the pointer is made to Object instead of a field of this Object. The pointers are divided on STATIC and DYNAMIC. All pointers that belong to a particular static pointer type point to the same Class (albeit, possibly, to different Object). In this case, the Class name is an integral part of the that pointer type. A dynamic pointer type describes pointers that may refer to different Classes. The Class, which may be linked through a pointer, can reside on the same or any other computer on the local area network. There is no hierarchy between Classes and the pointer can link to any Class, including its own.

Rsponsibility in Management: Definition and Features of Responsibility!

Meaning:
Responsibility refers to something to do something.
It is the duty of the subordinate to perform organisational tasks, functions or activities assigned to him. Authority and responsibility go side by side. When authority is delegated then some responsibility for getting the assigned task is also fixed. One can delegate authority but not responsibility.

Definition: "Responsibility is the obligation of a subordinate to carry out the duties assigned to him." — Knoottz and O'Donnell

"By responsibility we mean the work or duties assigned to a person by virtue of his position in the organisation. It refers to the mental and physical activities which must be performed to carry out a task or duty. That means every person who performs any kind of mental or physical effort as an assigned task has responsibility." — Allen

"Responsibility is the obligation to carry out assigned activities to the best of his abilities. " — George Terry

Responsibility is thus the result of superior-subordinate relationship. In other words, a subordinate’s obligations in any business unit will arise basically from his relationship with his superior who is given the authority to get something done. A superior/ manager/executive get the rights of compliance of orders when he assigns duties and debates authority, while accepting a job a subordinate incurs an obligation to perform the job successfully.

"The essence of responsibility is then obligation. Responsibility has no meaning except as applied to a person; a building, a machine or an animal cannot be held responsible." Responsibility is a concomitant of authority. A person who has authority has a corresponding responsibility for the proper exercise of authority given to him. Authority flows from a superior to subordinate while responsibility flows from a subordinate to a superior.

Features of Responsibility: The following are the characteristics or features of responsibility:
(i) Responsibility comes from superior-subordinate relationship. (iii) It arises from duty assigned.
(ii) It always flows upward from juniors to seniors. (iv) It cannot be delegated.
(v) It is the obligation to complete the job as per instructions. Responsibility may be continuing obligation or it may be discharged by accomplishing single task. Responsibility is a personal attribute. No person can shift his responsibility by delegating his authority to others.

Whether an individual exercises the authority himself or gets it exercised through others, he remains responsible to his own superior for proper performance. Thus, responsibility is absolute and can never be delegated or shifted to others.

The Leadership Challenge

The Responsibility of Top Management

The ISO 9000 standard contains high expectations for top management leadership and involvement to provide guidance to the overall quality management system. In fact, nearly 15% of the standard’s text is devoted to the subject of top management responsibility. Clearly, the designers of the standard have realized the imperative for the perspective and authority that top management must bring to ensure effective operation of the system.

Because of this, it can be expected that ISO registrars will approach the auditing of the standard with a heightened focus on the function of management in the system. The auditors will be looking for objective evidence that management has a regular discipline of involvement and leadership as prescribed by the standard. This evidence must be more than merely words of support for quality. The activities outlined in the requirements are all demonstrable, and records of such activities will be carefully reviewed.

This extra focus on the role of management is explained in the opening text of the Management Responsibility requirements section:

“Top management shall provide evidence of its commitment to the development and implementation of the quality management system and continually improve its effectiveness...” (ref. 5.1, ISO 9000).

Requirements for Top Management

The ISO 9000 standard lists six distinct requirements for top management. By “top management” the standard refers to the individual at the top of the organization (e.g. CEO, President, Chairman) and his/her direct reports. Depending upon the size and structure of the organization, one or two layers of management below this top group may be included in this scope.

In summary, the requirements for this leadership group are:
1. Consistent commitment to making the quality management system effective as demonstrated by regular communications, establishment of a quality policy and quality objectives, management reviews and resource provision (ref. 5.1).
2. Ensuring customer focus throughout the organization as demonstrated by clearly determining and consistently meeting customer requirements resulting in improved customer satisfaction (ref. 5.2).
3. Establishment and communication of a quality policy that articulates management’s intention that the company complies with all requirements (customer, regulatory, etc.) and will continually strive to improve the overall quality management system’s effectiveness (ref. 5.3).

4. Ongoing planning of measurable product quality and process quality objectives to be sure they are established and met throughout the organization, even when changes to the quality management system are made (ref. 5.4).

5. Defining and communicating responsibility and authority for everyone affecting the quality management system, including a designated management representative who has the authority to ensure the system is established and maintained and is responsible to report the system’s performance to top management (ref. 5.5). This requirement also includes the need to establish effective communication processes within the organization regarding the effectiveness of the quality management system.

6. Conducting a regular management review of the quality management system to ensure that it remains suitable, adequate and effective to satisfy the company’s quality policy and accomplish the organization’s quality objectives (ref. 5.6).

A management team responsible for preparing their organization for ISO 9000 registration will need to give focus and attention to the planning and implementation of the specific requirements for top management and the oversight of the development of the organization’s overall quality management system.

**Roles and responsibilities in a best practice performance management process**

To have a truly effective performance management process that supports employee performance, development and success, you need to get everyone involved. Having engaged and informed senior executives, managers and employees will ultimately result in higher participation rates and better quality performance management.

So you need to clearly communicate to everyone, what they are responsible for as part of your new performance management process. Here’s breakdown of the responsibilities of each stakeholder group: executives and leadership, managers, employees and HR.

**Executive and senior leadership responsibilities**

As an executive or senior leader, you need to be an enthusiastic champion of the new process. Make sure you are supportive of the process, communicate its value and engage others to participate.

Share your support through a variety of employee communications vehicles. And be prepared to answer questions from various groups about “what’s in it for me” to help build organizational commitment to the process.

Finally, pay it more than lip service. Use the information derived from the process to guide strategic decision-making about the organization.

**The managers’ responsibilities in the performance management process**

As a manager, you have a responsibility to recognize and reinforce strong performance in your employees, and identify and encourage improvement where needed. But to begin with, you need to view performance management as a two-way discussion that goes on throughout the year. Your employees should never be surprised by the ratings and feedback they receive in their formal performance reviews.

As a manager, you are expected to:

- Use the performance management process as a valuable tool for supporting employee development and improvement.
  - If your employees sense a lack of interest on your part, they’ll lose interest too.
  - When talking with your team about the process, be sure to emphasize its benefits, and encourage employees to take ownership of their own performance and development.
- Determine an appropriate schedule for regular performance conversations with those you manage directly.
  - Conduc short, regular meetings to discuss and record milestones, accomplishments, successes and challenges as they occur, when details are fresh in both your minds. This will allow you to better monitor progress on goals, and provide coaching as required. Plus, these short meetings reduce the effort it takes to prepare for and conduct your annual performance reviews because you’ve tracked progress and performance and provided the needed feedback when it was most valuable.
  - Use the annual performance review meeting to review the achievements, setbacks, development and training that have already been discussed throughout the year — and then use this information to establish goals and a development plan for the coming year.
- Deliver regular positive and constructive feedback.
  - Give employees feedback during one-on-one meetings and informally as regularly as possible.
  - Commend your employee in front of their peers.
  - Make performance notes about each employee in the period between conversations, so that come conversation time, you have concrete examples to share.
  - Remember that the goal of feedback is to describe desired behaviors and expectations, not to dwell on undesirable behaviors.
- Check-in on goal progress
  - Regularly check in with employees on their progress on goals; offer coaching or assistance, or revise goals as necessary.
- Communicate and revisit performance expectations.
  - Communicate your organizations’ performance standards and expectations to your employees. This will help your employees differentiate between acceptable and unacceptable behaviors and results and reduce any misunderstandings.
  - Gather feedback on employee performance from multiple sources. Use a 360-degree feedback or survey tool to complete and validate your own observations and perceptions.
- Improve your management and leadership skills.
  - Take the time to learn how to be a better manager and coach. Invest in your own development!
  - Acquaint yourself with the different management needs of the different generations.
  - Employees from the Millennial generation may have different needs and different expectations of managers. Research tells us they require constant feedback and recognition, and expect quick career advancement. Workers from other generations have different needs. Learn what motivates each employee, and adjust your management approach accordingly.
  - Coach your employees in a way that strengthens two-way communication and reinforces desired behaviors.
- When you want to focus attention on a specific aspect of the employee’s performance.
Your role as an employee in this performance management process is to:

- Focus on describing your expectations and the desired behaviors rather than describing the gaps.
- Take the time to understand why their performance is what it is, and get them to take ownership for performance improvements.
- Support your employees' professional and career development while making them accountable for it.
- Regularly ask employees about their career aspirations and help them identify areas they may wish to improve or develop, as well as resources available.
- Ensure each employee has a well-defined job description and understands the skills and competencies they must develop in order to progress up the career ladder.
- Give your employees the time and flexibility they need to complete learning and development activities.
- Ensure development is having an impact on performance.
- Submit your completed employee reviews by the designated deadline.
- Failing to complete your formal performance review documentation on time sends your employees the message that recognition of their success and support for their development is not your top priority. It may also delay any pay for performance/merit increases or bonuses your organization allocates to employees based on their performance ratings.
- Understand and correctly use your organization's rating scale.
- Be objective and have quantitative/qualitative facts ready to substantiate the ratings you give.
- Provide details on how the employee demonstrated the core and job specific competencies you are rating them on.
- Provide details on how they accomplished their goals, the milestones they met and work products they delivered.
- Assign each employee a development plan to help them improve their performance and support the organization's success.

**Employees' responsibilities**

Your role as an employee in this performance management process is to:

- Work towards achieving your individual goals, which help the organization reach its objectives.
- You and your manager should have set these goals collaboratively as part of your performance management activities.
- Keep track of your progress on your goals and regularly communicate their status to your manager, especially if you're facing challenges that could prevent you from achieving your goals.
- Take responsibility for your own professional and career development.
- Be clear about how you would like to grow professionally.
- Know what knowledge, skills and experience you want and need to develop.
- Actively seek opportunities for professional and career development, both in the organization or through external learning resources.
- Be open to feedback
- Accept constructive feedback and take the initiative to improve.
- Complete any development plans assigned to you and apply the learning to improve your performance.
- Seek support as required
- Work to establish and maintain a healthy relationship with your manager.
- Ask your manager for feedback and guidance, especially when you encounter challenges.
- Solicit feedback and guidance on your performance from others you work with.
- Keep a record of your performance achievements, successes and challenges.
- Keep a performance journal and share things like your successes, and the feedback and recognition you receive from others with your manager.
- Give others feedback.
- Just as you need feedback and recognition to improve your performance, your co-workers need it too. Give feedback verbally, as well as using online communication and social collaboration tools available to you. And don’t be afraid to copy managers on your written feedback so they can gain more insight into their employees’ performance.
- Complete your self-appraisal by the specified deadline.
- Reacquaint yourself with your job description, critical competencies for the role and performance expectations as defined by the organization.
- Understand and correctly use the organization's rating scale.
- Be honest about your performance but don’t underestimate your abilities.
- Be objective and have quantitative/qualitative facts ready to substantiate the ratings you give yourself.
- Provide details on how you demonstrated the core and job specific competencies you are being rated on.
- Provide details on how you accomplished your goals, the milestones you met and work products you delivered.
- Consider your current knowledge, skills and abilities as well as your career aspirations and identify learning activities that could benefit you and your organization.
- Draft your goals for the coming period, making sure they in some way contribute to the organization's goals, and are appropriate for your role.

**HR's responsibilities**

Your role as an HR business partner in this performance management process is to:

- Design a best practice performance management process.
- Set reasonable deadlines for completing each step in the process.
- Provide training to all executives, managers and employees on the process, the steps involved, their responsibilities, and the benefits to be gained by all, addressing each group's (executives, managers, employees) particular needs.
- Clearly explain your performance rating scale, the difference between the different levels of performance, and how you expect ratings to be used (e.g., what rating is used for good performance and given to most employees, what additional actions need to be taken when performance is judged to be above and below expectations, etc.)
- Provide managers with regular training on how to give feedback as well as on how to coach and develop their employees.
- Launch and manage your performance management process.
- Analyze and review the results of your process, identifying things like:
Learning how others are getting everyone to play a role in performance management

At the San Diego Zoo, they adopted performance management best practices to support a new strategic plan. Gradually, they’ve involved everyone, from all parts and levels of the organization, driving performance, accountability and engagement.

List of Business Management Responsibilities

Business managers direct the talent and resources within an organization to advance strategic business goals. While that is a simple definition, management is becoming more complex as managers must respond to both planned and unplanned issues that might arise within the organization. The manager’s job can also be marked by overload under the expectations to be both a generalist and a specialist. Planning and organizing is a core function of business management. Business planning involves developing business goals, and designing strategies and organizing business resources to advance those goals. Both internal data related to organizational performance and external data about the industry, markets and competition provide insights business management needs in order to direct the company’s resources and identify organizational needs.

Decision-Making
Management is responsible for the decision-making in an organization, such as choices related to changes needed to adapt to external and internal factors that impact business operations. Management must also decide where to use capital resources within an organization. Other decision-making responsibilities include selecting suppliers and vendors for goods and services for the organization.

Informational Role
Management is charged with informational responsibilities in an organization, disseminating relevant information within the workplace. This might include collecting, monitoring and reporting relevant data used to analyze business performance. A manager might also serve as the spokesperson for the organization, frequently responsible for transmitting organizational information to outsiders such as stakeholders and media professionals.

Interpersonal Role
Interpersonal communication is an important part of a manager’s duties across the board when communicating with customers, employees and suppliers. As a leader within the organization, a manager is a symbol of leadership, setting the atmosphere and tone of the organization. Management also ensures that staff is properly connecting within the workplace. This includes developing effective teams to manage programs and projects that further business objectives, as well as managing conflict resolution systems.

EDP Basic Concepts

The EDP Baseboard (or “motherboard”) consists of 4 ‘stations’ with the minimum configuration of the motherboard with a single plug-in processor module. All 4 stations are identical, and there are many permutations of CPU modules and Application modules possible. Even with just the minimum configuration of Motherboard and CPU module for example, you can easily run a web-server through the standard onboard Ethernet connection. There are various application modules; we have introduced an initial starter range consisting of basic digital and analogue I/O, a motor control module and a communications module. The more advanced user will discover that it is possible to run more than one processor module on the motherboard in a Master and Slave configuration.

The motherboard is an Extended Euro card size (220 x 100 mm) fitted with rubber feet to lay flat on the bench, but able to be used in a standard rack system. Add a 64-way DIN (RS 381-8696) connector and you can plug the EDP into a backplane. Connectors for four module stations are supplied, arranged to ensure correct module fitting. There are also fitted +3.3V and +5V voltage regulators, a back-up battery, an RJ45 Ethernet connector, a mini-USB connector, +12 volt power-supply jack, I/O breakout header and eight DIP switches ported onto the system I2C bus. The DIP switches allow the user software running on a processor module to read a configuration setting, enabling I/O ports to be set up correctly, for example, or for CAN or TCP/IP addresses to be set. Depending on the capability of the particular processor module in use, up to three I2C buses and two CAN networks are available. Many of the application modules use an I2C bus for primary communication with the processor providing maximum flexibility. Some processor chips will require +5 volts, others +3.3 volts. A factory link on the module selects the correct supply from the connector. This supply is linked to a further connector pin on all the other module stations providing a correct voltage reference or bus pull-up for the application modules. There is also duplication of an analogue input unit, to give a very large number of inputs.

CPU Modules
- STR9 Module
- PIC-PIM Module
- MBED Module
- XC167 Module
- Comms Module
- Motor MC2 Module

Application Modules
- Analog Module
- Digital I/O Module
- Motor MC1 Module

Reusable Components

The EDP baseboard is designed to be used and reused with new CPU and application modules being introduced on a regular basis. Its robust design has been rigorously tested, and every effort has been made at the design stage to protect the EDP from the most common human errors: the motherboard will have a significantly longer life than the average development board and is suitable for use in specialist applications requiring prolonged reliability.

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Electronic data processing (EDP) can refer to the use of automated methods to process commercial data. Typically, this uses relatively simple, repetitive activities to process large volumes of similar information. For example: stock updates applied to an inventory, banking transactions applied to account and customer master files, booking and ticketing transactions to an airline’s reservation system, billing for utility services. The modifier “electronic” or “automatic” was used with “data processing” (DP), especially c. 1960, to distinguish human clerical data processing from that done by computer.

### Advantages of Electronic Data Processing

- **Speed.** Information stored and managed via EDP can be retrieved almost instantly on a well-maintained internal network or even the Internet.
- **Efficient.** Summary documents and related materials such as invoices, reports, and statements can be automatically and quickly generated via EDP.
- **Economic.** Once an Electronic Data Processing system is created and implemented, over time it reduced the costs of managing data by a significant margin.
- **Reduced Labor.** Duplication of effort and repeated entries due to mistakes in manual data entry are reduced or eliminated by EDP.

### Elements of Electronic Data Processing

- **Hardware:** The servers and desktops or terminals used to enter and store data.
- **Software:** Spreadsheets, custom applications, databases, and other pieces of code used to manage and collect the data.
- **Procedure:** A coherent and agreed-upon system for entering and manipulating data, designed to eliminate duplication of entry and data corruption.
- **Personnel:** The staff trained to work with the EDP, ranging from the entire work force to a select group.

### EDP Cycle

- **Input:** The data is collected by the system, via keyboarding, file upload, or other workflow.
- **Processing:** The data is manipulated in some way, usually automated. This can include translation, formula or code application, or encryption.
- **Output:** The data is then output in transformation, either as part of a report or as a translated and modified form.
EDP Equipment
In the broadest sense, any equipment used to input, process, output, or display the data can be considered EDP Equipment. This would include:
- Desktop, laptop, tablet computers, terminals or dedicated data input equipment.
- Network equipment, wired or wireless, used to transmit data.
- Servers used to store data.
- Projectors, printers, and any other device used to output processed data.

Example of EDP
One of the most common examples of EDP in the modern age is warehouse stock monitoring and logistics. As orders come in, the data is input into the system and processed, transformed into a picking order and transmitted to the warehouse. The stock is picked from the shelves (manually or via automated system) and the item is deducted from the database to reflect the new reality in the warehouse itself.

Entrepreneurship Development Programmes: Meaning, Need and Objectives of EDP

Meaning:
As the term itself denotes, EDP is a programme meant to develop entrepreneurial abilities among the people. In other words, it refers to inculcation, development, and polishing of entrepreneurial skills into a person needed to establish and successfully run his/her enterprise. Thus, the concept of entrepreneurship development programme involves equipping a person with the required skills and knowledge needed for starting and running the enterprise.

Let us also consider a few important definitions of EDPs given by institutions and experts:
Small Industries Extension and Training Institute (SIET 1974), now National Institute of Small Industry Extension Training (NISIET), Hyderabad defined EDP as “an attempt to develop a person as entrepreneur through structural training.

The main purpose of such entrepreneurship development programme is to widen the base of entrepreneurship by development achievement motivation and entrepreneurial skills among the less privileged sections of the society.”

According to N. P. Singh (1985), "Entrepreneurship Development Programme is designed to help an individual in strengthening his entrepreneurial motive and in acquiring skills and capabilities necessary for playing his entrepreneurial role effectively. It is necessary to promote this understanding of motives and their impact on entrepreneurial values and behaviour for this purpose.”

Now, we can easily define EDP as a planned effort to identify, inculcate, develop, and polish the capabilities and skills as the prerequisites of a person to become and behave as an entrepreneur.

Need for EDPs:
That, entrepreneurs possess certain competencies or traits. These competencies or traits are the underlying characteristics of the entrepreneurs which result in superior performance and which distinguish successful entrepreneurs from the unsuccessful ones.

Then, the important question arises is: where do these traits come from? Or, whether these traits are in born in the entrepreneurs or can be induced and developed? In other words, whether the entrepreneurs are born or made? Behavioural scientists have tried to seek answers to these questions.

A well-known behavioural scientist David C. McClelland (1961) at Harvard University made an interesting investigation-cum-experiment into why certain societies displayed great creative powers at particular periods of their history? What was the cause of these creative bursts of energy? He found that ‘the need for achievement (n’ ach factor)’ was the answer to this question. It was the need for achievement that motivates people to work hard. According to him, money-making was incidental. It was only a measure of achievement, not its motivation.

In order to answer the next question whether this need for achievement could be induced, he conducted a five-year experimental study in Kakinada, i.e. one of the prosperous districts of Andhra Pradesh in India in collaboration with Small Industries Extension and Training Institute (SIET), Hyderabad.

This experiment is popularly known as ‘Kakinada Experiment’. Under this experiment, young persons were selected and put through a three-month training programme and motivated to see fresh goals.

One of the significant conclusions of the experiment was that the traditional beliefs did not seem to inhibit an entrepreneur and that the suitable training can provide the necessary motivation to the entrepreneurs (McClelland & Winter 1969). The achievement motivation had a positive impact on the performance of entrepreneurs.

In fact, the ‘Kakinada Experiment’ could be treated as a precursor to the present day EDP inputs on behavioural aspects. In a sense, ‘Kakinada Experiment’ is considered as the seed for the Entrepreneurship Development Programmes (EDPs) in India.

The fact remains that it was the ‘Kakinada Experiment’ that made people appreciate the need for and importance of the entrepreneurial training, now popularly known as ‘EDPs’, to induce motivation and competence among the young prospective entrepreneurs.

Based on this, it was the Gujarat Industrial Investment Corporation (GIIC) which, for the first time, started a three-month training programmes on entrepreneurship development. Impressed by the results of GIIC’s this training programme, the Government of India embarked, in 1971, on a massive programme on entrepreneurship development. Since then, there is no looking back in this front. By now, there are some 686 all-India and State level institutions engaged in conducting EDPs in hundreds imparting training to the candidates in thousands.
Till now, 12 State Governments have established state-level Centre for Entrepreneurship Development (CED) or Institute of Entrepreneurship Development (IED) to develop entrepreneurship by conducting EDPs. Today, the EDP in India has proliferated to such a magnitude that it has emerged as a national movement. It is worth mentioning that India operates the oldest and largest programmes for entrepreneurship development in any developing country.

The impact of India’s EDP movement is borne by the fact that the Indian model of entrepreneurship development is being adopted by some of the developing countries of Asia and Africa. Programmes similar to India’s EDPs are conducted in other countries also, for example, ‘Junior Achievement Programme’ based on the principle of ‘catch them young’ in USA and ‘Young Enterprises’ in the U. K.

**Objectives of EDP:** The major objectives of the Entrepreneurship Development Programmes (EDPs) are to:

- Develop and strengthen the entrepreneurial quality, i.e. motivation or need for achievement.
- Analyse environmental set up relating to small industry and small business.
- Select the product.
- Formulate proposal for the product.
- Understand the process and procedure involved in setting up a small enterprise.
- Know the sources of help and support available for starting a small scale industry.
- Acquire the necessary managerial skills required to run a small-scale industry.
- Know the pros and cons in becoming an entrepreneur.
- Appreciate the needed entrepreneurial discipline.
- Besides, some of the other important objectives of the EDPs are to:
  - Let the entrepreneur himself / herself set or reset objectives for his / her enterprise and strive for their realization.
  - Prepare him / her to accept the uncertainty in running a business.
  - Enable him / her to take decisions.
  - Enable to communicate clearly and effectively.
  - Develop a broad vision about the business.
  - Make him subscribe to the industrial democracy.
  - Develop passion for integrity and honesty.
  - Make him learn compliance with law.

**Types of Information Systems suitable for the different Functional Areas**

Information system is an integrated system set comprising components for collecting, storing, processing, and communicating information. All the businesses require different types of Information Systems for their information’s. There are several type of information system using organizations according to management and knowledge level, but these systems can be categorized more into small pieces according to the specified function they perform. The below given are some of the information systems according to the functional area it can be used.

**Human Resource**

As Human Resources are responsible for everything regarding the wellbeing of the people and the company, it maintains aspect of the required the Management and IT efficient device. The primary Techniques used by this efficient unit are

1. Employee management system
2. Office automation system
3. Management information system

**Finance and accounting**

- Systems to select new plant site or to design the overall plans for a new production facility.
- Market research systems (these may also be tactical).
- Long range forecasting systems.
- Corporate planning systems (contain simulation models).

**Tactical Systems**

- Budgeting system.
- Capital Budgeting.
- Investment Management.
- Cash Management.

**Operational Systems**

- Many of the sys. Below also have some tactical components.
- MRPII – Manufacturing Resource Planning.
- Customer contact management systems.
- Employee information systems.
- Inventory Control for 3 types of inv.
- Shop floor control; Quality control.
- Capacity Requirements Planning; Detailed Production Schedule.
- Delivery tracking and routing systems.
- Performance management systems (can also be tactical).
- Material Requirements Planning.
- Government reporting systems.
- Production Master Scheduling.

**A Summary of Functional Area Information Systems**

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<td>Financial condition analysis (ratios)</td>
<td>Systems to select new plant site or to design the overall plans for a new production facility</td>
<td>Sales forecasting systems</td>
<td>Market research systems (these may also be tactical)</td>
<td>Long-term workforce planning</td>
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<td>Advertising and promotion systems</td>
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- (ROE)
What Is the Difference Between Programmed & Unprogrammed Decisions From a Business Perspective?

**Programmed and Non-Programmed Decisions in Management**

**Programmed Decisions**
The Programmed decisions in Management of an organization are concerned with the relatively routine problems. These decisions are taken in the regular course of any business operations and occur at a day-to-day frequency. These decisions are repetitive and structured in nature. They are small and have a low scope of impact. The Information related to these types of decisions are readily available and can be processed in a pre-determined manner. These demand very little time and effort as there are pre-determined decision rules and procedures. These are taken at lower levels of management. For example, a decision regarding a personnel coming late regularly.

**Non-Programmed Decisions**
The Non-programmed decisions in management are concerned with unique or unusual problems. They are encountered in a very non-frequent manner. These decisions are unstructured, non-recurring and ill-defined in nature. Such decisions are relatively complex and have a long-term impact. The Information regarding these problems are not easily available. As such, they require high degree of executive judgement and deliberation. These are generally taken at higher levels in the organization. Eg-Decisions regarding the expansion of business

**Definition, similarities and differences of Programmed Decision and Non-Programmed Decision are** explained below;

**Programmed Decision**

Programmed decisions are those that are traditionally made using standard operating procedures or other well-defined methods. These are routines that deal with frequently occurring situations, such as requests for leaves of absence by employees.

In routine situations, it is usually much more desirable for managers to use programmed decision than to make a new decision for each similar situation.

In programmed decisions managers make a real decision only once, when the program is created. Subsequently, the program itself specifies procedures to follow when similar circumstances arise.

The creation of these routines results in the formulation of rules, procedures, and policies.
Programmed decisions do not necessarily remain confined to simple issues, such as vacation policies or similar such things; they are also used to deal with very complex issues, such as the types of tests that a doctor needs to conduct before performing a major surgery on a patient with diabetes.

To summarize, **programmed decisions features** are;
- Programmed decisions made using standard operating procedures.
- Deals with frequently occurring situations. (Such as requests for leaves of absence by employees)
- Much more appropriate for managers to use programmed decision for similar and frequent situations.
- In programmed decisions managers make a real decision only once and program itself specifies procedures to follow when similar circumstances arise.
- Leads to the formulation of rules, procedures, and policies.

**Non-Programmed Decision**

Non-programmed decisions are unique. They are often ill-structured, one-shot decisions. Traditionally they have been handled by techniques such as judgment, intuition, and creativity.

More recently **decision makers** have turned to heuristic problem-solving approaches in which logic; common sense and trial and error are used to deal with problems that are too large or too complex to be solved through quantitative or computerized approaches.

In fact, many management training programs on decision-making are designed to help managers think through problems using a logical, non-programmed approach. In this way they learn how to deal with extraordinary, unexpected, and unique problems.

**Non-programmed decision features** are;
- Situations for Non-programmed decisions are unique, ill-structured.
- Non-programmed decisions are one-shot decisions.
- Handled by techniques such as judgment, intuition, and creativity.
- A logical approach to deal with extraordinary, unexpected, and unique problems.
- Managers take heuristic problem-solving approaches in which logic; common sense and trial and error are used.

**Similarities of Programmed Decision & Non-Programmed Decision**

- Both are Required to run operations of Business efficiently.
- Complements each other in **setting goals** and managing resources of the organization.

<table>
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<th>Differences of Programmed Decision &amp; Non-Programmed Decision</th>
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<td><strong>Programmed Decision</strong></td>
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<td>Used for frequent situations of organization; both internal and external.</td>
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<td>Mostly lower level managers are making these decisions.</td>
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<td>Follows structured and non-creative patterns.</td>
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Programmed decisions usually relate to structured problems while non-programmed decisions are taken to solve unstructured problems. It is also to be noted that the programmed decisions are taken at the lowest level whereas the non-programmed decisions are taken at the highest level of organization hierarchy.

**Programmed and Non-Programmed Decisions | Difference**

**Programmed Decisions:**
1. These are for solving day to day and routine problems and are repetitive in nature.
2. Rules and procedures are described for taking these decisions.
3. These decisions remains consistent for a relatively longer period of time and over many situations.
4. These decisions are made for solving both simple and complex problems.
5. Decisions are of routine nature requiring no judgment.

**Non-Programmed Decisions:**
1. These are for solving non-repetitive tactical or unique problems.
2. Every decision will have to be taken separately by analyzing and evaluating each problem.
3. Every decision is different and there is no consistency.
4. Such decisions are for solving complex.
5. Such Decisions require judgment in each case.

<table>
<thead>
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<th>Types of Decisions: Programmed and Non-Programmed</th>
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<td>Various types of programed decisions are:</td>
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<td>(1) Organisational decisions</td>
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<td>Different types of non-programed decisions are:</td>
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<td>(1) Personal decisions,</td>
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<td>A brief description of different types of programmed and non-programed decisions is given below:</td>
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<tr>
<td>Programme</td>
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<tr>
<td>1. Nature of Problem</td>
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1. **Organisational and personal decisions**: These decisions reflect use of authority. Decisions taken in interest of the organisation are organisational decisions and decisions taken for personal interests are personal decisions. Organisational decisions can be delegated but personal decisions cannot.

Managers are officially authorised to make organisational decisions but they do not have authority to make personal decisions. They are based on personal biases. For example, firing an employee because he does not conform to rules is an organisational decision but firing due to personal enmity is a personal decision.

2. **Operational and strategic decisions**: These decisions reflect scope of decision-making processes. Operational decisions are taken as a matter of routine. They relate to daily operations and aim to achieve short-term objectives of the firm. They are taken by middle and lower-level managers within the framework of policies and procedures and allow limited use of discretion by managers. Their impact is also limited and short-range in nature.

These decisions affect part of the organisation and are based on pre-defined policies and procedures. For instance, purchase of stationery and raw material are day-to-day decisions which affect only the purchase department and are taken according to pre-defined procedures defined for the purchase department.

Decisions related to important and non-recurring problems are called strategic decisions. Managerial skill and judgment are used to make these decisions. They relate to long-term goals of the company, define relationship of the organisation with the environment and are risky in nature. They are taken by top-level managers. Decisions to update the technology, launch a new plant or change the policies are strategic decisions.

These decisions affect the whole or major part of the organisation and contribute directly to organisational objectives. They are usually not based on past experience and involve a major departure from earlier business practices regarding various business decisions like expansion of business in international markets, diversification, change in marketing mix etc.

**Strategic decisions involve three important elements:**

(a) **Result element**: It specifies the result (objective) to be achieved through the decision.

(b) **Action element**: It specifies the action to be taken to achieve the result.

(c) **Commitment element**: It specifies the dedication, loyalty and commitment with which people who are responsible for taking action to achieve results are involved in making the decisions.

3. **Research and crisis—intuitive decisions**: These decisions reflect urgency of decision-making. Decisions which involve regular survey of the market are research decisions and decisions made under situations of crisis or emergency are crisis—intuitive decisions. For example, decision to allocate funds to Research and Development for product designing is a research decision; decision to increase production of medicines because of earthquake or war is a crisis-intuitive decision.

4. **Opportunity and problem-solving decisions**: These decisions reflect foresightedness. Managers forecast opportunities to promote organisational growth. The decision to grow and diversify (market penetration and market development) is an opportunity decision. Problem-solving decision solves a specific problem. For example, decision to enter into new markets even when the company is making profits in the existing market is an opportunity decision and decision to drop a product line because it is unprofitable is a problem-solving decision.

**Decision Making—Programmed and Non-programmed Decisions**

- Programmed decisions are those decisions that can be pre-specified by a set of rules or decision procedures.
- Programmed decisions are reflected in rulebooks, decision tables and regulations.
- Programmed decisions imply decision making under certainty because all outcomes must be known.
- Non-programmed decisions have no pre-established decision rules or procedures.
- Non-programmed decisions may range from one-time decisions relating to a crisis to decisions relating to recurring problems where conditions change so much that decision rules cannot be formulated.
- Programmed decisions can be delegated to lower hierarchical levels in an organization or automated.
- Non-programmed decisions generally cannot be delegated to lower hierarchical levels or automated.

**Enterprise wide information systems.**

**Enterprise System** In the book "Enterprise Information Systems: Contemporary Trends and Issues," David Olson states that enterprise systems integrate a number of different applications, protocols and formats. In doing so, an enterprise system allows companies to integrate business processes, such as sales, deliveries and accounts receivable, by sharing information across business functions and employee hierarchies. Enterprise systems can replace multiple independent systems that may or may not interact with other systems and that process data to support particular business functions or processes. For example, enterprise resource planning supports the entire sales process that includes pre-sales activities, sales orders, inventory sourcing, deliveries, billing and customer payments. Enterprise resource planning, supply chain management and customer relationship management systems are each examples of enterprise systems.

**Customer Relationship Management**

Customer relationship management systems were developed to address the need to raise a sales department’s productivity and make the management of a company’s customers an effective way to increase sales. With CRM functions, such as sales opportunity management, a company learns more about its customers’ needs and buying behavior and combines this information with market information to enhance the quality of the company’s marketing plans and sales forecasts. Other attributes of the CRM system, including the integration of this system with other systems and system access via mobile devices, allow employees to update and compare data regardless of the system it’s in and to access information from any client site or other location. Equally important, CRM supports mass e-mail communications and automates the sales process workflow to improve employee productivity.

**Supply Chain Management**
A supply chain refers to the collection of people, tasks, equipment, data and other resources required to produce and move products from a vendor to a customer. Dr. Robert Hanfield of Bank of America describes supply chain management as the management of supply chain activities by the supply chain firms in an effective and efficient way. According to Hanfield, such activities include product development, material sourcing, production and logistics as well as the information systems that coordinate these activities. Information flows allow supply chain partners to coordinate their strategic and operational plans as well as the day-to-day flow of goods and materials through the supply chain. The physical flows include the manufacture, transport and storage of goods or materials.

**Enterprise Resource Planning**

The enterprise resource planning system integrates software applications just as a company integrates business processes, such as purchasing, finance, human resources and inventory management. Within an ERP system, the integrated software modules, such as sales, quality management and accounts receivable, communicate and share data. Each of these modules consists of multiple applications that perform the functions required to execute particular end-to-end business processes. For example, the sales module includes the applications necessary to create and manage sales contracts, sales orders, sales invoices and sales order pricing. ERP applications support not only various operational and administrative tasks, such as the creation of an account payable or a time sheet, they may also be customized to support a number of different industries, including oil and gas, retail and banking.

**Information System Plans**

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

**Strategic Information Systems Planning**

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

Following the broad mission and analysis of environment and constraints, concrete objectives of information systems is laid down along with the plan of achieving the objectives. The plan will include broad guidelines on allocation of resources, mechanisms of control of the process of information system development and other guidelines for implementing the strategies of the plan.

**Long Range Information System Planning**

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

**Collecting background data**

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

**Analyzing the broad long-term needs**

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

**Developing the long-range plan document**

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

This is a very important plan for developing the IS. It looks to satisfy the present information needs of the organization by implementing a portfolio of projects. The planning time horizon is one to two years and the focus is on the present. It normally contains the plan of action for the portfolio of IS projects, resource requirements for each, procurement of necessary resources for implementing the projects, staffing needs analysis, budgeting and funding issues, priority setting of the projects under development. This process of planning, resulting in the information systems, master plan document containing details on:

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

The short-range information system planning

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

SDLC Phases

Planning

Planning the system requires the user to define what the problem is. The planning may also include how the user would like to solve the problem. Defining the scope of the problem is also important in this stage as well. Defining the scope helps to prevent the project from scope creep. Once the problem is determined, and one or more solutions have been selected, planning to implement the solution begins. Multiple scenarios may be enacted to determine the best course of action for implementing the system.

Course of action should be well documented and take into consideration a schedule showing anticipated start and completion times of activities (milestones) leading to the objectives, knowing expenditures required to achieve objectives, scheduling regular status reviews (are we on course?), anticipating any organizational restructuring to accommodate the objectives, anticipating and planning for mitigation of risks that may hinder achievements, implementing policies and procedures for decision making, and defining a standard level of performance.

five of the main activities must exist” as he explain in his book the fives activities should include:

- Define the problem
- Gather Information
- Prioritize requirements
- Staff the project
- Build prototypes for the new system

Why do plans fail? Some of the many reasons are:

- Goals/specifications are not understood.
- Objectives are too extensive for the time allotted.
- Budgets were not accurate.
- Project is understaffed or under skilled.
- Status reviews were not scheduled or insufficient.
- Poor morale (no commitment).

One of the most difficult decisions in planning is to know when to pull the plug on a project. This will require an effective control and monitoring system. If you cannot monitor a system you cannot control it. No organization wants to admit failure but there may come a point when a project can no longer be salvaged. This is especially critical with Information Technology projects because of rapidly changing technologies. Most managers are reluctant to prematurely terminate a project as careers and egos are at stake. The fallacy of sunk costs may play a role as well. The result is that projects continue beyond the point of no return. To avoid this problem, monitor and control systems must be put in place early during the planning stage. It is critical to define and enforce milestones where a project will be terminated if necessary. A saving grace is that because a project is terminated it doesn’t make it a complete failure. Excessive cost are saved for the organization and management can walk away with lessons learned that can be applied to the next project. In general there are two types of monitoring "INFORMAL" and "FORMAL". Informal are typically general meetings, email, and observing. The formal include status reports, scheduled milestones, audits, reviews, and benchmarks. The formal reviews are generally more costly and are used during system development processes. Both systems can be used in combination and involve the questions: “what performance metrics to use” and “how often do reviews occur”? Attention and energy must be focused on identifying and correcting out-of-control processes.

Analysis

The analysis phase involves gathering requirements for the system. At this stage, business needs are studied with the intention of making business processes more efficient. The system analysis phase focuses on what the system will do in an effort that views all stakeholders, as viable sources of information. In the analysis phase, a significant amount of time is spent talking with stakeholders and reviewing the stakeholder’s input. Common stakeholders for IT projects are:

- Architecture office
- Testing & certification office
- Records management team
- Application support group

Once stakeholders have been recognized, the gathering and analysis of the requirements can begin. Requirement gathering must be related to business needs or opportunities. Requirement analysis involves capturing requirements and analyzing requirements. Capturing requirements is communicating with stakeholders to agree on what the requirements are. Analyzing requirements is using standard tools to produce a baseline of the requirements. Once the stakeholders concur on the requirements, the baseline is created and becomes the formal requirement source.

Within this analysis phase, the analyst is discovering and fact finding. Along with meeting with stakeholders, the analyst must meet with end users to understand what the user’s needs are and to learn about problems that affect the current system in order to assist with designing a new and more efficient system. There are several activities that must occur within the analysis phase.

- Gather Information
- Define the new system’s requirements
- Build prototypes for the new system
- Prioritize requirements
Design
The design phase is concerned with the physical construction of the system. Included are the design or configuration of the network (hardware, operating system, programming, etc.), design of user interfaces (forms, reports, etc.), design of system interfaces (for communication with other systems), and security issues. It is important that the proposed design be tested for performance, and to ensure that it meets the requirements outlined during the analysis phase. In other words, the main objective of this phase is to transform the previously defined requirements into a complete and detailed set of specifications which will be used during the next phase. Some of the activities that need to take place during the design phase are:

- Design the application
- Design and integrate the network
- Design and integrate the database
- Create a contingency plan
- Start a Maintenance, Training and Operations plan
- Review the design
- Articulate the business processes and procedures
- Establish a transition strategy
- Deliver the System Design Document
- Review final design

Implementation
Initiating a project first requires the documenting of needs or requirements. Clear objectives should be developed from this study with reasons for selecting the objectives. Deliverables then need to be documented along with the project scope. Scope can be refined during this initialization process. Assumptions and constraints should also be documented. All stakeholders should be involved in this process. This information will become the projects charter and the basis for initiating the project. The project then follows the PLAN-DO CHECK-ACT cycle. The results of each cycle will be linked to the next as input. This process should increase the likelihood of deliverable acceptance. In order to achieve deliverable of acceptance and meeting of objectives, the new system being built must be tested. Aligned with this, the end users must be fully trained so the company will benefit from the new system. There are five activities that must be performed during the implementation phase:

- Construct software components
- Verify and test
- Convert Data
- Training end users and document the system
- Install the system

Maintenance/Support
Maintenance and support covers all activities that are required once the system is in place. Activities include, but are not limited to:

- Phone support for users
- Physical onsite user support
- Resolving any issues that may arise with the new system
- Providing support materials/tools for users

The amount of support required may be determined based on the system. If it is a large system involving many different departments, maintenance and support may be needed for a longer time. If is a smaller system, maintenance and support may only be needed for a short time.

Systems Development Methods
This section discusses the most popular methods for developing computer-based information systems. A popular, traditional method is called structured analysis, but a newer strategy called object-oriented analysis and design also is used widely. Each method offers many variations. Some organizations develop their own approaches or adopt methods offered by software vendors or consultants. Most IT experts agree that no single, best system development strategy exists. Instead, a systems analyst should understand the alternative methods and their strengths and weaknesses.

Structured Analysis
Structured analysis is a traditional systems development technique that is time-tested and easy to understand. Because it describes the processes that transform data into useful information, structured analysis is called a process-centered technique. In addition to modeling the processes, structured analysis includes data organization and structure, relational database design, and user interface issues. Structured analysis uses a series of phases, called the systems development life cycle (SDLC) to plan, analyze, design, implement, and support an information system. Structured analysis relies on a set of process models that graphically describe a system. Process modeling identifies the data flowing into a process, the business rules that transform the data, and the resulting output data flow. Basically, the structured analysis technique requires that the developer defines three things: 1) what processing the system needs to do, 2) what data the system needs to store, and 3) what inputs and outputs will be needed in order for the system to work as a whole. In order to see how all these functions work together, the data flow diagram (DFD) is needed to show the inputs, processes storage, and outputs.

Object-Oriented Analysis
Whereas structured analysis regards processes and data as separate components, object-oriented analysis combines data and the processes that act on the data into things called objects. Object-oriented analysis defines the different types of objects that are doing the work and interacting with one another in the system and by showing user interactions, called use cases, are required to complete tasks. Systems analysts use O-O methods to model real-world business processes and operations. The result is a set of software objects that represent actual people, things, transactions, and events. Using an O-O programming language, a programmer then transforms the objects into reusable code and components. O-O analysis uses object models to represent data, behavior, and by what means objects affect other objects. By describing the objects/data and methods (processes) needed to support a business operation, a system developer can design reusable components that allow faster system implementation and decreased development cost. Many analysts believe that, compared with structured analysis, O-O methods are more flexible, efficient, and realistic in today’s dynamic business environment. The object-oriented approach has many benefits, they provide naturalness and reuse. The approach is natural because people tend to think about things in terms of tangible objects and because many systems within an organization uses the same objects (i.e. windows, dialog boxes, menus, and buttons) the classes can be used repeatedly. Also, O-O analysis provides an easy transition to popular O-O programming languages, such as Java and C++.

Other Development Strategies
In addition to structured analysis and O-O methods, there are other systems development techniques created by individual companies. For example, Microsoft has developed an approach called Microsoft Solutions Framework (MSF). Using MSF, you design a series of models, including a risk management model, a team model, model has a specific purpose and outputs that contribute to the overall design of the system. Although the Microsoft process differs from the SDLC phase-oriented approach, MSF developers do the same kind of planning, ask the same kinds of fact-finding questions, deal with the same kinds of design and implementation issues, and resolve the same kinds of problems. MSF uses O-O analysis and design concepts, but also examines a broader business and organizational context that surrounds the development of an information system.

**Systems development life cycle**

The systems development life cycle (SDLC), also referred to as the application development life-cycle, is a term used in systems engineering, information systems and software engineering to describe a process for planning, creating, testing, and deploying an information system. The systems development life-cycle concept applies to a range of hardware and software configurations, as a system can be composed of hardware only, software only, or a combination of both.

**Overview**

A systems development life cycle is composed of a number of clearly defined and distinct work phases which are used by systems engineers and systems developers to plan for, design, build, test, and deliver information systems. Like anything that is manufactured on an assembly line, an SDLC aims to produce high-quality systems that meet or exceed customer expectations, based on customer requirements, by delivering systems which move through each clearly defined phase, within scheduled time frames and cost estimates. Computer systems are complex and often especially with the recent rise of service-oriented architecture link multiple traditional systems potentially supplied by different software vendors. To manage this level of complexity, a number of SDLC models or methodologies have been created, such as “waterfall”; “spiral”; “Agile software development”; “rapid prototyping”; “incremental”; and “synchronize and stabilize”.

SDLC can be described along a spectrum of agile to iterative to sequential. Agile methodologies, such as XP and Scrum, focus on lightweight processes which allow for rapid changes (without necessarily following the pattern of SDLC approach) along the development cycle. Iterative methodologies, such as Rational Unified Process and dynamic systems development method, focus on limited project scope and expanding or improving products by multiple iterations. Sequential or big-design-up-front (BDUF) models, such as waterfall, focus on complete and correct planning to guide large projects and risks to successful and predictable results. Other models, such as anamorphic development, tend to focus on a form of development that is guided by project scope and adaptive iterations of feature development.

In project management a project can be defined both with a project life cycle (PLC) and an SDLC, during which slightly different activities occur. According to Taylor (2004), “the project life cycle encompasses all the activities of the project, while the systems development life cycle focuses on realizing the product requirements”.

SDLC is used during the development of an IT project, it describes the different stages involved in the project from the drawing board, through the completion of the project.

**Phases**

The systems development life cycle framework provides a sequence of activities for system designers and developers to follow. It consists of a set of steps or phases in which each phase of the SDLC uses the results of the previous one.

The SDLC adheres to important phases that are essential for developers, such as planning, analysis, design, and implementation, and are explained in the section below. It includes evaluation of present system, information gathering, feasibility study and request approval. A number of SDLC models have been created: waterfall, fountain, spiral, build and fix, rapid prototyping, incremental, synchronize and stabilize. The oldest of these, and the best known, is the waterfall model: a sequence of stages in which the output of each stage becomes the input for the next. These stages can be characterized and divided up in different ways, including the following:

- **Preliminary analysis**: The objective of phase 1 is to conduct a preliminary analysis, propose alternative solutions, describe costs and benefits and submit a preliminary plan with recommendations.

  Conduct the preliminary analysis: in this step, you need to find out the organization’s objectives and the nature and scope of the problem under study. Even if a problem refers only to a small segment of the organization itself, you need to find out what the objectives of the organization itself are. Then you need to see how the problem being studied fits in with them.

  Propose alternative solutions: In digging into the organization’s objectives and specific problems, you may have already covered some solutions. Alternate proposals may come from interviewing employees, clients, suppliers, and/or consultants. You can also study what competitors are doing. With this data, you will have three choices: leave the system as is, improve it, or develop a new system.

  Describe the costs and benefits.

- **Systems analysis, requirements definition**: Defines project goals into defined functions and operation of the intended application. It is the process of gathering and interpreting facts, diagnosing problems and recommending improvements to the system. Analyzes end-user information needs and also removes any inconsistencies and incompleteness in these requirements.

  A series of steps followed by the developer are:

  1. **Collection of Facts**: End user requirements are obtained through documentation, client interviews, observation and questionnaires,

  2. **Scrutiny of the existing system**: Identify pros and cons of the current system in-place, so as to carry forward the pros and avoid the cons in the new system.

  3. **Analyzing the proposed system**: Solutions to the shortcomings in step two are found and any specific user proposals are used to prepare the specifications.

- **Systems design**: Describes desired features and operations in detail, including screen layouts, business rules, process diagrams, pseudo code and other documentation.

- **Development**: The real code is written here.

- **Integration and testing**: Brings all the pieces together into a special testing environment, then checks for errors, bugs and interoperability.

- **Acceptance, installation, deployment**: The final stage of initial development, where the software is put into production and runs actual business.
Maintenance: During the maintenance stage of the SDLC, the system is assessed to ensure it does not become obsolete. This is also where changes are made to initial software. It involves continuous evaluation of the system in terms of its performance.

Evaluation: Some companies do not view this as an official stage of the SDLC, while others consider it to be an extension of the maintenance stage, and may be referred to in some circles as post-implementation review. This is where the system that was developed, as well as the entire process, is evaluated. Some of the questions that need to be answered include: does the newly implemented system meet the initial business requirements and objectives? Is the system reliable and fault-tolerant? Does the system function according to the approved functional requirements? In addition to evaluating the software that was released, it is important to assess the effectiveness of the development process. If there are any aspects of the entire process, or certain stages, that management is not satisfied with, this is the time to improve. Evaluation and assessment is a difficult issue. However, the company must reflect on the process and address weaknesses.

Disposal: In this phase, plans are developed for discarding system information, hardware and software in making the transition to a new system. The purpose here is to properly move, archive, discard or destroy information, hardware and software that is being replaced, in a manner that prevents any possibility of unauthorized disclosure of sensitive data. The disposal activities ensure proper migration to a new system. Particular emphasis is given to proper preservation and archival of data processed by the previous system. All of this should be done in accordance with the organization's security requirements.

In the following example (see picture) these stages of the systems development life cycle are divided in ten steps from definition to creation and modification of IT work products:

Not every project will require that the phases be sequentially executed. However, the phases are interdependent. Depending upon the size and complexity of the project, phases may be combined or may overlap.

System investigation
The system investigates the IT proposal. During this step, we must consider all current priorities that would be affected and how they should be handled. Before any system planning is done, a feasibility study should be conducted to determine if creating a new or improved system is a viable solution. This will help to determine the costs, benefits, resource requirements, and specific user needs required for completion. The development process can only continue once management approves of the recommendations from the feasibility study.

Following are different components of the feasibility study:

- Operational feasibility
- Economic feasibility
- Technical feasibility
- Legal/Political feasibility
- Human factors feasibility

System analysis
The goal of system analysis is to determine where the problem is, in an attempt to fix the system. This step involves breaking down the system in different pieces to analyze the situation, analyzing project goals, breaking down what needs to be created and attempting to engage users so that definite requirements can be defined.

Design
In systems design, the design functions and operations are described in detail, including screen layouts, business rules, process diagrams and other documentation. The output of this stage will describe the new system as a collection of modules or subsystems. The design stage takes as its initial input the requirements identified in the approved requirements document. For each requirement, a set of one or more design elements will be produced as a result of interviews, workshops, and/or prototype efforts.

Design elements describe the desired system features in detail, and generally include functional hierarchy diagrams, screen layout diagrams, tables of business rules, business process diagrams, pseudo-code, and a complete entity-relationship diagram with a full data dictionary. These design elements are intended to describe the system in sufficient detail, such that skilled developers and engineers may develop and deliver the system with minimal additional input design.

Environments
Environments are controlled areas where systems developers can build, distribute, install, configure, test, and execute systems that move through the SDLC. Each environment is aligned with different areas of the SDLC and is intended to have specific purposes. Examples of such environments include the:

- Development environment, where developers can work independently of each other before trying to merge their work with the work of others,
- Common build environment, where merged work can be built, together, as a combined system,
- Systems integration testing environment, where basic testing of a system's integration points to other upstream or downstream systems can be tested,
- User acceptance testing environment, where business stakeholders can test against their original business requirements,
- Production environment, where systems finally get deployed to, for final use by their intended end users.

Testing
The code is tested at various levels in software testing. Unit, system and user acceptance tests are often performed. This is a grey area as many different opinions exist as to what the stages of testing are and how much, if any iteration occurs. Iteration is not generally part of the waterfall model, but the means to rectify defects and validate fixes prior to deployment is incorporated into this phase.

The following are types of testing that may be relevant, depending on the type of system under development:

- Defect testing the failed scenarios, including defect
- Path testing
- Data set testing
- Unit testing
- System testing
- Integration testing
- Black-box testing
- White-box testing
- Regression testing
- Automation testing
- User acceptance testing
- Software performance testing

Training and transition
Once a system has been stabilized through adequate testing, the SDLC ensures that proper training on the system is performed or documented before transitioning the system to its support staff and end users.
Training usually covers operational training for those people who will be responsible for supporting the system as well as training for those end users who will be using the system after its delivery to a production operating environment.

After training has been successfully completed, systems engineers and developers transition the system to its final production environment, where it is intended to be used by its end users and supported by its support and operations staff.

Operations and maintenance

The deployment of the system includes changes and enhancements before the decommissioning or sunset of the system. Maintaining the system is an important aspect of SDLC. As key personnel change positions in the organization, new changes will be implemented. There are two approaches to system development; there is the traditional approach (structured) and object oriented. Information Engineering includes the traditional system approach, which is also called the structured analysis and design technique. The object oriented approach views the information system as a collection of objects that are integrated with each other to make a full and complete information system.

Evaluation

The final phase of the SDLC is to measure the effectiveness of the system and evaluate potential enhancements.

Systems analysis and design

The systems analysis and design (SAD) is the process of developing information systems (IS) that effectively use hardware, software, data, processes, and people to support the company's businesses objectives. System analysis and design can be considered the meta-development activity, which serves to set the stage and bound the problem. SAD can be leveraged to set the correct balance among competing high-level requirements in the functional and non-functional analysis domains. System analysis and design interacts strongly with distributed enterprise architecture, enterprise I.T. Architecture, and business architecture, and relies heavily on concepts such as partitioning, interfaces, personae and roles, and deployment/operational modeling to arrive at a high-level system description. This high level description is then further broken down into the components and modules which can be analyzed, designed, and constructed separately and integrated to accomplish the business goal. SDLC and SAD are cornerstones of full life cycle product and system planning.

Object-oriented analysis

Object-oriented analysis (OOA) is the process of analyzing a task (also known as a problem domain), to develop a conceptual model that can then be used to complete the task. A typical OOA model would describe computer software that could be used to satisfy a specific business goal. SDLC and SAD are cornerstones of full life cycle product and system planning.

Life cycle

Management and control

The SDLC phases serve as a programmatic guide to project activity and provide a flexible but consistent way to conduct projects to a depth matching the scope of the project. Each of the SDLC phase objectives are described in this section with key deliverables, a description of recommended tasks, and a summary of related control objectives for effective management. It is critical for the project manager to establish and monitor control objectives during each SDLC phase while executing projects. Control objectives help to provide a clear statement of the desired result or purpose and should be used throughout the entire SDLC process. Control objectives can be grouped into major categories (domains), and relate to the SDLC phases as shown in the figure. To manage and control any SDLC initiative, each project will be required
to establish some degree of a work breakdown structure (WBS) to capture and schedule the work necessary to complete the project. The WBS and all programmatic material should be kept in the "project description" section of the project notebook. The WBS format is mostly left to the project manager to establish in a way that best describes the project work.

There are some key areas that must be defined in the WBS as part of the SDLC policy. The following diagram describes three key areas that will be addressed in the WBS in a manner established by the project manager. The diagram shows coverage spans numerous phases of the SDLC but the associated MCD has a subset of primary mappings to the SDLC phases. For example, Analysis and Design is primarily performed as part of the Acquisition and Implementation Domain and System Build and Prototype is primarily performed as part of delivery and support.

**Work breakdown structured organization**

The upper section of the work breakdown structure (WBS) should identify the major phases and milestones of the project in a summary fashion. In addition, the upper section should provide an overview of the full scope and timeline of the project and will be part of the initial project description effort leading to project approval. The middle section of the WBS is based on the seven systems development life cycle phases as a guide for WBS task development. The WBS elements should consist of milestones and “tasks” as opposed to “activities” and have a definitive period (usually two weeks or more). Each task must have a measurable output (e.g. document, decision, or analysis). A WBS task may rely on one or more activities (e.g. software engineering, systems engineering) and may require close coordination with other tasks, either internal or external to the project. Any part of the project needing support from contractors should have a statement of work (SOW) written to include the appropriate tasks from the SDLC phases. The development of a SOW does not occur during a specific phase of SDLC but is developed to include the work from the SDLC process that may be conducted by external resources such as contractors.

**Baselines**

Baselines are an important part of the systems development life cycle. These baselines are established after four of the five phases of the SDLC and are critical to the iterative nature of the model. Each baseline is considered as a milestone in the SDLC.

- functional baseline: established after the conceptual design phase.
- allocated baseline: established after the preliminary design phase.
- product baseline: established after the detail design and development phase.
- updated product baseline: established after the production construction phase.

**Complementary methodologies**

Complementary software development methods to systems development life cycle are:

- Software prototyping
- Joint applications development (JAD)
- Rapid application development (RAD)
- Extreme programming (XP);
- Open-source development
- End-user development

**Strengths and weaknesses**

Few people in the modern computing world would use a strict waterfall model for their SDLC as many modern methodologies have superseded this thinking. Some will argue that the SDLC no longer applies to models like Agile computing, but it is still a term widely in use in technology circles. The SDLC practice has advantages in traditional models of systems development, that lends itself more to a structured environment. The disadvantages to using the SDLC methodology is when there is need for iterative development or (i.e. web development or e-commerce) where stakeholders need to review on a regular basis the software being designed. Instead of viewing SDLC from a strength or weakness perspective, it is far more important to take the best practices from the SDLC model and apply it to whatever may be most appropriate for the software being designed.

**A comparison of the strengths and weaknesses of SDLC:**

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Increased development time</td>
</tr>
<tr>
<td>Monitor large projects</td>
<td>Increased development cost</td>
</tr>
<tr>
<td>Detailed steps</td>
<td>Systems must be defined up front</td>
</tr>
<tr>
<td>Evaluate costs and completion targets</td>
<td>Rigidity</td>
</tr>
<tr>
<td>Documentation</td>
<td>Hard to estimate costs, project overruns</td>
</tr>
<tr>
<td>Well defined user input</td>
<td>User input is sometimes limited</td>
</tr>
<tr>
<td>Ease of maintenance</td>
<td></td>
</tr>
<tr>
<td>Development and design standards</td>
<td></td>
</tr>
<tr>
<td>Tolerates changes in MIS staffing</td>
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</tbody>
</table>

An alternative to the SDLC is rapid application development, which combines prototyping, joint application development and implementation of CASE tools. The advantages of RAD are speed, reduced development cost, and active user involvement in the development process.

**Prototyping in Systems Analysis**

**Introduction**

Organizations of all types do it. Microsoft, Disney, and Boeing do it. It is known by several names: simulate, model, prototype. It is a process by which organizations innovate, better communicate both with their customers and with each other internally, develop and improve their products. Boeing builds digital prototypes of its aircraft allowing the detection of design conflicts before the parts are manufactured and...
This paper will look at what prototyping is to systems analysis. It will explain some of the advantages and disadvantages of prototyping and discuss why an organization might or might not want to consider prototyping. It will discuss who should be involved in prototyping and how to choose a prototyping approach and a prototyping tool. This is meant to be an overview of prototyping in systems analysis rather than a step-by-step guide. Links are provided where more information is available online.

**What is Prototyping?**

As mentioned earlier a prototype is like a model or a simulation of a real thing. In systems analysis a prototype is a model of the system (or subsystem) under analysis. A system can be anything from the food ordering system at a restaurant to the air traffic control system of a major airport. Prototypes of these systems can take many forms. They can be paper-based or computer-based. They can model the entire system with real data or just a few screens with sample data. Prototyping is the process of developing prototypes. It is a methodology in its own right and a technique and supplemental methodology to other methodologies. In this case, we will focus on the ways in which prototyping is used as a technique and a supplemental methodology to the systems development life cycle (SDLC).

A survey of MIS managers in Fortune 1000 firms suggests that there are four prototyping methodologies in use today which supplement the traditional systems development life cycle:

1. **Illustrative**: produces only mockups of reports and screens.
2. **Simulated**: simulates some system functions but does not use real data or a database, model not implemented.
3. **Functional**: performs some actual system functions and uses real data and/or a database, model not implemented.
4. **Evolutionary**: produces model(s) that become part of the final operational system.

Others suggest such categorizations as evolutionary versus throw-away. Evolutionary in this case is similar to #4 mentioned above (sometimes known as developmental). It produces a model that evolves throughout the development of the system and eventually becomes the final system. Throw-away (sometimes known as exploratory, or expendable) would encompass the other three methodologies previously mentioned. A throw-away prototype is just what it sounds like. Once its purpose is fulfilled it is thrown away.

Another way that prototypes are classified is by the fidelity of the prototype, or the degree to which the prototype represents the appearance and interaction of the system. A low-fidelity prototype is one that is quickly constructed to depict concepts, design alternatives, and screen layouts. Medium-fidelity prototypes partially simulate the system interaction and functionality. High-fidelity prototypes are fully interactive, simulating much of the functionality in the final product. The chart below suggests techniques that could be used at different fidelity levels.

A horizontal prototype models many features with little functionality. While a vertical prototype models few features, but with great detail in functionality. A scenario prototype has both very few features and very little functionality. The figure below illustrates these concepts:

As shown here a prototype can be defined by its functionality, features, data, interaction, and lifespan. There are no doubt more ways to classify and categorize prototypes, but these few demonstrate how characteristics can vary from one prototype to the next.

**Advantages of Prototyping in Systems Analysis**

Systems analysis is the requirements determination phase of the systems development life cycle (SDLC). In this phase developers determine how the current system functions and what users would like to see in a new system. In *Rapid Development: Taming Wild Software Schedules*, Steve McConnell states that “A survey of more than 8000 projects found that the top three reasons that projects were delivered late, over budget, and with less functionality than desired all had to do with requirements-management practices: lack of user input, incomplete requirements, and changing requirements (Standish Group 1994).” Systems development today is any many ways software development. Just as with software, getting this phase right is critical to the success of the entire system. The reasons mentioned above for project shortfalls are really the result of poor communication. Prototyping, when used as a communication tool between the developers and the users, can help to overcome these problems.

As a model of the new system a prototype allows for several forms of communication. First, it allows the developers to communicate to the users their understanding of the requirements. (Obviously before a prototype can be built there must be some initial requirements discussions between developers and users). The initial prototype, whatever form it takes, will automatically reflect the developer's understanding of those early requirements. After viewing/interacting with the initial prototype the second form of communication begins. The users give the developers feedback. Not only will the users correct any misconceptions by the developers, but they will likely recognize misconceptions or requirements they did not anticipate of their own. From this point on the process is iterative. Developers will make corrections and changes to the prototype based on user feedback and the users will view/interact with the prototype and make changes to the requirements. This continues until they come to an agreement on the requirements or run out of time or money or both. At its best this process provides for very rich user input resulting in well thought out requirements both for the user and the developer.

**Improved communication is just one of many benefits that can be realized when prototyping in the systems analysis phase. Here are some others reported in systems development literature:**

- Provides a process to perfect the requirements definition.
- Provides a formal specification embodied in an operating replica.
- More enthusiastic and constructive end-user, customer participation in requirements activities.
- Improved morale of end-users, customers, and developers.
- Greater level of user satisfaction with systems development.
- Users better prepared for later stages of development due to familiarity with prototype.
- Delivery of early proof-of-concept.
- Prototype may be easily changed and even discarded.
- Allows productive work to proceed despite initial uncertainties.
- Demonstrates progress at an early stage of development.
- May provide early training for future users of the system.
- May produce some useful deliverables even if the project runs out of time or money.
Opinions on the cost of prototyping vary. Some feel prototyping can allow for lower maintenance costs since the prototype is meant for change. While upfront costs can be high when purchasing special prototyping tools. Others feel that the cost of prototyping is about the same as traditional requirements gathering. They argue the tool cost and extra time for building the prototype are offset by the time saved later in getting the requirements right.

Disadvantages of Prototyping in Systems Analysis

Even though the benefits of prototyping are strong there are disadvantages and potential risks associated with it. The primary concerns are that of excessive change requests and "feature creep". Just by the nature of the iterative process users will again and again request changes. As they re-examine the prototype they may think of new features they would like that are beyond the scope of the original project. These can be controlled with proper planning but both are legitimate concerns. Other concerns include:

- Can result in unrealistic schedule and budget expectations.
- Iterative nature makes it difficult for management to plan and schedule.
- Can bias the system analysis process. If the prototype is computer-based manual alternatives are unlikely to be considered.
- Working prototypes may lead management and customers to believe that the final product is almost ready for delivery.
- People can begin to think of the prototype as the solution.
- The excellent (or disappointing) performance characteristics of prototypes may mislead the customer.
- Prototypes generally lack security, auditing, and other controls, and data integrity may be difficult to ensure.
- Often inefficient and difficult to maintain.
- Tendency not to document.

Customers may not be prepared to provide the level or frequency of feedback required for iterative prototyping. 

Tying a Sensible Knot is a look at the best practices of New York State local government information systems projects. In a section on prototyping this guide summarizes how the NYS Department of Social Services considered “feature creep” to be a good thing.

Who should be involved in Prototyping?

The primary participants in the prototyping process are the developers and the users. The developers provide the development and prototyping expertise. The users provide the systems expertise. As with any project management support is critical both for the developers and the users. The developers will need support from their management to acquire the necessary resources for the project. Both developers and users will need management support to continue the iterative process through to its conclusion.

In the study described in Toward a Contingency Model for Selecting an Information System Prototyping Strategy, the authors found that there were five variables, when combined with prototyping, that affected system success. The first two variables involved project innovativeness and system impact on the organization. The remaining three variables involved the developers and users. The first developer/user variable determined to affect system success when used with prototyping was developer experience with prototyping. According to the study, the primary benefit of experience is that the developer is prepared for the frequent changes in user requirements and for the high level of interpersonal communication required. Ironically, this study found if developers were already familiar with the application in development prototyping was of little use because less interaction was needed to determine requirements. The remaining two factors which appear to affect system success are the amount of user participation and the number of users involved in the project. It should come as no surprise that when higher user participation is combined with prototyping projects are more likely to succeed. What is critical is that the high user participation comes from just a few people. A large number of users mixed with prototyping makes the development process more difficult to manage. Each user has his own ideas about how the system should work. Processing and implementing the changes of each user becomes considerably more difficult when a large number of users are involved.

Deciding whether to Prototype or not

Systems development efforts differ in so many ways. Each has its own scope, requirements, developers, users, management, level of innovativeness, development time, complexity, organizational culture, etc. While prototyping can be a strong asset for one project it can turn out to be a burden for another. The key is to use prototyping wisely. System development experts suggest that prototyping positively affects the outcome of a system under development in the following situations:

<table>
<thead>
<tr>
<th>Situation</th>
<th>Reason to consider prototyping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users are uncomfortable with abstract models</td>
<td>Gives user something real to interact with</td>
</tr>
<tr>
<td>*The project will have a long development time</td>
<td>Gives user and developers something to work with early on</td>
</tr>
<tr>
<td>The requirements are highly uncertain</td>
<td>Allows users to work through the requirements as the prototype develops</td>
</tr>
<tr>
<td>*No comparable system has been previously developed - high innovation</td>
<td>Allows for experimentation</td>
</tr>
<tr>
<td>Reaching a solution calls for simulation, experimentation, or incremental evaluation</td>
<td>Allows for simulation, experimentation, and incremental evaluation</td>
</tr>
<tr>
<td>A critical system is needed quickly</td>
<td>Prototyping tools are generally designed for quick implementation. Can begin requirements gathering quickly</td>
</tr>
<tr>
<td>Users are available</td>
<td>Allows for high user participation</td>
</tr>
</tbody>
</table>

Some suggest considering other options for:

<table>
<thead>
<tr>
<th>Situation</th>
<th>Reason to consider other options</th>
</tr>
</thead>
<tbody>
<tr>
<td>*an existing system</td>
<td>requirements are well known</td>
</tr>
<tr>
<td>algorithm-driven projects that involve heavy calculation</td>
<td>in general prototyping tools are not designed for this type of project</td>
</tr>
<tr>
<td>users are not available</td>
<td>many of the advantages of prototyping are lost</td>
</tr>
<tr>
<td>large number of users</td>
<td>managing requests for changes is almost impossible</td>
</tr>
</tbody>
</table>
These recommendations are not universal. For example, some argue that the high number of changes in requirements for a project of long duration justify prototyping. While others argue that prototyping's lack of manageability makes its use questionable in projects of long duration. Some argue that existing systems projects do not benefit from prototyping, while others argue that when the existing system becomes the prototype it can be beneficial.

Choosing the Prototyping Approach
Once an organization decides to use prototyping during systems analysis they must then decide on what kind of prototype they will build. Will they use an evolutionary or throw-away prototype? Will they use a low, medium or high-fidelity prototype? Will it demonstrate lots of features with little real functionality as with a horizontal prototype? Or will it have a lot of functionality in one area with few features as with a vertical prototype?

Here are some key points to considering when deciding on the most appropriate approach. The approach solutions suggested here are based on fidelity but the key points apply to any approach:

<table>
<thead>
<tr>
<th>Key Points</th>
<th>Solution based on fidelity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost and schedule constraints</td>
<td>If budget and schedule are limited, consider low-fidelity prototyping, especially paper mock-up, because they are very cheap and fast to develop. If there are experienced programmers with fast tools to build a computer-based prototype, medium-fidelity prototyping is also a consideration.</td>
</tr>
<tr>
<td>Navigation and flow</td>
<td>Medium-fidelity prototyping is good to simulate the system's interaction. In low-fidelity prototyping, storyboard can show the system's direction.</td>
</tr>
<tr>
<td>User driven or facilitator-driven</td>
<td>If a user-driven prototype is needed, medium to high-fidelity prototyping is recommended because users can directly interact with the prototype. User-driven prototypes are the type primarily discussed in this paper. Otherwise, if a facilitator-driven prototype is needed where, for example, a developer steps through screens while the user looks on, low-fidelity prototyping is the choice.</td>
</tr>
<tr>
<td>Look-and-feel the product</td>
<td>Medium and high-fidelity prototyping can help users gain the feeling of how the product works. If using a low-fidelity prototype, the developer must be good at facilitating the prototyping process.</td>
</tr>
<tr>
<td>Developer facilitation skill/programming skill</td>
<td>This choice is based on the experience level of the developer(s). If the developer has experience with prototyping using low-fidelity prototyping this may be the appropriate choice. If the developer has experience with medium to high-fidelity prototyping involving programming it may be the most appropriate.</td>
</tr>
</tbody>
</table>

Choosing a Prototyping Tool
After deciding on a the prototyping approach the prototyping tool must be selected. The goal is to fit the tool to the requirements of the system under development, the skills of the developers, and the needs of the users. Here is a brief list of prototyping tools starting at the top with the less formal moving down to more formal tools. The links in this list provide one of three things: either information about general use of the tool, information about prototyping use of the tool, or an example of the use of the tool with prototyping.

- Pencil and paper
- Drawing software
- Demo makers
- Animation and slide-show software such as Microsoft PowerPoint
- Screen painters, menu builders, report generators
- Perl + Motif + Tcl/Tk (UNIX)
- CASE tools such as Oracle Designer
- "Visual" RAD tools such as Optima++, Borland Delphi, and Visual Basic
- 4GLs such as FOCUS Six
- UI/MSs (User Interface Management Systems) such as WINTERP
- Executable specification languages (VDM variants)
- The tool of the final system.

Here are a set of features to be aware of when selecting a prototyping tool. They are derived from a set of requirements for user-interface prototyping, but can easily be extended to other parts of a prototyping project.

- **Ease of use:** good prototyping tools should allow all members to participate in development and refinement of the prototype. Steep learning curves are unacceptable because many of the contributors do not have time to learn the tools.
- **Fast turn-around:** in prototyping many small refinements must be made. Tools should allow developers to quickly make changes and quickly see the results.
- **Extensive control over prototype features:** prototyping tools should be very flexible so developers can try out new ideas.
- **Data collection capabilities:** for more complex projects an ideal prototyping tool would be able to capture information about task specifications, system functionality, interface functionality, screen layouts and behavior, design rationale, user feedback, benchmarks, reusable code.
- **Executionability:** the prototype should be as faithful to the real system as developers require to increase reliability of information collected.
- **Lifecycle support:** prototyping tools can help with all phases of development even beyond systems analysis.
- **Team design:** should support groups of people working together either simultaneously or asynchronously, or remotely if these are required by the project.
- **Version control:** developers may want to explore and evaluate alternative designs. The prototyping tool should allow for version control if it is required by the situation.

Prototyping within other Methodologies
It should be mentioned that prototyping is not only used as a supplement to the SDLC, but it is also heavily used in Rapid Application Development (RAD) and Object-Oriented methodologies.
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Technology Trends That Will Dominate 2017

Personally, I’m amazed at the technology we have available to us. It’s astounding to have the power to retrieve almost any information and communicate in a thousand different ways using a device that fits in your pocket. There’s always something new on the horizon, and we can’t help but wait and wonder what technological marvels are coming next. The way I see it, there are seven major tech trends we’re in store for in 2017. If you’re eyeing a sector in which to start a business, any of these is a pretty good bet. If you’re already an entrepreneur, think about how you can leverage these technologies to reach your target audience in new ways.

1. IoT and Smart Home Tech. We’ve been hearing about the forthcoming revolution of the Internet-of-Things (IoT) and resulting interconnectedness of smart home technology for years. So what’s the holdup? Why aren’t we all living in smart, connected homes by now? Part of the problem is too much competition, with not enough collaboration — there are tons of individual appliances and apps on the market, but few solutions to tie everything together into a single, seamless user experience. Now that bigger companies already well-equipped in uniform user experiences (like Google, Amazon, and Apple) are getting involved, I expect we’ll see some major advancements on this front in the coming year.

2. AR and VR. We’ve already seen some major steps forward for augmented reality (AR) and virtual reality (VR) technology in 2016. Oculus Rift was released, to positive reception, and thousands of VR apps and games followed. We also saw Pokémon Go, an AR game, explode with over 100 million downloads. The market is ready for AR and VR, and we’ve already got some early-stage devices and tech for these applications, but it’s going to be next year before we see things really take off. Once they do, you’ll need to be ready for AR and VR versions of practically everything — and ample marketing opportunities to follow.

3. Machine Learning. Machine learning has taken some massive strides forward in the past few years, even emerging to assist and enhance Google’s core search engine algorithm. But again, we’ve only seen it in a limited range of applications. Throughout 2017, I expect to see machine learning updates emerge across the board, entering almost any type of consumer application you can think of, from offering better recommended products based on prior purchase history to improving the user experience of an analytics app. It won’t be long before machine learning becomes a kind of “new normal,” with people expecting this type of artificial intelligence as a component of every form of technology.

4. Automation. Marketers will be (mostly) pleased to learn that automation will become a bigger mainstay in and throughout 2017, with advanced technology enabling the automation of previously human-exclusive tasks. We’ve had robotic journalists in circulation for a couple of years now, and I expect it won’t be long before they make another leap into more practical types of articles. It’s likely that we’ll start seeing productivity skyrocket in a number of white-collar type jobs — and we’ll start seeing some jobs disappear altogether. When automation is combined with machine learning, everything can improve even faster, so 2017 has the potential to be a truly landmark year.

5. Humanized Big Data. (visual, empathetic, qualitative) Big data has been a big topic for the past five years or so, when it started making headlines as a buzzword. The idea is that mass quantities of gathered data — which we now have access to — can help us in everything from planning better medical treatments to executing better marketing campaigns. But big data’s greatest strength — its quantitative, numerical foundation — is also a weakness. In 2017, I expect we’ll see advancements to humanize big data, seeking more empathetic and qualitative bits of data and projecting it in a more visualized, accessible way.

6. Physical-Digital Integrations. Mobile devices have been slowly adding technology into our daily lives. It’s rare to see anyone without a smartphone at any given time, giving us access to practically infinite information in the real-world. We already have things like site-to-store purchasing, enabling online customers to buy and pick up products in a physical retail location, but the next level will be even further integrations between physical and digital realities. Online brands like Amazon will start having more physical products, like Dash Buttons, and physical brands like Walmart will start having more digital features, like store maps and product trials.

7. Everything On-Demand. Thanks to brands like Uber (and the resulting madness of startups built on the premise of being the “Uber of __”), people are getting used to having everything on demand via phone apps. In 2017, I expect this to see this develop even further. We have thousands of apps available to us to get rides, food deliveries, and even a place to stay for the night, but soon we’ll see this evolve into even stranger territory.
CASE (computer-aided software engineering)

CASE (computer-aided software engineering) is the use of a computer-assisted method to organize and control the development of software, especially on large, complex projects involving many software components and people. Using CASE allows designers, code writers, testers, planners, and managers to share a common view of where a project stands at each stage of development. CASE helps ensure a disciplined, check-pointed process. A CASE tool may portray progress (or lack of it) graphically. It may also serve as a repository for or be linked to document and program libraries containing the project’s business plans, design requirements, design specifications, detailed code specifications, the code units, test cases and results, and marketing and service plans.

The Four Dimensions of ERP Consolidation

Organizations today are shouldered with an embarrassment of riches: too many software systems. How to best deal with the dilemma? Consolidation. But the integration challenges are not few in number.

CASE originated in the 1970s when computer companies were beginning to borrow ideas from the hardware manufacturing process and apply them to software development (which generally has been viewed as an insufficiently disciplined process). Some CASE tools supported the concepts of structured programming and similar organized development methods. More recently, CASE tools have had to encompass or accommodate visual programming tools and object-oriented programming. In corporations, a CASE tool may be part of a spectrum of processes designed to ensure quality in what is developed. (Many companies have their processes audited and certified as being in conformance with the ISO 9000 standard.)

Some of the benefits of CASE and similar approaches are that, by making the customer part of the process (through market analysis and focus groups, for example), a product is more likely to meet real-world requirements. Because the development process emphasizes testing and redesign, the cost of servicing a product over its lifetime can be reduced considerably. An organized approach to development encourages code and design reuse, reducing costs and improving quality. Finally, quality products tend to improve a corporation’s image, providing a competitive advantage in the marketplace.

CASE Tools

Introduction

Computer-Aided Software Engineering (CASE) technologies are tools that provide automated assistance for software development. The goal of introducing CASE tools is the reduction of the time and cost of software development and the enhancement of the quality of the systems developed. The interest in CASE tools and environments is based on expectations about increasing productivity, improving product quality, facilitating maintenance, and making software engineers’ task less odious and more enjoyable. A survey of the CASE tool market showed that the annual worldwide market for CASE fools was $4.8 billion in 1990 and grew to $12.11 billion in 1995. Behind such a prosperous CASE market, however, another result gained from the real investigation about the use of CASE tools revealed that CASE tools seem to be sparsely used after being bought in many enterprises.

CASE is the use of computer-based support in the software development process; a CASE tool is a computer-based product aimed at supporting one or more software engineering activities within a software development process; a CASE environment is a collection of CASE tools and other components together with an integration approach that supports most or all of the interactions that occur among the environment components, and between the users of the environment and the environment itself.

Are CASE Tools being used?

Many prior studies have reported limited use of CASE tools. In a survey of 53 companies, found that 39 (73.5%) had never used CASE. Of the 14 companies who had tried CASE, five had subsequently abandoned use of the tools. People within these fourteen companies believed that use of CASE tools improved documentation quality, improved analysis, and resulted in systems developed. The interest in CASE tools and environments is based on expectations about increasing productivity, improving product quality, facilitating maintenance, and making software engineers’ task less odious and more enjoyable. A survey of the CASE tool market showed that the annual worldwide market for CASE fools was $4.8 billion in 1990 and grew to $12.11 billion in 1995. Behind such a prosperous CASE market, however, another result gained from the real investigation about the use of CASE tools revealed that CASE tools seem to be sparsely used after being bought in many enterprises.

Popular features of CASE tools

The term Computer-Aided Software Engineering (CASE) encompasses many different products with different functionalities. In the International Workshop on Computer-Aided Software Engineering (IWCASE) definition of CASE very broad terms are used: “...tools and methods to support engineering approach to systems development at all stages of the process”. When the term CASE is used, it is important to clarify what is being discussed. Most classifications of CASE tools start by considering whether the tool is upper CASE, lower CASE, or integrated CASE [3]. An upper CASE tool (front end CASE) provides support for the early stages in the systems development life cycle such as requirements analysis and design. A lower CASE tool (back end CASE) provides support for the later stages in the life cycle such as code generation and testing. Integrated CASE tools support both the early and later stages. Further classifications usually list which functionalities are supported by the tool, such as data flow diagrams, entity relationships data models, etc. provides a different type of model of CASE functionality which helps organize CASE tools.

Automated Diagram Support

CASE Tools offer an excellent array of features that support the development and business community through its Automated Diagram Support feature. The various popular features that aid the development community are listed below:

- Checks for syntactic correctness
- Navigation to linked diagrams
- Automatic report generation
- Data dictionary support
- Layering
- System simulation
- Checks for consistency and completeness
- Requirements traceability
- Performance analysis

CASE Tools and its scope

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CASE technology is the automation of step by step methodologies for software and system development. CASE tools are characterized by the stage or stages of software development life cycle on which they focus. Since different tools covering different stages share common information, it is required that they integrate through some central repository system (data dictionary) to have a consistent view of such information. In phases of software development life cycle integrated through a central data dictionary. Case Tools are used in many ways in our organizations. Case tools can be broadly classed into these broader areas:

- Requirement Analysis Tool
- Structure Analysis Tool
- Software Design Tool
- Code Generation Tool
- Test Case Generation Tool
- Document Production Tool
- Reverse Engineering Tool

While many organizations still use the SDLC methodology, it is often supplemented with other methods. Many systems developers use the CASE tools in various stages of the Software Development Life Cycle. They mainly use it while developing the following methodologies:
- Life Cycle
- Object-oriented Approach
- Prototyping
- Rapid Applications Development (RAD)
- Joint Applications Development (JAD)
- Visual Integration of CASE Tools

The job of a systems developer may contain requirements analysis, process design, data design, and programming among other activities. But, not all systems developers do the same activities. One may spend most of his or her time on analysis; another, on design. The various activities that the system developers involve include Systems Analysis (including feasibility studies and requirements definition), Systems Design (including user interface, data, and process design), Programming (or generating code), Testing, Supervisory or other management tasks and Maintenance. CASE tools play an important role in helping the system developers to perform the task efficiently.

**CASE Tools in future...**

### Horizontal and Vertical Division of AO-groups

The whole system is composed of many active objects. Active objects (AO) are categorized into several groups. Active objects in the same group are responsible for the same type of tasks. For example, active objects to support SA/SD methodology and object-oriented methodology. This is what we call horizontal division. All AO-groups are organized hierarchically. For example, the group on top level is for users; the group on second level is for domains; the group on third level is for development knowledge; the group on fourth level is for tools; the group on fifth level is for technique support. This is what we call the vertical division. For each group, there is a delegate which is a local server of that group. The communication among different groups is through delegates at the corresponding levels.

### Knowledge Representation and Processing

The system maintains multiple layers of knowledge and has the ability of self-learning and self-improvement. Especially, the system can do reasoning on incomplete information. Otherwise, the system cannot 'figure out' users' intentions and the interaction between a user and a tool will not be able to continue in some cases. Each node can be bound to a set of rules. Mixed knowledge representation is good for reducing the size of the network, and thus speeding up the learning process. In neural network, an output can always be derived from any input, even if the input is incomplete. Self learning is a natural and standard process in a neural network.

### Visual Integration of CASE Tools

Although a CASE shell is very useful for the creation and integration of CASE tools, we believe it still is not simple and intuitive enough for CASE users. We suggest to provide CASE users with more intuitive means to describe the integration of CASE tools. A diagramming tool, similar to DFD diagramming tool, might be useful for this purpose. Pipe-filter, event-trigger and message passing models are all useful means to realize the integration of CASE tools.

### Work Flow Model

Basically, software project development is a team based activity. A CASE tool should be able to support this feature. For this purpose, it is necessary to model the work process, and the collaboration and coordination among team members. We hope to represent all these information through a work flow model. Currently, there are many ways to model a work flow for team based collaborative software development. However, most of them are too strict to change dynamically (on the fly). We suggest using decentralized process models, such as 'ViewPoint' (E), which can be described visually and is also possible to cope with deviations during process enactment.

### Java Technologies

We are sure that the next generation CASE tools will be able to operate in heterogeneous and distributed environments. JAVA is such a specification which allows for transparent access to applications operating on multiple computing platforms. JAVA is endorsed by the OMG, an organization that includes major computer manufacturers such as Digital, Sun, HP, IBM as well as software providers such as Microsoft, Sunsoft, and Object Design among its members. JAVA is possibly to become a de facto standard in the future. Based on this observation, we suggest that the next generation CASE tools are established on CORBA standard. To develop platform independent CASE tools, some platform independent programming languages, such as Java programming language will be used.

### Making a case for and against CASE Tools

<table>
<thead>
<tr>
<th>For</th>
<th>Against</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helps standardization of notations and diagrams</td>
<td>Limitations in the flexibility of documentation</td>
</tr>
<tr>
<td>Help communication between development team members</td>
<td>May lead to restriction to the tool’s capabilities</td>
</tr>
<tr>
<td>Automatically check the quality of the models</td>
<td>Major danger: completeness and syntactic correctness does NOT mean compliance with requirements</td>
</tr>
<tr>
<td>Reduction of time and effort</td>
<td>Costs associated with the use of the tool: purchase + training</td>
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<tr>
<td>Enhance reuse of models or models' components</td>
<td>Staff resistance to CASE tools</td>
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### Types of CASE tools

- Requirement Analysis Tool
- Structure Analysis Tool
- Software Design Tool
- Code Generation Tool
- Test Case Generation Tool
- Document Production Tool
- Reverse Engineering Tool
Decision Support System (DSS): Meaning, Features and Users

Meaning of Decision Support System (DSS):
A decision support system is that system which helps the management in taking the business decisions. It is a system which allows human-machine interface whereby, the decision-maker possess control throughout the decision making process. It has one primary objective that is to provide the managers with the necessary information for making intelligent decisions. This approach not only helps in bringing decision-making information directly to the executives, but also goes one step further than typical management information systems by allowing decision-maker to interact with the computer.

In this way, the computer is simply a tool, which helps the executives in evaluation of the alternatives so that they may reach on an effective decision. The ability of an individual to retail control over the decision making process is not only useful to solve well structured problems but also helps in solving semi structured and unstructured problems. Thus, Decision Support System (DSS) is a specialized MIS designed to support an executives’ skills at all stages of decision making i.e. problem identification, selecting relevant data, picking the approach to be used in decision making and evaluating the alternative courses of action.

A decision support system must generate information in such a form that executives may understand and at a time when such an information is needed and place the information under the direct control of the executives. Thus, the DSS enables the business executives to take the efficient, effective and economic decisions.

Features & characteristics of decision support system are:
(a) It is a way to organize information intended for use in decision-making. It envelope the use of a database for a specific decision making process. A decision support system does not automate transformation performed on data nor simply provide output in the form of report rather it supports the decision makers problem solving approach.
(b) A DSS allow the decision-maker to interact in a natural manner due to the careful design of the user interface.
(c) Decision support systems are designed to help support decisions that are formulated as semi structured, complex problem. These problems remain resistant to complete computerization.
(d) A DSS may be constructed to support one-time decision, those that are infrequent; however, the type of problem or opportunity best addressed through use of a DSS is one that requires human judgment.
(e) A decision support system is typically designed for either a particular decision-maker or a group of decision-makers. This allows the system designer to customize important system features to adapt to the type of representations.
(f) Rather than building a specific DSS from scratch, a system analyst can use a package of interrelated hardware and software called a DSS generator.
(g) A decision support system is best conceptualized as a process instead of a product.

Elements of Decision Support System:
Decision support systems were initially designed as data base management systems combined with mathematical modeling systems to provide powerful, flexible tools for quantitative analysis of management decisions.

More recently, the DSS concept has been extended by incorporating ideas from expert systems and cognitive psychology, which deals with how people solve problems and make decisions. Data are prerequisite for making managerial decisions but data alone is not sufficient to make the decision. There are various other factors that are to be taken into consideration while making managerial decisions. The sum total factors are:
1. Data
2. Decision rules
3. Mathematical models
4. Managerial knowledge
5. Human judgement.

Decisions based on set of decision rules by a data base system, since the rules depend on a data item in a data base: net profit Note, however, that it is up to the manager to decide which rules applies, since a conventional data base system does not know whether net profit is normal, above normal, or below normal.

Selection of the appropriate decision rule depends on the manager’s judgement on whether last year’s net profit was normal or not (of course, precise rules could be established for determining this as well).

The set of decision rules is considerably different because it requires a forecast of net profit for the next year. The kinds of data base systems contain historical and current data, not forecasts. Of course, forecasts are often based on mathematical or statistical models that require historical Data.

data base system can provide the Data on which to base such forecasts. The modeling component of the DSS provides the forecasting model.

Mathematically based forecasts are not without error, however, and they may not take all relevant factors into account. Thus, human judgement must be used to interpret and adjust the forecast. Managerial judgements such as these are based on knowledge of the organisation and its environment. This knowledge is not included in data base systems and is seldom found in computer systems at all. Experts systems try to capture expert knowledge of the problem domain, or specific problem area, and use that knowledge to make decisions. Knowledge is stored as a separate entity called a knowledge base, which is analogous to the Data base in a data base system.

In a data base system, the data base management system is a complex program that manipulates the Data base. In an expert system, the inference engine is a complex program that manipulates the knowledge base (which is sometimes called a data base in the expert system literature). Data in data base tends to be numeric, with some character data.
Information in knowledge bases is more qualitative or textual in nature, and interference engines may use qualitative reasoning rather than quantitative models to reach decisions.

There is already a clearly observable trend toward the development of decision support systems that integrate data bases, knowledge bases, mathematical models, and expert system inference engines into integrated systems for management decision making. The potential impact of these decision-support systems is tremendous.

**Users of Decision Support System:**

The ultimate user of a decision support system is the decision maker; however, he may not actually run the system. Based on his research on 56 Decision Support Systems, Alter identified following four distinct usage patterns:

1. **Terminal mode:** The decision maker uses the system through on line access.
2. **Clerk mode:** The decision maker uses the system directly but offline, preparing input on a coding form.
3. **Subscription mode:** The decision maker receives reports that are generated automatically on a regular basis.
4. **Intermediary mode:** The decision maker uses the system through intermediaries, who perform the analysis and interpret and report the results. The decision maker does not need to know the intermediary used the system to arrive at the requested information.

The role of an intermediary is common in the use of decision support systems and merits separate attention. It has typically been argued that decision support systems will be resisted because managers will refuse to use terminals. The job of chief executives is highly fragmented with frequent interruptions. Such a pattern of activity is a major constraint on the use of a system requiring concentration over a period of time. The use of an intermediary allows the manager to benefit from the decision support system without actually having to execute it.

There are two types of intermediaries that reflect different types of support for the manager:

(a) **Expert tool user:** This person is skilled in the application of one or more types of specialized problem solving tools. The expert tool user performs tasks which the problem solver does not have the skills or training to perform.

(b) **Staff assistant or staff analyst:** This person has specialized knowledge about problems and some experience with the decision support technology. The staff assistant essentially extends the manager’s capabilities by taking over many of the tasks of problem solving such as setting up the problem, obtaining data and building the initial model. The manager can concentrate on the more unstructured portions of the problem solving task. The staff assistant performs work the manager could do if time were available.

Although more intermediaries are staff assistants, there is also frequent need for the expert tool user. The use of intermediaries permits the systems to be more sophisticated and powerful. On line, interactive systems are still desirable with intermediaries because they allow them to work more quickly and efficiently.

**Role of Decision Support System in MIS:**

Decision support system is a special class of system which facilitate decision making. As in an organisation, at each and every point and time, decisions are to be taken irrespective of their nature. Some decisions may be routine and programmed decisions while other may be strategic, and non-programmed decisions.

But one thing is certain that decision making is done at all level of management. Decision support system involves the packages which help the managers to take right and timely decisions.

Decision support systems use data from the general management information system and they are used by a manager or a decision maker for decision support. The basic characteristic of the decision support system is that it is based on some tool, technique or model. These systems are used sometimes for testing new alternatives, training and learning. They are also used for sensiting the various parameters of the model.

The MIS designer has to look for all such situations and design the decision support system for integration in the system. The management information system would become more useful if the decision making is made person independent and executed with well designed decision support system.

All such embedded systems cover the normal variety of decision situations. If anything outside the considered variety crops up, decision support system will bring to the notice of the decision makers that action is called for in the situation.

The decision support system plays a dominant role in the management information system as a support to decision making.

**MIS - Decision Support System**

Decision support systems (DSS) are interactive software-based systems intended to help managers in decision-making by accessing large volumes of information generated from various related information systems involved in organizational business processes, such as office automation system, transaction processing system, etc.

DSS uses the summary information, exceptions, patterns, and trends using the analytical models. A decision support system helps in decision-making but does not necessarily give a decision itself. The decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.

**Programmed and Non-programmed Decisions**

There are two types of decisions - programmed and non-programmed decisions.

Programmed decisions are basically automated processes, general routine work, where:

- These decisions have been taken several times.
- These decisions follow some guidelines or rules.

For example, selecting a reorder level for inventories, is a programmed decision.

Non-programmed decisions occur in unusual and non-addressed situations, so:

- It would be a new decision.
- There will be no rules to follow.
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Decision support systems generally involve non-programmed decisions. Therefore, there will be no exact report, content, or format for these systems. Reports are generated on the fly.

**Attributes of a DSS**
- Complete control by decision-makers
- Support for data access
- High level of Interactivity
- Ease of use
- Extendibility
- Support for modeling and analysis

**Characteristics of a DSS**
- Support for decision-makers in semi-structured and unstructured problems.
- Support for managers at various managerial levels, ranging from top executive to line managers.
- Support for individuals and groups. Less structured problems often require the involvement of several individuals from different departments and organization level.
- Support for interdependent or sequential decisions.
- Support for intelligence, design, choice, and implementation.

**Benefits of DSS**
- Improves efficiency and speed of decision-making activities.
- Facilitates interpersonal communication.
- Increases the control, competitiveness and capability of futuristic decision-making of the organization.
- Since it is mostly used in non-programmed decisions, it reveals new approaches and sets up new evidences for an unusual decision.

**Components of a DSS**
- **Database Management System (DBMS):** To solve a problem the necessary data may come from internal or external database. In an organization, internal data are generated by a system such as TPS and MIS. External data come from a variety of sources such as newspapers, online data services, databases (financial, marketing, human resources).
- **Model Management System:** It stores and accesses models that managers use to make decisions. Such models are used for designing manufacturing facility, analyzing the financial health of an organization, forecasting demand of a product or service, etc.
- **Support Tools:** Support tools like online help; pull-down menus, user interfaces, graphical analysis, error correction mechanism, facilitates the user interactions with the system.

**Classification of DSS**
- **Text Oriented DSS:** It contains textually represented information that could have a bearing on decision. It allows documents to be electronically created, revised and viewed as needed.
- **Database Oriented DSS:** Database plays a major role here; it contains organized and highly structured data.
- **Spreadsheet Oriented DSS:** It contains information in spread sheets that allows create, view, modify procedural knowledge and also instructs the system to execute self-contained instructions. The most popular tool is Excel and Lotus 1-2-3.
- **Solver Oriented DSS:** It is based on a solver, which is an algorithm or procedure written for performing certain calculations and particular program type.
- **Rules Oriented DSS:** It follows certain procedures adopted as rules.
- **Rules Oriented DSS:** Procedures are adopted in rules oriented DSS. Export system is the example.
- **Compound DSS:** It is built by using two or more of the five structures explained above.

**Types of DSS**
- **Status Inquiry System:** It helps in taking operational, management level, or middle level management decisions, for example daily schedules of jobs to machines or machines to operators.
- **Data Analysis System:** It needs comparative analysis and makes use of formula or an algorithm, for example cash flow analysis, inventory analysis etc.
- **Information Analysis System:** In this system data is analyzed and the information report is generated. For example, sales analysis, accounts receivable systems, market analysis etc.
- **Accounting System:** It keeps track of accounting and finance related information, for example, final account, accounts receivables, accounts payables, etc. that keep track of the major aspects of the business.
- **Model Based System:** Simulation models or optimization models used for decision-making are used infrequently and creates general guidelines for operation or management.

**Decision Making: 7 Essential Nature of Decision Making**

Decision-making is a must for all managerial functions. In other words, decision-making in planning is as important as in organisation, co-ordination and control, because in each of these functions the manager has to choose from among a number of alternative courses of action.

Thus, according to him the former set of acts are decisions, while there are many subsidiary acts in decisions which are themselves automatic and of which the processes are usually unknown to the manager himself.

Deciding is a matter of fact, deciding and planning have related meaning. Planning, as a whole with its component parts like objectives, policies and procedures, is the outcome of decision-making.

In fact, the decision is the point at which plans, policies and objectives are translated into concrete actions. Planning leads to sound decision-making and implies decision-making, i.e. the selection from among alternatives of a course of action.

It is thus evident that decision-making is at the core of planning. For instance, the function of choosing of objectives, policies, procedures, programmes, rules, strategies and tactics etc., need the entire process of decision-making.
As planning is necessary for other managerial functions of organising, directing and controlling, decision-making too has a pervasive influence on all managerial functions. That is why; decision-making is regarded by many writers as a part of the planning process. But various types of operating orders and instructions are given by the middle and supervisory managers for getting the work accomplished through people. Such orders and instructions involve decision-making within the framework of planning.

Decisions are necessary on various issues and problems even in each of the functional areas of business like production, marketing, finance and personnel administration. We can therefore; say that decision-making process is at the centre of the management universe.

A manager reaps double advantage when he has to find a solution of a problem confronting him, viz.,

1. he serves the organisation when he successfully overcomes the problem
2. he derives, simultaneously personal satisfaction and a sense of accomplishment which is, in fact, the best reward to satisfy one’s egoistic demands.

A business executive is by profession a decision-maker. His life itself is a perpetual choice-making activity. Uncertainty or risk is his opponent; overcoming it is his mission. Whether the outcome is a consequence of luck or wisdom, the moment of decision-making is the most creative event in his life.

The following is the nature of decision-making:

1. **Goal-Oriented Process**: Decision-making is a goal-oriented process. It aims at achieving certain specific goals of the organisation.
2. **Selection Process**: Decision-making is a selection process in which best alternative course of action is chosen from the given alternative courses of action.
3. **Continuous Process**: Decision-making is a continuous process because a manager is required to take decisions continuously for different activities.
4. **Art as Well as Science**: Decision-making is considered both an art and a science.
5. **Responsibilities of Managers**: Decision-making is the responsibility of managers at different levels of management.
6. **Positive as Well as Negative**: Decision-making can be both positive and negative i.e. it may be positive (to perform certain activities) or negative (not to perform certain activities).
7. **Future Course of Action**: Decisions are made for future course of action based on the basis of past experiences and present conditions.

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**Decision Making: 7 Steps Involved in Decision Making | Business Management**

Seven most essential steps involved in decision making process are: 1. Define the problem, 2. Analysing the problem, 3. Developing alternative solutions, 4. Selecting the best type of alternative, 5. Implementation of the decision, 6. Follow up, 7. Monitoring and feedback!

Decision-making is concerned with the selection of one alternative course of action from two or more alternative courses of action. Precisely it can be stated as a choice-making activity.

These steps can be explained as under:

1. **Define the problem**: The first and the foremost step in the decision-making process are to define the real problem. A problem can be explained as a question for an appropriate solution. The manager should consider critical or strategic factors in defining the problem. These factors are, in fact, obstacles in the way of finding proper solution. These are also known as limiting factors.

For example, if a machine stops working due to non-availability of screw, screw is the limiting factor in this case. Similarly fuse is a limiting factor in house lighting. While selecting alternative or probable solution to the problem, the more the decision-making takes into account those factors that are limiting or critical to the alternative solutions, the easier it becomes to take the best decision.

Other examples of critical or limiting factor may be materials, money, managerial skill, technical know-how, employee morale and customer demand, political situation and government regulations, etc.

2. **Analysing the problem**: After defining the problem, the next important step is a systematic analysis of the available data. Sound decisions are based on proper collection, classification and analysis of facts and figures.

There are three principles relating to the analysis and classification as explained below:

(i) The futurity of the decision. This means to what length of time, the decision will be applicable to a course of action.
(ii) The impact of decision on other functions and areas of the business.
(iii) The qualitative considerations which come into the picture.

3. **Developing alternative solutions**: After defining and analysing the problem, the next step is to develop alternative solutions. The main aim of developing alternative solutions is to have the best possible decision out of the available alternative courses of action. In developing alternative solutions the manager comes across creative or original solutions to the problems.

In modern times, the techniques of operations research and computer applications are immensely helpful in the development of alternative courses of action.

4. **Selecting the best type of alternative**: After developing various alternatives, the manager has to select the best alternative. It is not an easy task.

The following are the four important points to be kept in mind in selecting the best from various alternatives:

(a) Risk element involved in each course of action against the expected gain.
(b) Economy of effort involved in each alternative, i.e. securing desired results with the least efforts.
(c) Proper timing of the decision and action.
(d) Final selection of decision is also affected by the limited resources available at our disposal. Human resources are always limited. We must have right type of people to carry out our decisions. Their calibre, understanding, intelligence and skill will finally determine what they can and cannot do.

5. **Implementation of the decision**: Under this step, a manager has to put the selected decision into action.

For proper and effective execution of the decision, three things are very important i.e.,

(a) Proper and effective communication of decisions to the subordinates. Decisions should be communicated in clear, concise and understandable manner.
(b) Acceptance of decision by the subordinates is important. Group participation and involvement of the employees will facilitate the smooth execution of decisions.
Almost every decision introduces a change and people are hesitant to accept a change. Implementation of the decision at the proper time plays an important role in the execution of the decision.

6. **Follow up:** A follow up system ensures the achievement of the objectives. It is exercised through control. Simply stated it is concerned with the process of checking the proper implementation of decision. Follow up is indispensable so as to modify and improve upon the decisions at the earliest opportunity.

7. **Monitoring and feedback:** Feedback provides the means of determining the effectiveness of the implemented decision. If possible, a mechanism should be built which would give periodic reports on the success of the implementation. In addition, the mechanisms should also serve as an instrument of “preventive maintenance”, so that the problems can be prevented before they occur.

According to Peter Drucker, the monitoring system should be such that the manager can go and look for himself for first-hand information which is always better than the written reports or other second-hand sources. In many situations, however, computers are very successfully used in monitoring since the information retrieval process is very quick and accurate and in some instances the self-correcting is instantaneous.

### Decision-making process

1. Define and clarify the issue - does it warrant action? If so, now? Is the matter urgent, important or both. See the Pareto Principle.
2. Gather all the facts and understand their causes.
3. Think about or brainstorm possible options and solutions. (See brainstorming process)
4. Consider and compare the ‘pros and cons’ of each option - consult others if necessary or useful - and for bigger complex decisions where there are several options, create a template which enables measurements according to different strategic factors (see SWOT, PEST, Porter).
5. Select the best option - avoid vagueness and weak compromises in trying to please everyone.
6. Explain your decision to those involved and affected, and follow up to ensure proper and effective implementation.

#### Seven Steps for Effective Problem Solving in the Workplace

Here are seven-steps for an effective problem-solving process.

1. **Identify the issues.**
   - Separate the listing of issues from the identification of interests (that’s the next step!).

2. **Understand everyone’s interests.**
   - This is a critical step that is usually missing.
   - Interests are the needs that you want satisfied by any given solution. We often ignore our true interests as we become attached to one particular solution.
   - The best solution is the one that satisfies everyone’s interests.
   - This is the time for active listening. Put down your differences for awhile and listen to each other with the intention to understand.
   - Separate the naming of interests from the listing of solutions.

3. **List the possible solutions (options)**
   - This is the time to do some brainstorming. There may be lots of room for creativity.
   - Separate the listing of options from the evaluation of the options.

4. **Evaluate the options.**
   - What are the pluses and minuses? Honestly!
   - Separate the evaluation of options from the selection of options.

5. **Select an option or options.**
   - What’s the best option, in the balance?
   - Is there a way to "bundle" a number of options together for a more satisfactory solution?

6. **Document the agreement(s).**
   - Don’t rely on memory.
   - Writing it down will help you think through all the details and implications.

7. **Agree on contingencies, monitoring, and evaluation.**
   - Conditions may change. Make contingency agreements about foreseeable future circumstances (If-then!).
   - How will you monitor compliance and follow-through?
   - Create opportunities to evaluate the agreements and their implementation. ("Let’s try it this way for three months and then look at it.")

#### Define the problem

The decision-making process begins when a manager identifies the real problem. The accurate definition of the problem affects all the steps that follow; if the problem is inaccurately defined, every step in the decision-making process will be based on an incorrect starting point. One way that a manager can help determine the true problem in a situation is by identifying the problem separately from its symptoms.

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Underlying Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low profits and/or declining sales</td>
<td>Poor market research</td>
</tr>
<tr>
<td>High costs</td>
<td>Poor design process; poorly trained employees</td>
</tr>
<tr>
<td>Low morale</td>
<td>Lack of communication between management and subordinates</td>
</tr>
<tr>
<td>High employee turnover</td>
<td>Rate of pay too low; job design not suitable</td>
</tr>
<tr>
<td>High rate of absenteeism</td>
<td>Employees believe that they are not valued</td>
</tr>
</tbody>
</table>

The most obviously troubling situations found in an organization can usually be identified as symptoms of underlying problems. (See Table for some examples of symptoms.) These symptoms all indicate that something is wrong with an organization, but they don’t identify root causes. A successful manager doesn’t just attack symptoms; he works to uncover the factors that cause these symptoms.

All managers want to make the best decisions. To do so, managers need to have the ideal resources — information, time, personnel, equipment, and supplies — and identify any limiting factors. Realistically, managers operate in an environment that normally doesn’t provide ideal resources. For example, they may lack the proper budget or may not have the most accurate information or any
extra time. So, they must choose to satisfice — to make the best decision possible with the information, resources, and time available. Time pressures frequently cause a manager to move forward after considering only the first or most obvious answers. However, successful problem solving requires thorough examination of the challenge, and a quick answer may not result in a permanent solution. Thus, a manager should think through and investigate several alternative solutions to a single problem before making a quick decision.

One of the best known methods for developing alternatives is through brainstorming, where a group works together to generate ideas and alternative solutions. The assumption behind brainstorming is that the group dynamic stimulates thinking — one person’s ideas, no matter how outrageous, can generate ideas from the others in the group. Ideally, this spawning of ideas is contagious, and before long, lots of suggestions and ideas flow. Brainstorming usually requires 30 minutes to an hour. The following specific rules should be followed during brainstorming sessions:

**Concentrate on the problem at hand.** This rule keeps the discussion very specific and avoids the group’s tendency to address the events leading up to the current problem.

**Entertain all ideas.** In fact, the more ideas that come up, the better. In other words, there are no bad ideas. Encouragement of the group to freely offer all thoughts on the subject is important. Participants should be encouraged to present ideas no matter how ridiculous they seem, because such ideas may spark a creative thought on the part of someone else.

**Refrain from allowing members to evaluate others’ ideas on the spot.** All judgments should be deferred until all thoughts are presented, and the group concurs on the best ideas.

Although brainstorming is the most common technique to develop alternative solutions, managers can use several other ways to help develop solutions. Here are some examples:

**Nominal group technique.** This method involves the use of a highly structured meeting, complete with an agenda, and restricts discussion or interpersonal communication during the decision-making process. This technique is useful because it ensures that every group member has equal input in the decision-making process. It also avoids some of the pitfalls, such as pressure to conform, group dominance, hostility, and conflict, that can plague a more interactive, spontaneous, unstructured forum such as brainstorming.

**Delphi technique.** With this technique, participants never meet, but a group leader uses written questionnaires to conduct the decision making. No matter what technique is used, group decision making has clear advantages and disadvantages when compared with individual decision making. The following are the advantages:

- Groups provide a broader perspective.
- Employees are more likely to be satisfied and to support the final decision.
- Opportunities for discussion help answer questions and reduce uncertainties for the decision makers.

**These points are among the disadvantages:**

- This method can be more time-consuming than an individual making the decision on his own.
- The decision reached could be a compromise rather than the optimal solution.
- Individuals become guilty of groupthink — the tendency of members of a group to conform to the prevailing opinions of the group. Groups may have difficulty performing tasks because the group, rather than a single individual, makes the decision, resulting in confusion when it comes time to implement and evaluate the decision.
- The results of dozens of individual-versus-group performance studies indicate that groups not only tend to make better decisions than a person acting alone, but also that groups tend to inspire star performers to even higher levels of productivity.
- So, are two (or more) heads better than one? The answer depends on several factors, such as the nature of the task, the abilities of the group members, and the form of interaction. Because a manager often has a choice between making a decision independently or including others in the decision making, she needs to understand the advantages and disadvantages of group decision making.

The purpose of this step is to decide the relative merits of each idea. Managers must identify the advantages and disadvantages of each alternative solution before making a final decision.

Evaluating the alternatives can be done in numerous ways. Here are a few possibilities:

- Determine the pros and cons of each alternative.
- Perform a cost-benefit analysis for each alternative.
- Weight each factor important in the decision, ranking each alternative relative to its ability to meet each factor, and then multiply by a probability factor to provide a final value for each alternative.

**Importance of Management Support Systems for Business Enterprises**

Management support systems focus on managerial uses of information resources. These systems provide information to manage for planning and decision making. The information provided by these systems is based on both the internal and external data using various data analysis tools. They also offer a choice to the user to select out of these tools for the purpose of data analysis. These systems serve the information needs of managers at middle and top levels in the managerial hierarchy.

There are three types of management support systems, namely:

- **a) Decision Support Systems**,  
- **b) Executive Information (support) Systems** and  
- **c) Expert Systems**.

**Decision Support Systems:**

Decision support systems (DSS) are designed to support the decision making process of managers to improve their effectiveness and thereby efficiency of the enterprise. They are based on the premise that managerial judgement cannot be replaced by any computer based solution. However, by offering the support of data and models, it is
The basic purpose of DSS is to extend the capability of a manager’s decision making process by supporting tools and data made available to him under his direct control. DSS neither presupposes specific information requirements and predefined tools for analysis for different types of decisions nor does it impose any solutions on a manager. Thus, it gives flexibility to the manager to decide the input data, tool of analysis, depth of analysis and reliance on the outcome of Analysis for decision making. DSS offers an interactive environment for users and thus permits manager to experiment with data and models to develop the optimal decision making strategy in a given situation. DSS are also described as interactive information systems that help managers utilise data analysis models to solve unstructured problems. DSS uses technologies that may be termed as its building blocks. They are represented in Figure 10.3.

**Types and features of DSS:**

DSS may be data oriented or model oriented. The data oriented DSSs have greater input of data retrieval and data analysis. The model oriented DSS has powerful facilities for simulation of decision scenarios by estimating the outcome of an action and generating suggestions. In fact, it is difficult to find a DSS exclusively for data retrieval and analysis or, simply, for modelling. In fact, most DSSs contain a mix of both types of facilities.

**DSSs have the following features that make them distinct from other types of information systems:**

a) DSS does not aim at any specific type of decisions. It has the flexibility of use in various unexpected decision situations.

b) The user friendly interface of DSS makes it different from other types of information systems. Once a manager has used a DSS for some time, its irregular use does not adversely affect the ease of use.

c) The report generators and graphic facilities in DSS provide better ways of representing the information generated by use of models in DSS. These facilities add value to the information.

d) DSS offers any user complete control over the system. The input, method of processing and output are controlled by the user.

**Benefits from DSS:**

An Information system must have its own justification to be a candidate worth considering for inclusion in the applications portfolio of an enterprise. The justifications are generally in terms of the benefits in generating information to assist in external reporting and managerial decision making process. The benefit that a DSS can offer includes:

a) Evaluation of a larger number of alternatives as the facilities in DSS reduce the time and effort in collecting and analysis of data for different alternatives.

b) Modelling and forecasting becomes easy for managers using DSS enabling them to get more insight into the business processes.

c) Usefulness in intra-group and inter-group communication because it makes it possible to explain to others, how one has arrived at a particular conclusion. The rationale assigns respectability to conclusions and earns the backing of others in the enterprise.

d) Facilities for quicker analysis of data for unstructured decision making, thereby, improving the speed of response in unexpected decision making situations.

e) Quicker spotting of variances and exceptions. Frequent users of DSS have found that DSS enables them to anticipate outcomes with the help of efficient ad hoc query facility.

f) In-depth analysis of data and therefore, more effective use of data resource.

**Applications of DSS:**

DSS have found success in enterprises of medium to large size and in decision scenarios requiring in-depth analysis of internal and external data. The success of DSS depends, to a large extent, on top management support, regularity and length of use, training of managers and variety of decision making situations.

If the business process is simple and repetitive in nature, DSS may not be able to justify its costs. DSS applied to structured decisions only add to costs and confusion. DSS have been found to be useful in decision areas where flexibility in data and modelling is required for better decision making. The typical areas of application of DSS in production and finance functions of business are:

**Production:**

Procurement analysis, cost estimation and analysis, production planning and scheduling, make or buy decisions, inventory planning and control, manpower loading, etc.

**Finance:**

Capital budgeting, financial planning and analysis, tax planning, strategic financial planning, budgeting, cash and working capital management, debt and equity financing analysis, foreign exchange risk management, financial performance analysis, variance analysis, etc.

The decision support systems are developed using a process different from the traditional system development process as they are supposed to process internal as well as external data. They need to be independent and interactive.

**Executive Information Systems:**

DSS are designed to cater to the information needs of managers at middle to top levels. They relate to rule-based work doing modelling and analysis of data in order to make it useful in decision making. However, at the top of managerial level, there is a need to focus more on packaging and delivery of information than on generation of information. The top manager deserves better environment for information access than that provided by DSS.

The top executives need fast access to up-to-date, concise information and exception reports with facilities to personalisation and analysis. The information systems designed to cater to such needs of top executives are called Executive Information Systems (EIS) or Executive Support Systems.
These systems act as electronic briefing systems and offer tremendous flexibility in use. EIS uses internal as well as external information and offers an interactive and a user friendly operating environment.

**Applications of EIS:**

**Executive Briefing:**
EIS offers up-to-date information on different aspects of the executive’s interest. The briefing is, generally, related to the performance of various profit centres and offers status reports on various activities of the enterprise. Though a certain amount of briefing takes place in DSS as well the information comes as and when it is asked for, from the databases. In EIS, the information is automatically downloaded periodically from databases in the form of finished reports. This automatic downloading ensures that executive does not remain out of touch for long during the days of extreme pressure of workload.

**Personalised Analysis:**
EIS offers facilities for data analysis using the models of user’s choice. Spread sheets and statistical techniques are available in EIS for asking. The difference, here, is that EIS not only helps the user in analysis of data, but also in interpretation of the outcome of the analysis.

**Exceptions Reporting:**
An important component of EIS is the exception reporting module. EIS caters to this requirement of executives effectively and forewarns the executive of the substantial variations from the plans. They permit, with varying degrees, further investigation into the reasons for deviations and possible impact of proposed salvage operations. This ability to probe into the matter to get a little more than just the exception makes EIS a very useful tool for the executive in the efficient discharge of his functions.

**Model Based Analysis:**
EIS has facilities for model based information analysis and this feature is common with DSS. But, the model based analysis in EIS is different from that in DSS in the sense that the input data in EIS is limited and obtained from both internal and external sources. It may be noted that EIS is not an isolated collection of computer reports of information for executive. EIS is a set of integrated tools and technologies woven into the total information system environment of the enterprise. It may be noted that EIS supports all the users and not necessarily the top executives of the enterprise. All those who help top executives should have access to EIS and it must cater to the information needs of all such people.

**DSS and EIS:**
Some of the facilities in EIS are also found in DSS and, as such, the line of distinction sometimes becomes blurred. The overlapping cannot be ruled out in such systems. Figure 10.4 shows the types of information support that these two systems provide to a manager.

**Benefits of EIS:**
EIS offers the following benefits to a business enterprise:

a) **Information support for strategic decisions:** EIS helps executives in relying more on facts than on intuition and business judgement for their strategic decisions.

b) **Changing the focus:** A top executive’s frequent queries regarding a set of critical success factors have an impact on the priorities of people at lower levels of management. Thus, it is easier for an executive using EIS to pass on the message to functional managers regarding the need to maintain quality standards, just by making frequent queries from EIS regarding the quality of products. The executive’s queries can set the thrust of activities in the enterprise and thus change the priorities in the enterprise.

**Critical success factors in EIS implementation:**
EIS intends to provide firsthand knowledge to top executives regarding the potential benefits of information systems in the enterprise. Therefore, it is necessary to ensure that EIS, once planned, must be implemented successfully. The problems of implementation in EIS can be numerous but a few of the common ones are as follows:

a) **Difficulty in system specification:** The target users of EIS are neither clear about their specific information requirement nor have the time to chalk out the specifications of the information system. The users, thus, deserve a few options to try out before they are able to specify the services required by them. Prototyping is considered to be a better strategy in the design of EIS.

b) **Large volumes of data:** Ad hoc Query facilities demand access to a large volume of data. The satisfaction of such queries may require use of statistical tools processing bulk data before it can meet the requirement of information in the query. This may take time and the response of the system may be slow.

It is, therefore, essential to anticipate the broad issues on which the queries are likely to focus and information regarding such issues may be regularly generated and stored separately for access to EIS.

c) **Resistance from lower levels:** EIS is likely to face resistance also from the people at almost all levels and more from managers at lower levels. It is so because now the boss has access to latest information and regarding the day-to-day functioning in each department even before the departmental heads have gone through and understood it. Rochart anticipates serious implications of such access to databases on the new politics of data ownership among the managers. However, a data- the base manager can address this problem by carefully handling distributions button of data.
d) Management styles: It would be difficult to implement EIS in the case of enterprises having an IT averse culture. Some top executives do not favour use of IT in decision making. They have more confidence in their business judgement and wish to leave data analysis either to their subordinates or to the domain experts who help them. This problem is quite serious. Therefore, EIS in such environments are aimed at top positions. They are limited, in scope, to services where the success rate is known to be very high. Once the confidence in IT and EIS is generated EIS may add more services to itself.

e) Increased size and cost: If the manager finds an EIS useful, he expects his subordinates also to use it. Those who do not use it, find it very difficult to live up to the expectations of their boss in so far as awareness regarding the business environment is concerned. Thus, the EIS gets overloaded and costs climb up sharply because the number of users shall grow in geometric proportions.

Thus, implementation of EIS should be undertaken very carefully. It is advisable to select an opportune time for implementation. People resist changes more when the going is smooth and are more willing to try out something new in a crisis. Therefore, the most opportune time of EIS implementation is when people are searching for new solutions to their problems. Pilot installation is considered the most suitable installation strategy for EIS. A selective approach is better in the initial stages of EIS design and new services are added in EIS only after the initial model is successful. User involvement and support are critical in the successful implementation of EIS.

**Expert Systems:**

The increasing complexities and dynamism in the emerging business environment require greater interaction of functional managers with the experts so as to get timely advice. These experts would not only sift information from vast pools of diverse information, but also use their expertise to offer advice.

Traditionally, the expertise available in an organisation has provided an important basis for achieving, improving and maintaining its competitive position. All other things being equal, firms without comparable expertise are at a disadvantage.

Human experts may not be able to cope with the new challenges, given the constraints of time and complexities of the new environment. Besides, there may not be uniformity and consistency of advice for a given decision situation over a period.

This is so because of the obvious inability of human beings to capture the impact of various decision variables all the time. The Information Fatigue Syndrome and the limitations of human experts in the changing business environment have resulted in increasing popularity of business expert systems (BES).

These systems simulate human activity and keep capturing and systematising business knowledge, extending the decision making capabilities of expensive and scarce human experts, so that others can use their decision experiences. They offer the advantage of flexibility in capturing and representing information of different types in diverse forms.

A business expert system receives a problem from the user, identifies its data requirements, analyses the relevant data against the decision rules (contained in a knowledge system). Once the problem is solved, the system through its inference engine reports the solution to the user and is also able to explain its line of reasoning in reaching that solution.

A business expert system can act as an aid to managerial effectiveness by providing advice. Its solutions/advices are always consistent, uniform, thorough and methodical. It functions as a standardised problem solver. The business expert system is able to explain the line of reasoning it uses for solving a problem.

A user can study the rationale and is free to accept, modify or reject the solution. Unlike other expert systems in the field of medicine, engineering, etc the objective of the business expert system is not to replace evaluation by human expert(s) by the computer program.

Rather, the objective is to acquire the expertise of the human expert and make it available in a standardised form to human expert(s) and others in the organisation. They work out strategies to use knowledge in the application areas so as to develop plausible solutions to the problems.

The typical areas of application of expert system in business include:

- Make or buy decisions
- New product launch decisions
- Determining credit limits
- Incentive systems
- Product development
- Investment counselling
- Performance evaluation
- Customer query
- Production scheduling
- Project evaluations
- Routing decisions

**Building blocks of business expert systems:**

Although the expert system methodology has been developed over the last two decades, it is still in its infancy when viewed from the viewpoint of a business manager. Thus, there is no standard model for a business expert system. Holsapple identifies three basic components of BES namely user interface, inference engine and knowledge system. The relationships among these components are represented in Figure 10.5.

A user poses a problem before the BES using the user interface. The inference engine tries to understand the problem, structure it in such a way so that the knowledge system can be used to solve it. Then it uses the knowledge system to seek solutions to the problem.

The knowledge system consists of stored reasoning expertise and is addressed by the inference engine to seek solutions to the problem. The knowledge system may consist of knowledge representation tools such as rule sets, databases, spreadsheets, frame-oriented structures, case bases, semantic nets, texts, graphics, etc. The inference engine may interact with users to get more details regarding the decision making environment.

**Procurement options:**

A business expert system is a complex system and requires long term commitment on the part of an enterprise to be able to deliver goods. Due to the dynamics of business, the usefulness of the BESs may be reduced because of changes in the business environment.
Some of the BESs can become obsolete even during the development stage if they are not properly planned. It is essential to be aware of the procurement options, so that the development time and cost could be reduced and a balance between flexibility and efficiency could be maintained in the system.

Broadly, there are three procurement options for BES:

a) Acquire a fully developed system: A number of ready-made BESs are available for different types of problems identified in the list of applications of BES mentioned earlier. These ready-made solutions have all the three components fully developed and are in a ready to use state. They have the advantages of being economical, well tested and quicker implementation but in many decision situations they are not suitable.

b) Acquire artificial intelligence shell: The artificial intelligence shell consists of a rule set manager and an inference engine. The rule set manager is provided with the expertise represented by various knowledge representation tools. Once the expert knowledge is represented, it rules set is tested on the past information and once found correct, the shell becomes usable with the help of the inference engine.

This option gives the flexibility for a manager to define his own rule sets and get a custom made BES operational in a short period of time. However, such shells that are available in the market have their own areas of applications that they are most suited for.

c) Custom built system: In case the first two options appear to be infeasible or are considered advisable due to the uniqueness of the problem, one may opt for custom made BES. They cost more and take a longer time, but, are very useful in unique or specific kinds of decision making situations.

Benefits of expert systems:

a) Coding of expertise: The significant benefit of business expert system is that it helps in formalising/codifying the reasoning ability of an organisation. In the process of development of BES, attempts are made to represent expertise in the form of rules, frames, cases, text and graphs.

This leads to compilation of knowledge regarding the expertise so far held firmly to chest by the experts. Such a store of expertise can provide a basis for better training of human experts in the organisation besides leading to better decision making.

b) Enhanced understanding of business process: It enhances the understanding of the decision making process that may in turn lead to improvement in the process. During the development process, the existing ways of decision making are identified and reviewed. This helps in improving the decision making process. Frequent interaction of experts with BES is a great learning process and results in mutual enhancement of each other’s problem solving capabilities.

c) Timely availability of expertise: BES is able to provide expertise when a human expert is not available. These systems do not have problems of availability that is quite common among human experts. BESs are available to users for consultations at odd hours, have no prior engagements, do not proceed on leave for one reason or the other and do not resign from the enterprise to join a competitor.

d) Easy replication: The marginal cost of replicating a BES is insignificant. Once a BES is successful at one place, it can be replicated at other places having similar decision making environments, without loss of time or opportunity.

e) Eliminates routine consultation requests: BES can help a human expert in reducing his work load by directing the routine type of consultation requests to BES. This enables the human expert to concentrate on more challenging problems that are not solved by BES.

f) Consistency: BES offers consistent and uniform advice on problems. Their advice does not suffer from overlooking some facets, forgetting some of the steps, personal bias or temperamental problems.

g) Line of logic: BES offers a line of logic used along with the solution. This enables manager to critically examine the solutions and find out whether the line of reasoning used is valid or not. This helps the manager understand the strength and weaknesses of the solution and apply his business judgement to arrive at decisions.

h) Strategic applications: The benefits of BES help in product and service differentiation and reduced costs. They also help in developing niche markets where competitors without such systems may not be effective. Thus, BESs can provide the strategic edge to an enterprise.

Critical success factors in implementation of BES:

The critcism of BESs provide numerous reasons for the impracticability of BES. The criticism in most of the cases is not unfounded. It is essential that the problems relating to development and implementation are anticipated and necessary precautions are taken to ensure success of BES.

The following factors may be kept in view in this connection:

a) Cost effectiveness: Most of the BESs are very expensive and sometimes it is economical to use human experts. It is necessary to keep the cost of BES low to ensure that the cost is justified by the potential benefits. The first two procurement options help in keeping the cost of BES at lower levels.

b) Selective in scope: The more ambitious BES may require a longer duration of the development process and heavy costs. It may be remembered that not all decisions offer the same rate of return on investment in BES.

One should be selective in including applications in BES and a comprehensive BES, perhaps requires a lot of information system expertise. The artificial intelligence technologies are still evolving and it may be economically viable to have wider scope for BES.

c) User friendliness: BESs are very complex systems having powerful techniques for data analysis. They require a lot of training effort before they can be effectively used. It is, therefore, necessary to have more user-friendly user-interface and more explicit and unambiguous menu structures.

d) Multi-user environment: Most BES are stand alone systems. However, many a time, decision expertise is an outcome of collective and group activity. BES having multi-user environment are likely to be more successful than stand alone systems.

What a manager needs to know about BESs:

BES uses multiples of knowledge engineering tools of which many may be beyond the comprehension of an ordinary functional manager. However, as a user of the BES, a manager need not know the technical details of the knowledge system.

What he needs to know regarding BES is:

i. The opportunities for application of BES in one’s business activities and relative potential of each application in formalisation of knowledge.

ii. Basic BES technologies and their favourite areas of application.

iii. Feasibility of using artificial intelligence shell.
iv. Role of BES in supporting people in their activities.
v. Technical and economic feasibility of BES.

The potential benefits from BES are quite fascinating. Perhaps, what is required is to develop cost effective tools for building up the BES and willing participation by domain experts in the development process that is evolutionary in nature.

Limitations of business expert systems:
BESS have proven their potential benefits in many applications and quite a few have been very successful. However, there are a few limitations of BESS. These limitations are due to the assumptions that BESS make regarding:

i. The availability of a willing domain human expert who is able to articulate knowledge and has a proven record in making effective decisions. Such experts are rarely available, particularly in new domains where knowledge is also in a state of evolution.

ii. The decision making environment is simple, well structured and not subject to frequent changes. In reality, decision making takes place in complex, dynamic and a multi-dimensional environment. As a consequence, articulating knowledge is very difficult.

The BESS lack flexibility that is needed in the light of the dynamics of business. Multi-dimensional decision making environment makes group decision making essential. Getting an expert who understands all the dimensions of the business problems is becoming increasingly difficult. It may be remembered that BESS are well suited for limited type of applications and are not for totally replacing human experts.

As a consequence, BESS are losing their popularity. They are considered suitable for limited type of applications. The new artificial intelligence tools such as neural networks, fuzzy logic, case based reasoning, etc. are being added to inference engines to make them more suitable for changing needs of business.

Side by side, attempts are being made to use the AI tools for developing add-on software to perform limited functions. These add-ons are termed as intelligent agents.

Intelligent Agents:
Intelligent agents are software components that perform a part of the process using a knowledge base. They work generally with shared information systems and operate in a semi-autonomous manner.

These programs communicate with users and the information bases to perform self contained tasks. These programs are integrated into different applications to enhance the information analysis services of the information system. These agents are being used for a variety of applications such as:

a) Detection and alarm systems:
The intelligent agents are being used to establish a system of detecting exceptions in the data bases, communication systems, etc. and issuing necessary alarms to the concerned users. ‘Management by exception’ would find a new dimension in managerial activities when such intelligent agents start delivering information.

b) Information search engines:
Intelligent agents are also being developed to function as information search engines for replying to the queries received from different types of users. For example, a ministry may get a number of requests for information, everyday. Intelligent agents can interpret the requests and sift information from the database and send the reply in the appropriate form to the user.

Similarly, intelligent agents could add value to the Railways information system by proper management of passenger enquiries regarding various operations. An intelligent agent links the Internet, the internal network and CD-ROMs to search filter and deliver personalised information. A smaller version of such search engine is already available in LOTUS-NOTES.

c) Desk top applications:
As the availability of intelligent agents becomes common on PCs, they would act as personal meeting managers, personal librarians, personal financial advisors, etc. These agents would automatically arrange telephonic contact with clients, fix appointments and issue alarms to ensure that the appointment is not ignored inadvertently.

These agents would look for write-ups on subjects of interest from Internet magazines and collect information from other sources including electronic libraries and CD-ROMs to provide information that one gets with the help of secretaries, today.

New Information Analysis Tools:
Intelligent agents use a variety of information analysis tools. These tools not only sift information from heap of data but also deliver the information in a meaningful way. The important among these tools are data mining, data mapping, data visualisation, neural networks, etc.

a) Data mining:
Data mining refers to examination of large volume of data for trends and patterns, establishing cross relationships among various factors that may hitherto remain hidden in the heap of data. It involves drill down techniques to break down higher level figures into lower level figures.

The ‘traffic lights’ provide alert signals when exceptions are encountered. Data mining finds its applications wherever there are complex and subtle relationships between individual products or services that are not easy to identify but have significant implications for revenues and profitability. A notable feature of data mining is that it analyses the entire available data instead of picking up samples for analysis.

Figure 10.6 illustrates the process of data mining.

Data mining made its debut in retail commodity marketing and it was quite natural. However, it has applications in other business activities as well. It can help managers establish relations among various factors influencing different decision variables.

Data mining as a technique is still in its infancy. It holds a great promise particularly because it can help in identifying opportunities and enable managers to react quickly to the current opportunities and impending dangers.

b) Data mapping:
Data mapping tools provide graphical view of the information superimposed on a map of a geographical area or territory. They can provide quicker view of the geographical spread/concentration of the demand for the products and customers’ preferences, expectations and market sentiments. They can also help in identification of local factors influencing market behaviour at different points of time. Such mapping tools can be of great help in improving comprehension of voluminous data information as it has been found that a large proportion of data stored is geographical in nature. However, mapping tools need to be enriched with more details regarding the characteristic features of each geographical area and the associated similarities of neighbouring areas.

c) Data visualisation tools:
These tools primarily aim at representing data with the help of three dimensional visuals. These visuals may be histograms that may be navigated for further details of its component data, with the help of any pointing device like mouse. The visual may take more imaginative shapes such as spherical balls of varying sizes and colours or any other shape that may be directly related to the subject matter or behaviour of data. Data visualisation tools have the ability to summarise data in such a way that the users take less time to visualise the situation. It helps in focusing on the currently relevant part of data and enables the user to explore for more in case it interests him. Data visualisation techniques should also help in simulation, sensitivity analysis and answering ‘what if’ questions.

To get a glimpse of their applications in financial management, let us take an example of the classical ratio analysis for measuring the performance of an enterprise. Ratio when used carefully, can contribute a lot in providing an insight into the state of affairs. However, a large number of ratios relating to an enterprise with varying interpretations when compared with industry and country ratios would be too cumbersome and resist comprehension of intricate relationships. Visualisation techniques can help in putting them in the right perspective.

A three dimensional visual putting the values in the form of coloured balls/boxes and the components/lower level values contained in the bigger balls representing high level values can help in better understanding of relationships and comparison with corresponding industry and country standards. For example, a banking company yield on performing assets may be calculated and shown along with the concerned values of Cost of funds; Market interest rate; interest tax/other taxes; Asset mix; and Financial risk along with the industry ratios in the form of two dimensional tables or array of ratios. Alternatively, the company’s ratio is shown as a ball on a colour monitor along with the industry’s ratio in distinguishing colours and proportionate sizes. By hitting with the help of a mouse at each ball, the user can break open the ball to give five additional balls. Each one of these balls represents one of the factors listed above. The sizes of these balls are associated with their relative significance in determining the value of yield on performing assets, both for the company and the industry.

d) Genetic algorithms and neural networks:
Genetic algorithms are also being recognised as effective tools for analysis of financial data. These tools establish decision rules and patterns from the past data and help in hypothesising various situations. With the availability of advanced tools of fuzzy statistics and high speed computing facilities, genetic algorithms are now finding new applications in financial modelling.

Neural networks try to emulate human brains with the additional strength in arithmetic accuracy in processing large volume data using complex algorithms. These networks when confronted with relevant data, dig out patterns in data and develop models, test them, forecast future events and learn from mistakes. These intelligent agents have the potential of enabling managers to anticipate changes in business environment more promptly so that they can change their strategies well in time. In this way, they help in improving the adaptability of the business processes.

Most of these tools try to analyse information on real time basis and thus the most recent scenario is presented to the manager with much of technical analysis done by himself. Software giants like Oracle, Cognos and Comshare have started offering intelligent agents as add-ons with their traditional application products. Some of the others offer independent software tools for data management, modelling and information presentation. However, at present, these tools are very simple and in their primitive form.

Support for decision-making

What is support for decision-making?
Just as people who use a wheelchair need a ramp to access a building, many people with cognitive disabilities need support to be able to make decisions and determine their own lives. Supported decision making is the practice of providing support to people with cognitive disabilities to be able to make decisions.

Why is support for decision-making important?
The right to make decisions about one’s own life is a fundamental right within the United Nations Convention on the Rights of Persons with Disabilities and a central aim of contemporary disability policy. However, there is a long history of people with disabilities being denied the right to make decisions for themselves.

Most people require support when making decisions about their lives. They may talk to friends and family, or seek support from professionals in relation to decisions about their health, finances, or career. Being able to make all kinds of decisions for ourselves is important for our mental health and well-being and increases self-determination and agency over our own lives.

People with cognitive disabilities (including intellectual disability and acquired brain injury) benefit from making their own decisions. Oftentimes, this requires support from other people.

“Over one million Australians have some form of cognitive impairment due to intellectual disability or acquired brain injury and require significant levels of support for decision making.” (Douglas, Bigby, Knox & Browning, 2015, p. 37)

The National Disability Insurance Scheme (NDIS) means that people with cognitive disability will be required to make decisions about the services they use and the kinds of care that they receive. Within this new climate decision-making is particularly important.

Decision Making Styles: How Do You Decide?
We all make decisions every day. Some are only of minor importance such as; “Which socks am I going to wear today?” Some of the decisions you make will have an impact on your life for a long time to come. Some decisions will not only affect you, but will have far reaching implications for others, as well. If you are a business owner, or you manage employees, it is important to be aware of personal decision making style and how it affects the people you work with each day. Understanding how your decision making style affects others will help you to make the serious leadership calls that define a successful leader.

What is Decision Making?
This seems like an easy question, but take a moment and think about how you would answer. What process do you go through when making a decision? How about when you must make decisions as part of a group? Decision making can be defined as the cognitive process which results in the selection of a course of action among several alternative scenarios. Your decision making style can be intellectual or emotional, rational or irrational. The rational decision maker follows four steps to making a decision.

1. Identify the problem
2. Generate multiple possible solutions for the problem
3. Select the solution deemed most likely to solve the problem
4. Implement the solution and evaluate its effectiveness

Now with that in mind, we then need to understand the decision making style that we most often employ and how that style affects the ultimate results.

Decision Making Styles
Decision making can be grouped into four main styles. The four styles are, Directive style, Analytic style, Conceptual style, and Behavioral style. Although no one fits completely into just one style category, you should have characteristics that fit, more or less, into one or two styles. Each style looks at decisions in a somewhat different way. Each style deals with processing the information on which the decision is based differently.

Directive Style
For the person that is a directive style decision maker, structure is very important. The directive decision maker is aggressive and expects immediate results. The typical directive style decision maker takes charge of a situation, makes quick decisions and expects those “under” him to carry out those decisions immediately, with no questions asked. They rely on their own information, knowledge, experience and judgment. The directive style decision maker tends to follow the rules and is an excellent verbal communicator. On the negative side of things, directive style decision makers act quickly and often don’t have all of the facts. They can be rash and fail to consider other options when addressing a problem. Directive decision makers focus on short-term results instead of long-term solutions.

Analytic Style
If your decision making style is analytic, you probably enjoy solving problems and puzzles. An analytic style decision maker is innovative and likes to analyze large amounts of data before making a decision. They are adaptable and can function well even under unique or challenging situations. Unfortunately, this style of decision making can be very slow and time consuming. An analytic decision maker wants to use direct observation, data, and facts when coming to a decision. They also tend to want to control every aspect of the process.

Conceptual Style
Conceptual style decision makers like to look at problems from an artistic angle. They are extremely creative and like to look for solutions that are outside the box. They are achievement oriented and like to think far into the future when making important decisions. A conceptual style decision maker will take risks and try to make decisions that take a broad vision in problem solving.

Behavioral Style
People who use a behavioral decision making style are very interested in making sure that everyone works well together and avoids conflict. They are very persuasive talkers and are good at getting people to see things their way. Behavioral decision makers like working with a group. Together they attempt to reconcile differences and negotiate a solution that is acceptable to all parties.

Group Decision Making Styles
Group decision making has its own set of models. Each decision making style affects the group in a unique way and has its own best uses. Knowing which style to use in a particularly situation can be the difference between success and failure, especially in a business environment.

Autocratic Group Decision Making Style
An autocratic decision making style is one in which the leader takes complete control and ownership of the decision. The leader is completely responsible for the outcome that results from the decision, whether that outcome is positive or negative. The autocratic leader does not ask for suggestions or ideas from the team and decides based on their own internal information and perception of the situation.

Using this method produces a very fast decision for which the leader is personally responsible. In an emergency situation, the autocratic style is often the best choice. The disadvantages can sometimes include less than desired effort from the people that must carry out the decision. If an employee or group member is affected by the decision, but was not included in the decision making process, morale may suffer. If the result of the decision is not positive, members of the group may begin to feel resentful and believe they could have done a better job themselves. This can cause the leader to lose credibility.

Democratic Group Decision Making Style
Democratic group decision making can be useful when a quick decision is needed utilizing a minimum amount of group participation. In this style of group decision making the leader gives up ownership and control of a decision and allows the group to vote. As the name implies, majority vote will decide what action is taken.

The disadvantage of this style can be a lack of individual responsibility. There is no one person that can claim responsibility for the decision reached by the group. Since there is not a requirement for a consensus it opens up the possibility that someone will deny responsibility because they voted against the group’s decision.

Collective Group Decision Making Style
In this style of group decision making, the leader will involve the members of the organization in all aspects of the decision making process, but makes the final decision alone. The leader deliberately asks and encourages group members to participate by giving their ideas, perceptions, knowledge, and information concerning the situation. This brings to light other perspectives on the situation although the leader maintains complete control of the final decision.

In this group decision making style, the leader is completely responsible for the decision and the results, positive or negative. There are advantages to this style, such as the involvement and participation of the group. This style of group decision making requires the leader to be an excellent communicator, as well as an excellent listener. This gives the leader an accurate understanding of the situation and allows for better overall decision making. The disadvantages collective group decision making are that this can be a very slow decision making process and it offers less security due to the number of people involved in the process.

**Consensus Group Decision Making Style**

In the consensus decision making style, the leader gives up complete control of the decision. The whole group is totally involved and invested the decision. There is no individual responsibility for the leader using this type of group decision making. This style differs from the democratic style because everyone must agree on the decision. If there is not total agreement by everyone the decision becomes unworkable.

This type of group decision making fosters a strong group commitment because everyone involved has a stake in the decisions success. By involving everyone completely this decision making style has a high probability of success. It is, however, a very slow process and it can be difficult for a group to learn to work together in this manner. This is a useful decision making style for a group that will be together for a long period of time such that the members can develop a strong, long term, professional relationship.

**How Can Understanding Decision Making Styles Help?**

By understanding your personal decision making style, it is possible to make adjustments according to the situation and results you are working towards. Strong decision making requires the ability to assess the situation, determine the best style of decision making, and utilize that style to come to a positive solution. These are leadership skills that will benefit you both personally and professionally. By consistently using the correct style of decision making, you will prove yourself to be a valuable asset as a leader.

**The Four Decision Making Styles**

**Introduction to the four decision making styles**

All of us make decisions everyday. We make decisions as to where to eat and what to eat everyday. On a business level, the managers make decisions, ranging from hiring and firing to merger and acquisitions.

All of us make different decisions based on our decision-making styles. The four decision-making styles are: Directive, Analytic, Conceptual, and Behavioral.

**Directive style**

Directive style decision-making has low tolerance for ambiguity and is rational. When a manager spots the dirt on the window, and orders the cleaner to clean the window now, that is a directive style decision-making. The Cleaner has to follow the instruction, and does not need to ask for clarification.

**Analytic style**

Analytic style decision-making has high tolerance for ambiguity and is rational. The decision-making style is due to uncertainty, and lack of information. For example, when the management is discussing about acquisition. They do not make decision fast. They want to have more information before they make the major acquisition. They have to find answers to many “what if” questions.

**Conceptual style**

Conceptual style decision-making is characterized by high tolerance for ambiguity and is intuitive in nature. This kind of decision making is for a long term, and subjected to changes. For example, after Singapore gained independence, the Singapore government decided on industrialization. That was a conceptual style decision-making. There was no guarantee of success, and no historical data for analysis.

As a result of the decision, Jurong Industrial Park was developed along with roads and infrastructure.

**Behavioral style**

Behavioral style decision-making has low tolerance for ambiguity and is intuitive. The manager possesses behavioral style decision-making will engage in team discussion. He is responsive to the mood of the team members. He makes decision based on what feels right, and what will motivate the team members to perform. The decision is communicated clearly and leaves no room for doubt.

**Conclusion to the four decision making styles**

In reality, most of us possess more than one style of decision-making. In many cases, we switch the method of making decision based on the seriousness of the decision.

**What are Group Decision Support Systems? What are its Components and Features?**

The Decision Support System has been designed in such a way that it can be used conveniently by the individual decision maker but the decision makers need to work in groups. So this Decision Support System does not suit such a process which has given way for the development of the group Decision Support System, which provides with the following advantages over the Decision Support System

1. Better comprehensive consideration of the problems and the various relating issues.
2. Better group understanding of the problem.
3. Less likelihood of quibbling with the help of the 20/20 hindsight.
4. Better group commitment to the decision.
5. Better communication to/with the implementers.

Group Decision Support System according to De Sanctis and Galleupe is "an interactive computer based system, which helps in solving the various un-structured problems with the help of the decision makers working in the groups."
Basic components of the Group Decision Support System

1. Hardware
   i. Input / output devices.
   ii. Audio visual instruments.
   iii. Electronic display board/ screens.
   iv. Computer equipments.
   v. Conferencing infrastructure.
   vi. Network systems.

2. Software
   i. Database and database management system.
   ii. Modeling capabilities.
   iii. Dialogue management with multiple user access.
   iv. Specialized application programmes to facilitate the group
   v. Access.

3. People and the procedure
   i. Trained facilitators.
   ii. Decision making participants.
   iii. Support staff.
   iv. Laid down procedure.
   v. Modus operandi.

Features of the Group Decision Support System

1. Very much similar to the Decision Support System.
2. A group decision facilitator.
3. Extension or expansion of the Decision Support System.
4. Helps in concentrating on the merits of the input without considering about the fact that who gave it.
5. Enables every group member to address the issues.

Group Decision Support System success depends on the following factors

1. Improved pre planning.
2. Increased participation.
3. Open, collaborative meeting atmosphere.
4. Criticism free idea generation.
5. Idea organization and then evaluation.
6. Setting priorities.
7. Making decisions depending on the priorities.
8. Documentation.
9. Record keeping of the meetings.
10. Access to the external information.
11. Preservation of the 'organization memory'.

Group Decision Support System (GDSS)

A group decision support system (GDSS) is an interactive computer based system that facilitates a number of decision-makers (working together in a group) in finding solutions to problems that are unstructured in nature. They are designed in such a way that they take input from multiple users interacting simultaneously with the systems to arrive at a decision as a group.

The tools and techniques provided by group decision support system improve the quality and effectiveness of the group meetings.

Groupware and web-based tools for electronic meetings and videoconferencing also support some of the group decision making process, but their main function is to make communication possible between the decision makers.

In a group decision support system (GDSS) electronic meeting, each participant is provided with a computer. The computers are connected to each other, to the facilitator’s computer and to the file server. A projection screen is available at the front of the room. The facilitator and the participants can both project digital text and images onto this screen.

A group decision support system (GDSS) meeting comprises different phases, such as idea generation, discussion, voting, vote counting and so on. The facilitator manages and controls the execution of these phases. The use of various software tools in the meeting is also controlled by the facilitator.

Components of Group Decision Support System (GDSS)

A Group decision support system (GDSS) is composed of 3 main components, namely hardware, software tools, and people.

- **Hardware**: It includes electronic hardware like computer, equipment used for networking, electronic display boards and audio visual equipment. It also includes the conference facility, including the physical setup—the room, the tables and the chairs—laid out in such a manner that they can support group discussion and teamwork.

- **Software Tools**: It includes various tools and techniques, such as electronic questionnaires, electronic brainstorming tools, idea organizers, tools for setting priority, policy formation tool, etc. The use of these software tools in a group meeting helps the group decision makers to plan, organize ideas, gather information, establish priorities, take decisions and to document the meeting proceedings. As a result, meetings become more productive.

- **People**: It compromises the members participating in the meeting, a trained facilitator who helps with the proceedings of the meeting, and an expert staff to support the hardware and software. The GDSS components together provide a favorable environment for carrying out group meetings.

Features of Group Decision Support System (GDSS)

- **Ease of Use**: It consists of an interactive interface that makes working with GDSS simple and easy.

- **Better Decision Making**: It provides the conference room setting and various software tools that facilitate users at different locations to make decisions as a group resulting in better decisions.

- **Emphasis on Semi-structured and Unstructured Decisions**: It provides important information that assists middle and higher level management in making semi-structured and unstructured decisions.

- **Specific and General Support**: The facilitator controls the different phases of the group decision support system meeting (idea generation, discussion, voting and vote counting etc.) what is displayed on the central screen and the type of ranking and voting that takes place, etc. In addition, the facilitator also provides general support to the group and helps them to use the system.

- **Supports all Phases of the Decision Making**: It support all the four phases of decision making, viz intelligence, design, choice and implementation.

- **Supports Positive Group Behavior**: In a group meeting, as participants can share their ideas more openly without the fear of being criticized, they display more positive group behavior towards the subject matter of the meeting.

Group Decision Support System (GDSS) Software Tools

Group decision support system software tools helps the decision makers in organizing their ideas, gathering required information and setting and ranking priorities. Some of these tools are as follows:

- **Electronic Questionnaire**: The information generated using the questionnaires helps the organizers of the meeting to identify the issues that need immediate attention, thereby enabling the organizers to create a meeting plan in advance.
**CBIS (computer based information system)**

**A. Understanding CBIS**

Computer Based Information Systems or Computer Based Information System (CBIS) is a data processing system into a high-quality information and can be used as tools that support decision-making, coordination and control as well as visualization and analysis. Some terms related to CBIS include data, information, systems, information systems and computer base. Here's an explanation of each term.

**Data -** Data is a description of things and events that we hadapi.Jadi in essence, the fact that the data describing an event and a real unity that will be used as a basic ingredient information.

**Information -** Information is the result of processing the data into a form that is more useful for illustrating receiving a real events and can be used as a tool for making a decision.

**System -** Systems are entities, both abstract and concrete, which consists of several interrelated components to each other. Object that has no connection with the elements of a system is not a component of the system.

**Information System -** Information System is an information generating system. With the integration between subsystems owned, information systems will be able to provide quality information, precise, fast and accurate in accordance with the management who need them.

**Based Computers -** Information Systems' computer-based "means that the computer plays an important role in an information system. In theory, the application of an information system does not have to use computers in their activities. But in practice not possible systems are very complex information that can be run well if without a computer. Accurate information systems and effective, in fact always associated with the term "computer-based" or processing information based on the computer.

**B. Era of Globalization and High Level of Competition**

Some strategies that can be done every company to be won a competition conducted in a turbulent era of this.

1. Mastery of technology to produce goods and services.  
2. Improving the quality of human resources.  
3. Marketplace appropriate.  
4. Establishment of accurate information systems to assist each decision.

**C. Sub-System of Computer-Based Information System**

1. Accounting Information System  
2. Management Information System  
3. Decision Support System  
4. Office Automation (Virtual Office)  
5. Expert System

**ACCOUNTING INFORMATION SYSTEMS (AIS)**

SIA is an information system that implements corporate accounting application, ie as data processing companies, the Company can not choose to use the SIA or not, this system is a necessity. All companies basically implement procedures the same. SIA is more oriented to the data than the information, although there was some information generated. SIA provides a consistent database for other information. SIA is the only system responsible for the information needs of information outside the company, providing environmental information to all except the competition.

The main task of this information system are:

- Data collection  
- Manipulation of data  
- Data storage  
- Provide documents

**Data Collection** Any action taken by the company that involve environmental elements such activities is called the transaction, the action described by a data record, the recording is known as transaction processing.Data processing system to collect data that describe each company's internal actions and transactions within the enterprise.

**Data Manipulation** is the task of changing data into information. Data manipulation include:

- Classification, identification and grouping data using the encoding of transaction records.  
- Sorting, preparation of a specific order based on the code or other data elements.  
- Calculating, arithmetic and logic operations are performed on the data elem.  
- Summarizing, the data so that the resulting inference total, average and others.

**Data Storage** The data has been recorded and stored in secondary storage media, and logically integrated in the form of a database.

**Provision Document** SIA produces the information to individuals or organizations both within and outside the company, which was triggered by two things, namely:

- Actions, which is the output if anything happens.  
- Time, which is the output at a given moment.

**Characteristics SIA**

- Carry out the necessary tasks.  
- With a focus on a relatively standard procedure.  
- Dealing with detailed data.  
- Focusing on the historical.  
- Provide a minimum of troubleshooting information.

**Role SIA In CBIS**

- SIA produces some output information in the form of standard accounting reports.  
- SIA provides a comprehensive database for use in solving problems.
All information has similar characteristics to the field of functional areas (marketing, manufacturing, tabless, and finance), management level (operational, managerial, and strategic), and the user (manager or non-manager) driver's license information to obtain data from the database, where database contains data and information from the SIA and the environment.

A SIM can also be an inter-organizational information systems (IOS) if a SIM connected to the SIM on other companies such as the Supplier.

SIM and AIS - SIM using data provided by SIA in the database, and other information from the environment. The contents of the database is used by software to make periodic reports and special reports, as well as mathematical models to simulate aspects of company operations.

SIM & EntIS - SIM will be formed as a whole if all the organizations information systems have been formed and connected to each other. Data and information stored in the same database and can be used in other functional areas. SIM is the basis for the establishment of information systems more sophisticated and complex emerging in recent years, the Corporate Information System also known as Enterprise Information System (EntIS)

Software Maker Reports - Software makers are reports that the software used to produce periodic reports and special reports. Periodic reports of its forms and special reports may look the same. There are differences of timeliness and time periodic prepared horizon. Laporan particular schedule, the early period of limited driver's license provision of periodic reports on course, but it becomes difficult to accept when the SIM has implemented HRIS and EIS.

Special reports are provided if there is something extraordinary, sepertl accident report on manufacturing, or a specific report from the database query. Special reports usually provide a portrait of something that is happening or has just occurred, in contrast to the periodic reports that is more oriented to the past or what could also terjadi. Laporan is a combination of periodic reports and special reports, for example, to compare current earnings with reports in the same period the previous year. This report called Management by exception. Management by exception can be incorporated into the report in four ways.

- Report if there is an exception, as in the following example, data shown only for overtime data only.
- The report uses a sequence to highlight exceptions. The following report shows the commodity which has the largest sales value to the smallest.
- Reports based on the grouping of an exception. The report is designed so that managers can find perkekeucialian in certain areas, for example if he wants to see the receivables older than 90 days.
- Reports that show variance from the normal, such as reports to show how the difference between sales and sales arget actually.

Mathematical Model

The second type of SIM software form mathematical models. Mathematical models can be categorized in three characteristics of the influence of time, the level of confidence, and optimization capabilities. Mathematical model based on the influence of time can be grouped into static or dynamic models, dynamic models have a variable time, so that the simulation results will be based on the analysis period. Mathematical model based on confidence level, the model includes deterministic or probabilistic models. Deterministic model is the model that the results will be known with certainty if the value of the variables that shape known. Probabilistic model will generate possibilities although the shape variables known with certainty.

Model based optimization capabilities can be divided into the optimization model or suboptimasi. Optimization model is a model that can choose the best solution from the various alternatives, to achieve this model of the problem must have a very good struktur. Suboptimasisesebut model model satisfying model, allows managers to enter a series of decisions and the model will project the result, this model does not identify the best decision but to help managers decide that.

EOQ model is a model that has characteristics of static, deterministic, and optimization.

Pros and Cons of Mathematics Model

A manager who uses mathematical models will benefit:

- Making a model of learning experiences.
- Speed of simulation provides the ability to evaluate the impact of a decision as quickly as possible than to wait after the decision is made.
- Models provide predictive power that can not be provided by other information-producing methods.
- The model is cheaper than the method of trial and error. Modeling is expensive but it does not mean than the impact of bad decisions.

The main weaknesses of the use of mathematical models:

- High degree of difficulty in the modeling business systems often result does not include all factors that affect. The loss of the dominant factors will greatly affect the quality of information it generates.
- It takes skill level of high mathematical model to obtain the right. Identification of factors will not be completely useless if Modeler does not have the ability to connect with mathematical operators right.

Output Model

Simulation models can be presented in two forms of output display are:

- Output tables, which is the output of the display of letters and numbers that are used when all necessary data is displayed.
- Output Graphs, appears after the computer era, WYSIWYG, pioneered by Lotus in Microcomputer drafts. Graphical display is now become a compulsory furit to provide information systems.

The graph has the ability to:

- Sums quickly
- Detect trends from time to time.
- Predicting an event.
- Looking for a simple description of a situation.

Choosing a good graphics by Jarvenpaa & Dicson are:

- Diagram the line / trunk, is used to infer the data.
- Diagram the line / trunk group, to see the trend.
- Diagram of stem groups is better than pie chart, to present the parts of a whole.
- Diagram the line / trunk groups, either to compare different patterns of variables than the diagram line / stacked bar.
- Use the horizontal bar of the vertical rod when comparing different variables.
- Place a value on the horizontal rod tip for easy reading.
- Use a single line or trunk to compare the data points between the individual variables.

**Decision Support Systems (Decision Support System)**

In an effort to solve a problem solver will be a lot of decision making. Decisions must be taken to avoid or reduce negative impacts or to
The decision divided into:
- Decisions are programmed, and the routine is repeated.
- Decisions are not programmed, is new and not structured, there is no certain method to handle because unprecedented.

Managers do four stages of decision-making, namely:
- 
- 
- 
- 

Type DSS
The first type only allows managers to take a decision elements, such as asking how many sales region X.

The second type of special reports menungkinkan obtained from a file, such as inventory reports.

The third type allows the manager received a report from different files, such as the income statement.

The fourth type allows managers to see the effects of various decisions. For example changes in product prices and their implications for profits.

The fifth type allows managers to accept the proposed decision, for example, obtain the optimal price diroleh of a mathematical model.

type DSS sixth is capable of providing a decision, such as computers that decide the amount of premium to customers under the age of 25, working in the Trans Am, etc. Stay in Houston.

DSS first three simply by using a database query, while the last three must include a mathematical model.

Destination DSS
- Assist managers to make decisions for semi-structured problem-solving.
- Support the assessment manager is not trying to replace it.
- Improve the effectiveness of decision-making on efficiency manager.

EXPERT SYSTEM (ES)
Expert system (Expert System) is an information system that has artificial intelligence (Artificial Intelegent) that resembles human intelligence. Expert system similar to the DSS is aimed at providing support for high-level troubleshooting for users. Differences ES and ES DSS is the ability to explain the flow of his reasoning in reaching a specific solution. Very often explain how to solve the problem proved more valuable than the solution itself.

Characteristics of Expert System
- Have the ability to learn or understand the problem from experience.
- Providing rapid response and satisfactory to the new situation.
- Able to handle complex problems (semi-structured).
- Solving problems by reasoning.
- Using knowledge to menyelasaikan problem.

Expert System Part
User Interface, is the part that allows managers mamasuk an instructions and information into and receive information from the expert system.

1. There are four methods of input that is
- Menu
- Commands
- Natural Language
- Customized Interfaces

2. Output Expert System, among others:
- Explanation of the question
- Explanation of solving problems

3. Knowledge Base, is a part that contains the facts that explain the problem areas, and also explains techniques that explain how the problem of those facts fit one another in a logical sequence. The term problem domain is used to describe the problem areas.

4. Interference Engine, is part of expert systems that perform reasoning using the knowledge base content based on a particular order. During the consultation, interference engine testing rules one by one and when the right conditions naka one action is taken.

5. Development Engine is a tool used to create expert systems, in this case the two devices are commonly used programming language and the ES shell.

Expert System Examples
- XSEL, an expert system that acts as an assistant sales agent sales on DEC computers, which helps customers choose the computer that meet their individual needs.
- MYCIN, an expert system developed at Stanford University's 19,870 years with the aim of helping medical personnel in diagnosing diseases caused by bacteria.
- Prospector, the system created Richard Duda, Peter Hard, and Rene Reboh in 1978 that provides the ability of a geologist.

OFFICE automation (OA)
Office automation is now referred to as a virtual office, includes all the electronic systems of formal and informal communication is primarily concerned with information to and from the people within and outside the company. OA users are divided into four categories, namely:

- Manager, is responsible for managing company resources.
- Professional, but did not manage to contribute a special expertise that distinguishes them with secretaries and clerks.
- Secretary was assigned to assist skilled workers (Managers & Professional) for carrying out various tasks correspondence, answering the phone, and schedule meetings.
- Employee Administration, perform the duties for the secretary, such as copiers mengioperasikan, menyusun documents, save documents, and send mail.

Destination OA
- Avoiding costs, the computer cannot replace the current employees, but at least delay the addition of poegawai required to handle the additional workload.
- Problem Solving groups, contribute to communication between managers.
- Complement, OA cannot replace the traditional interpersonal communication such as face to face, telephone conversation, writing memos, and the like, but OA is complete so that when combined with traditional media will provide synergy.

OA Applications
- Word Processing
- E-Mail
- Voice Mail
- Electronic Calendaring
- Audio Conferencing
- Video Conferencing
Current information system is the most important issues in management control. This is because the purpose of management control is to assist management in coordinating subunit-sub-unit of the organization and directs these parts to achieve company goals. Two things of interest from the definition above is coordinating and directing. Of course in these two processes requires a system for coordinating and directing the process can work effectively so that corporate goals can be achieved.

The main benefits of the development of information systems for management control systems are:
- Saving time (time saving)
- Cost savings (cost saving)
- Improved effectiveness (effectiveness)
- Technology development (technology development)
- Accounting personnel development (accounting staff development).

With a variety of benefits and contributions provided, it is expected of each company can survive in the arena of an increasingly tight competition.

**DSS, GDSS & ESS/EIS**

**1. Decision Support Systems (DSS)**

DSS generally take less time and money to develop than MIS. They are interactive in the sense that the user interacts with the data directly, and are useful for solving semi-structured problems.

The generic DSS has 3 components (Laudon & Laudon, 1998):
- The database of a DSS is a collection of information often taken from the firm's own internal transaction systems.
- The model base consists of the analytical tools used by the system. Perhaps this is the most critical difference between MIS and DSS.
- The easy to use software system - MIS generally have very simple analytical tools – averages, summations, deviation from plan, and the like. DSS, however, have very sophisticated analytical and modelling tools, such as built-in spreadsheets, statistical analysis, and simulation.

One of the most widely used capabilities of DSS analytical and modelling tools is 'what-if' analysis – examining the impact of changes in one or more factors or values on outcomes. What if we raised prices by 10 percent – how much would profits increase? How much more would it cost to produce our product if the cost of employee wages rose by 15 percent? (Laudon & Laudon, 1998).

Apart from what-if analysis there are three other analytical modelling activities DSS are capable of:
- Sensitivity analysis
- Goal-seeking analysis
- Optimisation analysis

Distinguishing between MIS and DSS is not always easy. Generally MIS produce routine reports on a batch basis with regular schedule every day, week, or month. DSS produce reports, but they also permit the user to ask new and unanticipated questions and to intervene directly online to change the manner in which the data are presented.

DSS are designed to be ad hoc, quick response systems that are initiated and controlled by managerial end users. DSS are thus able to directly support the specific types of decisions and the personal decision-making styles and needs of individual managers.
For example: a MIS might provide a monthly report of profit by item, whereas, a DSS would store the profit by item for later analysis. The DSS would allow decision maker to decide whether s/he wants the analysis to be for individual products, groups of related products, or products in a particular region, etc (Stair & Reynolds, 1999).

Characteristics of DSS include:
- Handle large amount of data from different sources
- Provide report and presentation flexibility
- Perform complex, sophisticated analysis and comparison using advanced software packages
- Support optimisation, satisfying, and heuristics approaches

2. Group Decision Support Systems (GDSS)

GDSS primarily support work of individuals. In an organisation there are many decisions that need to be taken by a collective group of people rather than one individual. Special Systems called GDSS have been developed in order to support such decision-making. A GDSS is an interactive computer-based system to facilitate the solution of organisational problems by a set of decision-makers working together.

2.1 Problems with Large Meetings

Some kinds of problems have always been observed that are associated more with large meetings than with small meetings. By large meetings we mean meetings with generally more than 15 participants, but can go much beyond that, for example: 40 or even 50. Some of the identified problems are:
- Time consuming
- Dominance over the meeting
- Honesty and participation

2.2 Groupware

Software that helps groups of people work together more efficiently and effectively are generally known as groupware (Stair and Reynolds, 1999). They enable information to be shared by people collaborating on solving problems, and hence are also called collaborative computing software.

Groupware provide communication, collaboration, and co-ordination among groups. The software allows the members of the group to collaborate either synchronously or asynchronously. Software associated with groupware include: E-mail, calendar programs, video conferencing, document sharing, etc. Examples of groupware include: Lotus Notes, Novell Groupwise, Microsoft Exchange.

Groupware is often used with Workflow Management Systems (WFMS) for reengineering of companies (Bocij et al., 1999).

2.3 What is a GDSS?

A GDSS incorporates groupware technology with DSS technology. Additionally to a DSS, a GDSS also has hardware and software supporting group processes and facilitates meetings. The technology may include advanced presentation devices, computer access to various (internal and external) databases, capabilities for the participants to communicate electronically and software to summarise members’ ideas, to report votes, to calculate weights of decision alternatives and to anonymously record ideas. Basically, GDSS provided automatically means to enter, record, and build on team members’ ideas. Usually a group facilitator co-ordinates the use of the technology in the process of conducting the meeting.

2.4 GDSS Software

GDSS software provide support both to the individual and to the group. At individual workstations editing, graphics, spread sheets, access to various databases, email, and various other groupware facilities are provided. For the group, in addition to information retrieval and presentation facilities provided include: capabilities of summarising, aggregating and collecting results, ranking or rating opinions, and prioritising tasks.

2.5 Characteristics of GDSS

GDSS must support both decisions making support and process support. Decision making features such as, access to decision making models and model management tools, access to data and database management tools, etc. have already been discussed under DSS. Apart from these GDSS must provide capabilities such as alternative generation (brainstorming), issue interpretation, consolidation of ideas, parallel communication, electronic recording, etc.

2.6 Examples of GDSS

GDSS can be found in business applications such as:
- Negotiations
- Support teams involved in design work, quality control, research, etc.
- Project management
- Training decision makers to deal with disaster situations or high risk situations

3. Executive Support Systems (ESS)/ EIS

ESS have been developed to serve the information needs of managers at the highest organisational levels. They combine data from both internal and external sources to help senior managers solve unstructured problems. Thus they provide executives with immediate and easy access to information about a firm’s critical factors, for example: key factors that are critical to accomplishing an organisation’s strategic objectives. In an ESS, information is presented in forms tailored to the preferences of the executives using the system.

ESS usually fall into one of three categories (Laudon & Laudon 1998):
- That which focus on executive communications and office work
- That which provides a more convenient interface to corporate data
- Those that focus on developing elaborate scenarios, applying statistical models to company forecasts

Although initially intended for top executives ESS are gradually becoming widely used by managers, analysts, and other knowledge workers that they are sometimes called ‘everyone’s information systems’. ESS are also known as Executive Information Systems (EIS), and Enterprise Information Systems.

The most common benefits of an EIS are improvement in the quality and quantity of information available to executives. Executive decision making, especially that of strategic nature is complex and multidimensional. Conventional MIS are designed to cater for structured and much simpler problems. Since EIS are designed to cater for a much narrower user group they have the capability of information presentation which suits the decision style of specific users. Contrarily, MIS cater for a larger user group and therefore, providing such user specific presentation capabilities will be very expensive to implement.

A good EIS must offer a high-speed, non-technical way for managers to investigate business dynamics (i.e., to understand where and why things are happening so tactical changes and course corrections can be made). This is also a major area that distinguishes EIS from a standard MIS. Any summary coming up on an EIS screen must offer instant access to the supporting detail. The supporting detail must be
The relationship between TPS, MIS and ESS

Describe the relationship between TPS, MIS and ESS. Describe each with examples from a real African scenario.

Answer:

Transaction Processing System (TPS) is a type of system which usually helps an organization to handle its daily business operations and transactions in an efficient and effective manner by processing and recording each operation. A transaction is an occurrence in which goods, services, or money are passed from one person, account, etc., to another. Such operations/transactions may include customer orders, purchase orders as well as handling of invoices. A TPS is therefore responsible for collecting, storing, and retrieving data pertaining to the transactions that have taken place in an organization and finally generate reports which are used by other levels of management. The characteristics of a TPS include performance, reliability and consistency. Transaction Processing Systems are usually used at the operational level (by employees who are at the bottom level) of an organization’s hierarchy as shown on Figure 2 below. An example of a TPS is a point of sale in a supermarket such as Nakumatt which is used to record each sale transaction which takes place in the supermarket. At the end of the day, a record of all transactions can be generated from the TPS in order to view which products have been sold.

Management Information System (MIS) is a system which brings together people (the management), information as well as the systems (both hardware and software). This type of system is important in an organization as it provides information that is essential to operations, management and decision making functions. Some of these functions include planning, controlling, decision making, organizing, and staffing. Management Information Systems are usually used at the tactical level (by employees who are at the middle level) of the organization’s management hierarchy as shown on Figure 2 below. An example of an MIS is the University of Nairobi’s Student Management Information System (SMIS) which can be used to generate reports about the registration status of the students in order to determine who is eligible to sit for the end of semester examinations.

Executive Support System (ESS) is a system that is used in an organization to provide summarized information in form of graphs or charts that is tailored for the organization’s executives. They (executives) address non-routine and unstructured decisions which usually require judgment, evaluation and insight. Typical questions for ESSs are:

- In what business should we be?
- What are our competitors doing?
- What new acquisitions should we consider to increase market share?
- What is the optimal speed at which a particular vessel can optimize its profit and still meet its delivery schedule?
- What are our competitors doing?
- What new acquisitions should we consider to increase market share?

The ESSs usually draw summarized information from other MISs at the lower level of management such as the Transaction Processing System. An example of an Executive Support System is an expert system or a knowledge based system which can be used for sales forecasting and perhaps lead to review of business strategy. Executive Support Systems are usually useful to the employees who are at the top-most (strategic) level of the organization’s management hierarchy such as senior managers as shown on Figure 2 below. An example of an ESS is the Softmar Chartering and VesselOps system in South Africa which is used to manage chartering and vessel operations. Some of the questions it helps answer include:

- Given customer delivery requirements and an offered freight rate, which vessel should be assigned at what rate to maximize profits?
- What new acquisitions should we consider to increase market share?
- What is the optimal speed at which a particular vessel can optimize its profit and still meet its delivery schedule?

Figure 1: A hierarchical representation of the different types of Systems

Figure 2: A pictorial representation of the levels in which the different types of Systems are used in an organization.

The relationship between TPS, MIS and ESS

The TPS is the major source of data for other systems in an organization. Since they record daily routine transactions in an organization, they help in structured decision-making. MIS usually receive and utilize the data they get from the TPS. The ESS is the major recipient of data from the lower-level systems which is mainly used in unstructured decision-making.

Below is a video further explaining the differences between the Systems as well as how they are interrelated.

<table>
<thead>
<tr>
<th>DIMENSION</th>
<th>DSS</th>
<th>MIS</th>
<th>EIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Analysis, decision Support</td>
<td>Information processing</td>
<td>Status Access</td>
</tr>
<tr>
<td>Typical Users Served</td>
<td>Analysts, professions, managers (via intermediaries)</td>
<td>Middle, lower levels, sometime senior executives</td>
<td>Senior Executives Expediency</td>
</tr>
<tr>
<td>Impetus</td>
<td>Effectiveness</td>
<td>Efficiency</td>
<td>Environmental scanning, performance evaluation, identifying problems and opportunities</td>
</tr>
<tr>
<td>Application</td>
<td>Diversified Areas where Managerial Decisions are made</td>
<td>Production control, sales forecasts, financial analysis, human resource management</td>
<td></td>
</tr>
<tr>
<td>Database(s)</td>
<td>Special</td>
<td>Corporate</td>
<td>Special</td>
</tr>
<tr>
<td>Decision</td>
<td>Supports semi-structured and Direct or indirect support, mainly</td>
<td>Special support, mainly high level</td>
<td></td>
</tr>
</tbody>
</table>

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Decision Support Systems (DSS)

Decision Support Systems (DSS) are a class of computerized information system that support decision-making activities. DSS are interactive computer-based systems and subsystems intended to help decision makers use communications technologies, data, documents, knowledge and/or models to complete decision process tasks.

A decision support system may present information graphically and may include an expert system or computer languages and simulation, capabilities, modelling science models.

There are a number of Decision Support Systems. These can be categorized into five types:

- **Communication-driven DSS**: Most communications-driven DSSs are targeted at internal teams, including partners. Its purpose is to help conduct a meeting, or for users to collaborate. The most common technology used to deploy the DSS is a web or client server. Examples: chats and instant messaging softwares, online collaboration and net-meeting systems.

- **Data-driven DSS**: Most data-driven DSSs are targeted at managers, staff and also product/service suppliers. It is used to query a database or data warehouse to seek specific answers for specific purposes. It is deployed via a main frame system, client/server link, or via the web. Examples: computer-based databases that have a query system to check (including the incorporation of data to add value to existing databases).

- **Document-driven DSS**: Document-driven DSSs are more common, targeted at a broad base of user groups. The purpose of such a DSS is to search web pages and find documents on a specific set of keywords or search terms. The usual technology used to set up such DSSs are via the web or a client/server system. Examples:
  - **Knowledge-driven DSS**: Knowledge-driven DSSs or ‘knowledgebase’ are they are known, are a catch-all category covering a broad range of systems covering users within the organization setting it up, but may also include others interacting with the organization - for example, consumers of a business. It is essentially used to provide management advice or to choose products/services. The typical deployment technology used to set up such systems could be client/server systems, the web, or software running on stand-alone PCs.
  - **Model-driven DSS**: Model-driven DSSs are complex systems that help analyse decisions or choose between different options. These are used by managers and staff members of a business, or people who interact with the organization, for a number of purposes depending on how the model is set up - scheduling, decision analyses etc. These DSSs can be deployed via software/hardware in stand-alone PCs, client/server systems, or the web.
**Phases of decision-making**

**The Decision Making Models**

1. **The Classical Model**
   On confrontation of a manager with a certain decision making situation, the manager would collect all the critical information and the data that is required for performing a particular activity and also would take the decision that will certainly be for the betterment of the organization.

2. **The Administrative Model**
   a. In such a model, the manager has more concern for himself.
   b. On confrontation of a manager with a certain decision making situation, the manager would collect what ever information or the data that will be available and then will take a decision, which may not be in the best interests of the organization but will certainly be good for fulfilling his personal interests.
   c. Expediency and the opportunism, both act as the hallmarks of the Administrative Model.

3. **The Herbert Simon Model**
   a. This model is linked with the decision making process.
   b. Explains the core of the decision making.
   c. Used as the base for explaining the decision making process.
   d. According the Herbert Simon Model, the process of the decision making consists of the following phases —

   **A. The Intelligence Phase** — In this phase, the various activities for finding out the problems related to the searching of the operating environment are involved. By this, the identification of the various conditions can be done which ultimately helps in taking the decisions at the different levels. Extensive and the comprehensive database is must for the Intelligence phase, making this phase very suitable for searching or scanning of the environment.

   In this phase, the type of the environment forms a very major factor and hence the types of the environment can be categorized as the follows —
   - I. The Societal Environment — Mainly includes the economic, the legal and the social environment and it is this type of the environment in which the organization operates.
   - II. The Competitive Environment: — Includes the understanding and the analyzing of the characteristics, the trends and the behavior of or at the market place and also the various players of the market in which the organization operates.
   - III. The Organizational Environment — Includes the various capabilities, the strengths, the weaknesses, the constraints and the various other factors that affect the ability of the organization to discharge or operate its various types of the activities.

   **B. The Design Phase** — The inventing, the developing and the analyzing of the various alternatives or the solutions to the particular problem forms a major part of this phase. The various steps that are to be followed in this phase can be summarized as the follows —
   1. Support in getting the in depth knowledge of the problem.
   2. A correct model of the situation can be made and the assumptions of the model need to be tested.
   3. Support for the generation of the solutions can be obtained by —
      - I. Manipulation of the model for the development of the insights.
      - II. Creation of the database retrieval system.
   4. Support for testing the feasibility of the solutions.

   **C. The Choice Phase** — The selection of a specific alternative or the course of the action from the ones which have been generated and considered during the design phase, takes place during this phase. The choice procedure and the implementation of the chosen alternative form a very major part of the Choice phase.

   The flow of the activities takes place from the intelligence phase to the design phase and then finally to the choice phase. But one very important point that must be remembered here is that at any phase there may be a return to a previous phase.

   **Limitations of the Simon Model**
   1. This model does not go further than the choice model.
   2. Does not include the cognizance of the implementation and also of the feedback aspects.

   **How does Simon’s Model correspond to the Scientific Method and to the Systems Development Life Cycle (SDLC)?**

<table>
<thead>
<tr>
<th>SIMON’S MODEL</th>
<th>SCIENTIFIC APPROACH</th>
<th>SDLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence</td>
<td>Define Problem</td>
<td>System Investigation</td>
</tr>
<tr>
<td>Design</td>
<td>Develop Alternatives</td>
<td>System Analysis</td>
</tr>
<tr>
<td>Choice</td>
<td>Select Solution / Design Solution</td>
<td>System Design</td>
</tr>
<tr>
<td>Implementation</td>
<td>Implement Solution</td>
<td>Implementation</td>
</tr>
<tr>
<td>Review</td>
<td></td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Human Nature: From Holistic to Dichotomous Model and Back**

For centuries, the dichotomous model of human nature has been unanimously accepted in the European Christian world. The Greek word "διχοτόμος" (dichotomíōs) means partition, bisection, and bifurcation. In logic, dichotomy means division of the whole into parts that absolutely cannot overlap. Similarly, the human nature has been seen as a composition of two absolutely different entities: the Soul and the Body. The Soul has been considered as an eternal and Divine creature. The body has been seen as a transient and material substance, created from the “dust of the earth” and returning to be the dust after termination of co-habitation with the Soul. An artistic representation of this model illustrated the Body as a horse, and the Soul-as a rider.
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Rider and horse as an illustration for the dichotomous human nature. It seems to me that this model was invented by somebody that has little experience with horses. Good jockey simply cannot see herself and her horse in any other way than One Whole.

This model certainly contributed to the development of humanism and human right concepts. Human beings, as the owners of Divine soul (regardless their social status), demanded to be treated accordingly. However, this model diminished the development of psychopharmacology. According to the dichotomous model, only the bodily discomfort can be treated by a chemical intervention. The pain of the soul can only be relieved by praying or spiritual consulting. However, despite all philosophical concepts, human beings still tried to obtain relief from mental pain by absolutely earthly means, such as alcohol.

Paradoxically, the holistic position on the human nature, invented in the Ancient Greece and inherited and developed classical Roman the medieval Muslim scholars, was much closer to the contemporary neuropharmacology than the early modern Europe. Hippocrates, at c. 400 BC, suggested that our mind is actually a puzzle created by four cross-interacting humors, coming from our body.

Hippocrates. Introduces pretty accurate psychopharmacological model 2,500 years ago.

Blood, originated from the Liver, corresponds to the positive energy, motivation, pleasure, reward, and social activity. The Yellow Bile, coming from the Gall Bladder, corresponds to the anger and aggression. The Black Bile, produced by spleen, mediate sadness and melancholia.

Finally, the Phlegm, synthetized in the lungs, is responsible to our intellect and reasoning.

Hippocrates’s humorism. The liver is over-represented.

The Gerek-Roman physical Galen introduced the concept of the human personality, which is well accepted in psychology, psychiatry and neuroscience till today.

Galen

Galen explained different personalities of humans by different composition of Hypocrite’s humors. Lively, sociable, carefree Sanguine temperament is a result of over-influence of the liver and its product, the Blood. Impulsive and frequently aggressive Choleric people are over-controlled by their Yellow File. Thoughtful, reasonable, and calm Phlegmatic people live under the Phlegm influence. Introvert, anxious, and low-self-esteem Melancholic individuals have nobody or nothing to blame but their spleen over-producing the Black Bile.

... and his our temperaments

One further step (small for man and big for mankind) was done by polymath from medieval Khwarezm, Abu Ali Ibn Sina, known in the West as Avicenna.

Ibn Sina. Idea introduced in the Middle Age Khwarezm still accepted in DSM-V

Ibn Sina distinguished between the different-within the normal boundaries-compositions of Four Humors, which correspond to different temperaments or personalities, and non-proportional outburst of one of these Humors, which results in the disease, mental or physical. This strong distinguishing between different types of personality, from one side, and various mental disorders, from the other side, is still the ABC of psychology and psychiatry.

And back to the four humors. Paradoxically, but the modern neuroscience and neuropsychopharmacology are more or less based on the same model, with few updates. The humors are actually coming from the brain and not from other body organs (their precursors, however, are coming from the body). They are more than four humors (but not that much more). These humors are now called neurotransmitters. Here are the figures from the "Essential Psychopharmacology" of Stahl, a popular textbook for the Contemporary Medical Schools:

The figure explains the role of three brain neurotransmitters, serotonin, dopamine, and norepinephrine, in the regulation of our emotions and behavior. Is not it actually reminds the schemas or Hippocrates, Galen, and Ibn Sina?

Trans dichotomous model

In computational complexity theory, and more specifically in the analysis of algorithms with integer data, the trans dichotomous model is a variation of the random access machine in which the machine word size is assumed to match the problem size. The model was proposed by Michael Fredman and Dan Willard, who chose its name "because the dichotomy between the machine model and the problem size is crossed in a reasonable manner."

In a problem such as integer sorting in which there are n integers to be sorted, the trans dichotomous model assumes that each integer may be stored in a single word of computer memory, that operations on single words take constant time per operation, and that the number of bits that can be stored in a single word is at least \(\log_2 n\). The goal of complexity analysis in this model is to find time bounds that depend only on \(n\) and not on the actual size of the input values or the machine words. In modeling integer computation, it is necessary to assume that machine words are limited in size, because models with unlimited precision are unreasonably powerful (able to solve PSPACE-complete problems in polynomial time). The trans-dichotomous model makes a minimal assumption of this type: that there is some limit, and that the limit is large enough to allow random access indexing into the input data.

As well as its application to integer sorting, the trans dichotomous model has also been applied to the design of priority queues and to problems in computational geometry and graph algorithms.

Simon’s Model of Decision-Making
Herbert Simon made key contributions to enhance our understanding of the decision-making process. In fact, he pioneered the field of decision support systems. According to (Simon 1960) and his later work with (Newell 1972), decision-making is a process with distinct stages. He suggested for the first time the decision-making model of human beings. His model of decision-making has three stages:

1. Intelligence which deals with the problem identification and the data collection on the problem.
2. Design which deals with the generation of alternative solutions to the problem at hand.
3. Choice which is selecting the 'best' solution from amongst the alternative solutions using some criterion.

The figure given below depicts Simon's decision-making model clearly.

**Intelligence Phase:**
This is the first step towards the decision-making process. In this step the decision-maker identifies/detects the problem or opportunity. A problem in the managerial context is detecting anything that is not according to the plan, rule or standard. An example of problem is the detection of sudden very high attrition for the present month by a HR manager among workers. Opportunity seeking on the other hand is the identification of a promising circumstance that might lead to better results. An example of identification of opportunity is a marketing manager gets to know that two of his competitors will shut down operations (demand being constant) for some reason in the next three months, this means that he will be able to sell more in the market.

Thus, we see that either in the case of a problem or for the purpose of opportunity seeking the decision-making process is initiated and the first stage is the clear understanding of the stimulus that triggers this process. So if a problem/opportunity triggers this process then the first stage deals with the complete understanding of the problem/opportunity. Intelligence phase of decision-making process involves:

- **Problem Searching**
- **Problem Formulation**

**Problem Searching:** For searching the problem, the reality or actual is compared to some standards. Differences are measured & the differences are evaluated to determine whether there is any problem or not.

**Problem Formulation:** When the problem is identified, there is always a risk of solving the wrong problem. In problem formulation, establishing relations with some problem solved earlier or an analogy proves quite useful.

**Design Phase:**
Design is the process of designing solution outlines for the problem. Alternative solutions are designed to solve the same problem. Each alternative solution is evaluated after gathering data about the solution. The evaluation is done on the basis of criteria to identify the positive and negative aspects of each solution. Quantitative tools and models are used to arrive at these solutions. At this stage the solutions are only outlines of actual solutions and are meant for analysis of their suitability alone. A lot of creativity and innovation is required to design solutions.

**Choice Phase:**
It is the stage in which the possible solutions are compared against one another to find out the most suitable solution. The 'best' solution may be identified using quantitative tools like decision tree analysis or qualitative tools like the six thinking hats technique, force field analysis, etc.

This is not as easy as it sounds because each solution presents a scenario and the problem itself may have multiple objectives making the choice process a very difficult one. Also uncertainty about the outcomes and scenarios make the choice of a single solution difficult.

**Cognitive/Learning Styles**
Cognitive styles refer to the preferred way an individual processes information. Unlike individual differences in abilities which describe peak performance, styles describe a person's typical mode of thinking, remembering or problem solving. Furthermore, styles are usually considered to be bipolar dimensions whereas abilities are unipolar (ranging from zero to a maximum value). Having more of ability is usually considered beneficial while having a particular cognitive style simply denotes a tendency to behave in a certain manner. Cognitive style is a usually described as a personality dimension which influences attitudes, values, and social interaction.

A number of cognitive styles have been identified and studied over the years. Field independence versus field dependence is probably the most well-known style. It refers to a tendency to approach the environment in an analytical, as opposed to global, fashion. At a perceptual level, field independent personalities are able to distinguish figures as discrete from their backgrounds compared to field dependent individuals who experience events in an undifferentiated way. In addition, field dependent individuals have a greater social orientation relative to field independent personalities. Studies have identified a number connections between this cognitive style and learning (see Messick, 1978). For example, field independent individuals are likely to learn more effectively under conditions of intrinsic motivation (e.g., self-study) and are influenced less by social reinforcement.

Other cognitive styles that have been identified include:

- **scanning** - differences in the extent and intensity of attention resulting in variations in the vividness of experience and the span of awareness
- **leveling versus sharpening** - individual variations in remembering that pertain to the distinctiveness of memories and the tendency to merge similar events
- **reflection versus impulsivity** - individual consistencies in the speed and adequacy with which alternative hypotheses are formed and responses made
- **conceptual differentiation** - differences in the tendency to categorize perceived similarities among stimuli in terms of separate concepts or dimensions

Learning styles specifically deal with characteristic styles of learning. Kolb (1984) proposes a theory of experiential learning that involves four principal stages: concrete experiences (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). The CE/AC and AE/RO dimensions are polar opposites as far as learning styles are concerned and Kolb postulates four types of learners (divergers, assimilators, convergers, and accommodators) depending upon their position on these two dimensions. For example, an accommodator prefers concrete experiences and active experimentation (AE, CE).

Pask has described a learning style called serialist versus holist. Serialists prefer to learn in a sequential fashion, whereas holists prefer to learn in a hierarchial manner (i.e., top-down).

Theoretically, cognitive and learning styles could be used to predict what kind of instructional strategies or methods would be most effective for a given individual and learning task. Research to date on this problem has not identified many robust relationships. However,
The expert systems are capable of diagnosing a problem, deriving a solution, interpreting input, predicting results, and suggesting alternative options to a problem. The components of ES include knowledge base, inference engine, and user interface. The knowledge base contains domain-specific and high-quality knowledge. Knowledge is required to exhibit intelligence. The success of any ES majorly depends upon the collection of highly accurate and precise knowledge.

**Artificial Intelligence - Expert Systems**

Expert systems (ES) are one of the prominent research domains of AI. It is introduced by the researchers at Stanford University, Computer Science Department.

**What are Expert Systems?**

The expert systems are the computer applications developed to solve complex problems in a particular domain, at the level of extraordinary human intelligence and expertise.

**Characteristics of Expert Systems**

- High performance
- Understandable
- Reliable
- Highly responsive
- Advising
- Demonstrating
- Explaining
- Producing accurate output for inadequate knowledge base
- Instructing and assisting human in decision making
- Deriving a solution
- Interpreting input
- Refining their own knowledge
- Diagnosing
- Predicting results
- Justifying the conclusion
- User Interface

**Inference Engine**

**Knowledge Engineer**

**User Interface**

**Components of Expert Systems**

- Knowledge Base
- Inference Engine
- User Interface

**A. Knowledge Base**

It contains domain-specific and high-quality knowledge. Knowledge is required to exhibit intelligence. The success of any ES majorly depends upon the collection of highly accurate and precise knowledge.

**What is Knowledge?**
Components of Knowledge Base
The knowledge base of an ES is a store of both, factual and heuristic knowledge.
- **Factual Knowledge** – It is the information widely accepted by the Knowledge Engineers and scholars in the task domain.
- **Heuristic Knowledge** – It is about practice, accurate judgement, one’s ability of evaluation, and guessing.

Knowledge representation It is the method used to organize and formalize the knowledge in the knowledge base. It is in the form of IF-THEN-ELSE rules.

Knowledge Acquisition The success of any expert system majorly depends on the quality, completeness, and accuracy of the information stored in the knowledge base.

The knowledge base is formed by readings from various experts, scholars, and the Knowledge Engineers. The knowledge engineer is a person with the qualities of empathy, quick learning, and case analyzing skills.

He acquires information from subject expert by recording, interviewing, and observing him at work, etc. He then categorizes and organizes the information in a meaningful way, in the form of IF-THEN-ELSE rules, to be used by interference machine. The knowledge engineer also monitors the development of the ES.

B. Inference Engine
Use of efficient procedures and rules by the Inference Engine is essential in deducting a correct, flawless solution.

In case of knowledge-based ES, the Inference Engine acquires and manipulates the knowledge from the knowledge base to arrive at a particular solution. In case of rule based ES, it –
- Applies rules repeatedly to the facts, which are obtained from earlier rule application.
- Adds new knowledge into the knowledge base if required.
- Resolves rules conflict when multiple rules are applicable to a particular case.

To recommend a solution, the Inference Engine uses the following strategies –
- **Forward Chaining**
- **Backward Chaining**

**Forward Chaining** It is a strategy of an expert system to answer the question, “What can happen next?”

Here, the Inference Engine follows the chain of conditions and derivations and finally deduces the outcome. It considers all the facts and rules, and sorts them before concluding to a solution.

This strategy is followed for working on conclusion, result, or effect. For example, prediction of share market status as an effect of changes in interest rates.

**Backward Chaining** With this strategy, an expert system finds out the answer to the question, “Why this happened?”

On the basis of what has already happened, the Inference Engine tries to find out which conditions could have happened in the past for this result. This strategy is followed for finding out cause or reason. For example, diagnosis of blood cancer in humans.

C. User Interface
User interface provides interaction between user of the ES and the ES itself. It is generally Natural Language Processing so as to be used by the user who is well-versed in the task domain. The user of the ES need not be necessarily an expert in Artificial Intelligence.

It explains how the ES has arrived at a particular recommendation. The explanation may appear in the following forms –
- Natural language displayed on screen.
- Verbal narrations in natural language.
- Listing of rule numbers displayed on the screen.

The user interface makes it easy to trace the credibility of the deductions.

Requirements of Efficient ES User Interface
- It should help users to accomplish their goals in shortest possible way.
- It should be designed to work for user’s existing or desired work practices.
- Its technology should be adaptable to user’s requirements; not the other way round.
- It should make efficient use of user input.

**Expert Systems Limitations**
1) No technology can offer easy and complete solution. 2) Large systems are costly, 3) require significant development time, and computer resources. 4) ESs have their limitations which include –
- Limitations of the technology
- Difficult knowledge acquisition
- ES are difficult to maintain
- High development costs

**Applications of Expert System**
The following table shows where ES can be applied.

<table>
<thead>
<tr>
<th>Application</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Domain</td>
<td>Camera lens design, automobile design.</td>
</tr>
<tr>
<td>Medical Domain</td>
<td>Diagnosis Systems to deduce cause of disease from observed data, conduction</td>
</tr>
<tr>
<td></td>
<td>medical operations on humans.</td>
</tr>
<tr>
<td>Monitoring Systems</td>
<td>Comparing data continuously with observed system or with prescribed behavior</td>
</tr>
<tr>
<td></td>
<td>such as leakage monitoring in long petroleum pipeline.</td>
</tr>
<tr>
<td>Process Control Systems</td>
<td>Controlling a physical process based on monitoring.</td>
</tr>
<tr>
<td>Knowledge Domain</td>
<td>Finding out faults in vehicles, computers.</td>
</tr>
<tr>
<td>Finance/Commerce</td>
<td>Detection of possible fraud, suspicious transactions, stock market trading,</td>
</tr>
<tr>
<td></td>
<td>Airline scheduling, cargo scheduling.</td>
</tr>
</tbody>
</table>

**Expert System Technology**
There are several levels of ES technologies available. Expert systems technologies include –

- **Expert System Development Environment** – The ES development environment includes hardware and tools. They are –
  - Workstations, minicomputers, mainframes.
  - High level Symbolic Programming Languages such as LISP (LISt Programming) and PROgrammation en LOGique (PROLOG).
  - Large databases.
- **Tools** – They reduce the effort and cost involved in developing an expert system to large extent.
  - Powerful editors and debugging tools with multi-windows.
  - They provide rapid prototyping.
Shells – A shell is nothing but an expert system without knowledge base. A shell provides the developers with knowledge acquisition, inference engine, user interface, and explanation facility. For example, few shells are given below –
  o Java Expert System Shell (JESS) that provides fully developed Java API for creating an expert system.
  o Vidwan, a shell developed at the National Centre for Software Technology, Mumbai in 1993. It enables knowledge encoding in the form of IF-THEN rules.

**Development of Expert Systems: General Steps**

The process of ES development is iterative. Steps in developing the ES include –

**Identify Problem Domain**
- The problem must be suitable for an expert system to solve it.
- Find the experts in task domain for the ES project.
- Establish cost-effectiveness of the system.

**Design the System**
- Identify the ES Technology
- Know and establish the degree of integration with the other systems and databases.
- Realize how the concepts can represent the domain knowledge best.

**Develop the Prototype From Knowledge Base**
- The knowledge engineer works to –
  - Acquire domain knowledge from the expert.
  - Represent it in the form of IF-THEN-ELSE rules.

**Test and Refine the Prototype**
- The knowledge engineer uses sample cases to test the prototype for any deficiencies in performance.
- End users test the prototypes of the ES.

**Develop and Complete the ES**
- Test and ensure the interaction of the ES with all elements of its environment, including end users, databases, and other information systems.
- Document the ES project well.
- Train the user to use ES.

**Maintain the ES**
- Keep the knowledge base up-to-date by regular review and update.
- Cater for new interfaces with other information systems, as those systems evolve.

**Benefits of Expert Systems**
- Availability – They are easily available due to mass production of software.
- Less Production Cost – Production cost is reasonable. This makes them affordable.
- Speed – They offer great speed. They reduce the amount of work an individual puts in.
- Less Error Rate – Error rate is low as compared to human errors.
- Reducing Risk – They can work in the environment dangerous to humans.
- Steady response – They work steadily without getting motional, tensed or fatigued.