INTRODUCTION TO INFORMATION SYSTEMS ANALYSIS & DESIGN

What is an information system?

There are more than a hundred definitions of the word system, but most seem to have a common thread that suggests that a system is an orderly grouping of interdependent components linked together according to a plan to achieve a specific objective. The word component may refer to physical parts (engines, wings of aircraft, car), managerial steps (planning, organizing and controlling), or a system in a multi-level structure. The component may be simple or complex, basic or advanced. They may be single computer with a keyboard, memory, and printer or a series of intelligent terminals linked to a mainframe. In either case, each component is part of the total system and has to do its share of work for the system to achieve the intended goal. This orientation requires an orderly grouping of the components for the design of a successful system. The study of systems concepts, then, has three basic implications:

1. A system must be designed to achieve a predetermined objective.

2. Interrelationships and interdependence must exist among the components.

3. The objectives of the organization as a whole have a higher priority than the objectives of its subsystems. For example, computerizing personnel applications must conform to the organization's policy on privacy, confidentiality and security, as will as making selected data (e.g. payroll) available to the accounting division on request.

In business, System Analysis and Design refers to the process of examining a business situation with the intent of improving it through better procedures and methods. System analysis and design relates to shaping organizations, improving performance and achieving objectives for profitability and growth. The emphasis is on systems in action, the relationships among subsystems and their contribution to meeting a common goal.

Over View of System Analysis and Design

Systems development can generally be thought of as having two major components: **Systems analysis** and **Systems design**.

System design is the process of planning a new business system or one to replace or complement an existing system. But before this planning can be done, we must

thoroughly understand the old system and determine how computers can best be used to make its operation more effective.

System analysis, then, is the process of gathering and interpreting facts, diagnosing problems, and using the information to recommend improvements to the system. This is the job of the systems analyst.

Characteristics of a System

Our definition of a system suggests some characteristics that are present in all systems: organization (order), interaction, interdependence, integration and a central objective.

i. Organization

Organization implies structure and order. It is the arrangement of components that helps to achieve objectives. In the design of a business system, for example, the hierarchical relationships starting with the president on top and leading downward to the blue – collar workers represents the organization structure. Such an arrangement portrays a system – subsystem relationship, defines the authority structure, specifies the formal flow of communication and formalizes the chain of command. Like – wise, a computer system is designed around an input device, a central processing unit, an output device and one or more storage units. When linked together they work as a whole system for producing information.

ii. Interaction

Interaction refers to the manner in which each component functions with other components of the system. In an organization, for example, purchasing must interact with production, advertising with sales and payroll with personnel. In a computer system, the central processing unit must interact with the input device to solve a problem. In turn, the main memory holds programs and data that the arithmetic unit uses for computation. The interrelationship between these components enables the computer to perform.

iii. Interdependence

Interdependence means that parts of the organization or computer system depend on one another. They are coordinated and linked together according

to a plan. One subsystem depends on the input of another subsystem for proper functioning: that is, the output of one subsystem is the required input for another subsystem. This interdependence is crucial in systems work.

An integrated information system is designed to serve the needs of authorized users (department heads, managers, etc.) for quick access and retrieval via remote terminals. The interdependence between the personnel subsystem and the organization's users is obvious.

In summary, no subsystem can function in isolation because it is dependent on the data (inputs) it receives from other subsystems to perform its required tasks. Interdependence is further illustrated by the activities and support of systems analysts, programmers, and the operations staff in a computer centre. A decision to computerize an application is initiated by the user, analyzed and designed by the analyst, programmed and tested by the programmer, and run by the computer operator. None of these persons can perform property without the required input from others in the computer center subsystem.

iv. Integration

Integration refers to the holism of systems. Synthesis follows analysis to achieve the central objective of the organization. Integration is concerned with how a system is tied together. It is more than sharing a physical part or location. It means that parts of the system work together within the system even though each part performs a unique function. Successful integration will typically produce a synergistic effect and greater total impact than if each component works separately.

v. Central objective

The last characteristic of a system is its central objective. Objectives may be real or stated. Although a stated objective may be the real objective, it is not uncommon for an organization to state one objective and operate to achieve another. The important point is that users must know the central objective of a computer application early in the analysis for a successful design and conversion. Political as well as organizational considerations often cloud the real objective.

This means that the analyst must work around such obstacles to identify the real objective of the proposed change.

Elements of a System

In most cases, systems analysts operate in a dynamic environment where change is a way of life. The environment may be a business firm, a business application, or a computer system. To reconstruct a system, the following key elements must be considered:

1. Outputs and inputs.
2. Processor(s).
3. Control.
4. Feedback.
5. Environment.
6. Boundaries and interface.

Types of systems

The frame of reference within which one views a system is related to the use of the systems approach for analysis. Systems have been classified in different ways. Common classifications are: (1) physical or abstract, (2) open or closed, and (3) "man –made" information systems.

i. Physical or abstract systems

Physical systems are tangible entities that may be static or dynamic in operation. For example, the physical parts of the computer center are the officers, desks, and chairs that facilitate operation of the computer. They can be seen and counted; they are static. In contrast, a programmed computer is a dynamic system. Data, programs, output, and applications change as the user's demands or the priority of the information requested changes.

Abstract systems are conceptual or non-physical entities. They may be as straightforward as formulas of relationships among sets of variables or models – the abstract conceptualization of physical situations. A model is a representation of a real or a planned system. The use of models makes it easier for the analyst to visualize relationships in the system under study. The objective is to point out the significant elements and the key interrelationships of a complex system.

ii. Open or Closed Systems

Another classification of systems is based on their degree of independence. An open system has many interfaces with its environment. It permits interaction across its boundary; it receives inputs from and delivers outputs to the outside. An information system falls into this category, since it must adapt to the changing demands of the user. In contrast, a closed system is isolated from environmental influences. In reality, a completely closed system is rare. In systems analysis, organizations, applications and computers are invariably open, dynamic systems influenced by their environment.

A focus on the characteristics of an open system is particularly timely in the light of present – day business concerns with computer fraud, invasion of privacy, security controls, and ethics in computing. Whereas the technical aspects of systems analysis deal with internal routines within the user's application area, systems analysis as an open system tends to expand the scope of analysis to relationships between the user area and other users and to environmental factor that must be considered before a new system is finally approved. Furthermore, being open to suggestions implies that the analyst has to be flexible and the system being designed has to be responsive to the changing needs of the user and the environment.

Five important characteristics of open systems can be identified.

1. **Input from outside**: Open systems are self – adjusting and self-regulating. When functioning properly, an open system reaches a steady state or equilibrium. In a retail firm, for example, a steady state exists when goods are purchased and sold without being either out of stock or overstocked. An increase in the cost of goods forces a comparable increase in prices or decrease in operating costs. This response gives the firm its steady state.

2. **Entropy**: All dynamic systems tend to run down over time, resulting in entropy or loss of energy. Open systems resist entropy by seeking new inputs or modifying the processes to return to a steady state. In our example, no reaction to increase in cost of merchandise makes the business unprofitable which could force it into insolvency – a state of disorganization.

3. **Process, output and cycles**: Open systems produce useful output and operate in cycles, following a continuous flow path.

4. **Differentiation**: Open systems have a tendency toward an increasing specialization of functions and a greater differentiation of their components. In business, the roles of people and machines tend toward greater specialization and greater interaction. This characteristic offers a compelling reason for the increasing value of the concept of systems in the systems analyst's thinking.

5. **Equifinality**: The term implies that goals are achieved through differing courses of action and a variety of paths. In most systems, there is more of a consensus on goals than on paths to reach the goals.

iii. Man – Made Information Systems

Ideally, information reduces uncertainty about a state or event. For example, information that the wind is calm reduces the uncertainty that the boat trip will be pleasant. An information system is the basis for interaction between the user and the analyst. It provides instruction, commands and feedback. It determines the nature of the relationships among decision-makers. In fact, it may be viewed as a decision center for personnel at all levels. From this basis, an information system may be defined as a set of devices, procedures and operating systems designed around user based criteria to produce information and communicate it to the user for planning, control and performance. In systems analysis, it is important to keep in mind that considering an alternative system means improving one or more of these criteria.

A business has several information systems; each is designed for a purpose and works to accommodate data flow, communications, decision making, control and effectiveness. The major information systems are formal, informal and computer based.

a. Formal Information system

A formal information system is based on the organization represented by the organization chart. The chart is a map of positions and their authority relationships, indicated by boxes and connected by straight lines. It is concerned with the pattern of authority, communication and workflow. Information is formally disseminated in instructions, memos, or reports from top management to the intended user in the organization. This structure also allows feedback up the chain of command for follow –up.

b. Informal Information Systems

The formal information system is a power structure designed to achieve company goals. An organization's emphasis on control to ensure performance tends to restrict the communication flow among employees. As a result, an informal information system develops. It is an employee based system designed to meet personnel and vocational needs and to help solve work – related problems. It also funnels information upward through indirect channels. In this respect, it is a useful system because it works within the framework of the business and its stated policies.

In doing a systems study, the analyst should have a knowledge of the chain of command, the power-authority-influence network, and how decisions are made to get a feel for how much support can be expected for a prospective installation. Furthermore, knowledge about the inner workings of the employee- based system is useful during the exploratory phase of analysis. Employee cooperation and participation are crucial in preventing sabotage and training users. Since computers cannot provide reliable information without user staff support, a proper interface with the informal communication channels could mean the difference between the success and failure of new systems.

c. Computer – Based Information Systems

A third class of information system relies on the computer for handling business applications. The computer is now a required source of information. Systems analysis relies heavily on computers for problem solving. This suggests that the analyst must be familiar with computer technology and have experience in handling people in an organizational context.

i. Management Information Systems (MIS)

The computer has had a significant impact on the techniques used by management to operate a business. The level of the manager in the organization is also a factor in determining the kind of information needed to solve a problem. Lower – level management needs detailed internal information to make day – to – day, relatively structured control decisions. Higher – level management, for whom long – range objectives are the primary concerns, requires summarized information from a variety of sources to attain goals. In either case, management action is based on information that is accurate, relevant, complete, concise, and timely. MIS has been successful in meeting these information criteria quickly and responsively.

MIS is a person – machine system and a highly integrated grouping of information – processing functions designed to provide management with a comprehensive picture of specific operations. It is actually a combination of information systems. To do the job, it should operate in real time, handling inquires as quickly as they are received. Management information must also be available early enough to affect a decision. Operationally, MIS should provide for file definition, file maintenance and updating, transaction and inquiry processing and one or more databases linked to an organizational database. Within a MIS, a single transaction can simultaneously update all related data files in the system. In so doing, data redundancy (duplication) and the time it takes to duplicate data are kept to a minimum, thus insuring that data are kept current at all times.

A key element of MIS is the *database* – a non-redundant collection of interrelated data items that can be processed through application programs and available to many users. All records must be related in some way. Sharing common data means that many programs can use the same files or records. Information is accessed through a data base management system (DBMS). It is a part of the software that handles virtually every activity involving the physical database.

The primary users of MIS are middle and top management, operational managers and support staff. Middle and top management use MIS for preparing forecasts, special requests for analysis, long – range plans and periodic reports. Operational managers use MIS primarily for short- range planning, periodic and exception reports. The support staff finds MIS useful for the special analysis of information and reports to help management in planning and control. Providing data for use in MIS is the function of most levels of personnel in the organization. Once entered into the system, the information is no longer owned by the initiating user but becomes available to all authorized users.

Today's typical MIS poses several problems. Most MIS reports are historical and tend to be dated. Another problem is that many installations have databases that are not in line with user requirements. This means that many MIS environments have not been congruent with the real world of the user. Finally, an inadequate or incomplete update of the database jeopardizes the reliability for all users.

A major problem encountered in MIS design is obtaining the acceptance and support of those who will interface with the system. Personnel who perceive that their jobs are threatened may resist the implementation of MIS. In understanding both technology and human

behavior, the analyst faces the challenge of selling change to the right people for a successful installation.

ii. Decision Support Systems (DSS)

One reason cited in the literature of management's frustration with MIS is the limited support it provides top management for decision making. DSS advances the capabilities of MIS. It assists management in making decisions. It is actually a continually evolving model that relies heavily on operations research.

Gorry and Morton Coined the term decision support system (DSS). The origin of the term is simple:

- Decision – emphasizes decision making in problem situations, not information processing, retrieval, or reporting.
- Support – requires computer-aided decision situations with enough "structure" to permit computer support.
- System – accentuates the integrated nature of problem solving, suggesting a combined "man", machine, and decision environment.

Categories of Information

There are three categories of information related to managerial levels and the decision managers make. The first level is strategic information, which relates to long –range planning policies that are of direct interest to upper management. Information such as population growth, trends in financial investment and human resources changes would be of interest to top company officials who are responsible for developing policies and determining long-range goals. This type of information is achieved with the aid of Decision Support System (DSS).

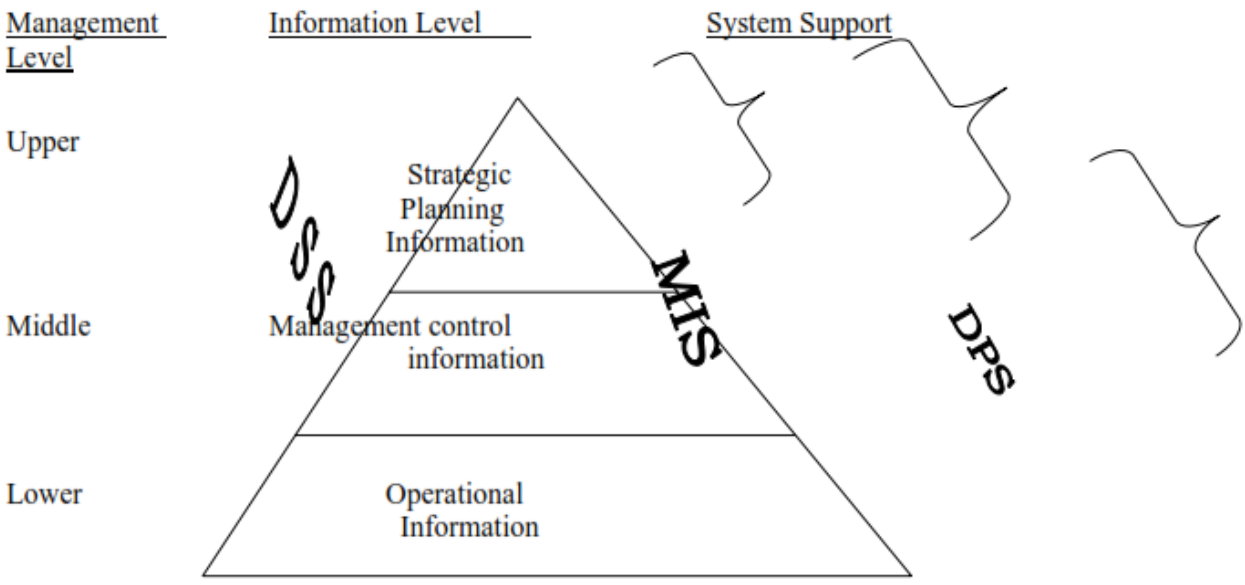
The second level of information is managerial information. It is of direct use to middle management and department heads for implementation and control. Examples are sales analysis, cash flow projection and annual financial statements. This information is of use in short – and intermediate -range planning – that is months rather than years. It is maintained with the aid of management information systems (MIS).

The third information level is operational information, which is short-term, daily information used to operate departments and enforce the day-to-day rules and regulations of the business. Examples are daily employee absent sheets, overdue purchase orders and current

stocks available. Operational information is established by data processing systems (DPS). Figure 1 shows the same.

The nature of the information and managerial levels is also related to the major types of decision making: structured and unstructured decision making. An organizational process that is closed, stable and mechanistic tends to be more structured, computational and relies on routine decision making for planning and control. Such decision making is related to lower-level management and is readily supported with computer systems. In contrast, open, adaptive, dynamic processes increase the uncertainty associated with decision making and are generally evidenced by a lack of structure in the decision – making process. Lack of structure as well as extra-organizational and incomplete information makes it difficult to secure computer support.

Figure 1 Management and information levels in a typical organization



Therefore, in designing an information system, the analyst needs to determine the type of information needed, the level of the information, how it is structured and in what format it is before deciding on the system needed to produce it. This is another reason for having a background in systems theory and organizations.

Summary:

A system is orderly grouping of interdependent components linked together according to a plan to achieve a specific objective. Its main characteristic are organization, interaction,

interdependence, integration and a central objective. To construct a system, system analyst must consider its elements- input and output, processors, control, feedback, and environment. System are classified as physical or abstract, open or closed, and man-made information systems. A system may be schematic, static or dynamic. An information system is an open system that allows inputs and facilitates interaction with the user. The main characteristic of an open system are input from outside, processing, output, operation in cycles through feedback, differentiation, and equifinality. Three level of information in organization that require a special type of information system. Strategic information system for long range planning policies and upper management. Managerial information system helps middle management and department heads in policy implementation and control. Operational information system helps the daily information needed to operate the business. Future emphasizes on the decision support system not on information processing, it requires a computer aided environment and accentuates a combined man and machine and decision environment.