UNIT 1 GENERAL SYSTEMS THEORY

Structure

1.0 OBJECTIVES

After studying this unit you will be able to:

- define an information system;
- identify the parts and types of an information system;
- understand the concept of general systems theory; conduct a systems study;
- know the main features of system analysis; and
- assess the role of a system analyst.

1.1 INTRODUCTION

In the past few decades, a new and dynamic activity has developed in organizations the design, operation and management of computer-based information systems. While many organizational activities and resources have been devoted to the acquisition and processing of information for a long time, the advent of the computer and its application in LIS activities have greatly extended the information processing capabilities. Computer-based information systems have thus influenced the organizations of all types and sizes.

System concepts are very abstract and, therefore, are not always appealing to many people. But understanding the systems can lead to the same benefits as understanding the mathematics of abstract business concepts. Thus, the system concept is more a philosophy while systems analysis is a methodology for viewing complex wholes at a manageable level of abstraction. It presents systems abstractly, using just enough detail to allow the analyst to identify and specify alternatives for the design and modification of a system.

The reason for studying its systems is to identity the various characteristics that may varry from one system to another. Many of their characteristics of the systems are similar, and the strategies for analysing and improving them, are, therefore, similar. Various concepts related to systems are referred to collectively as general systems theory.

In this unit, we examine the general systems theory and the related aspects that are applicable to the environment for information systems.

1.2 INFORMATION SYSTEMS

In the present day, Information systems are becoming crucial to the functioning of modern organizations and businesses. Organizations are using more and more information systems technology to gain competitive advantages over their rivals.

What is an information system ? An information system is a formalized structure, which can, form various sources, collect, store, process and report data and the information necessary for management in decision making and other purposes. Not all information systems and structures are formal, non do information systems have to be computer-based. Thus an information system is a set of organized procedures which, when executed, provides information to support decision making. Here, we define information as a tangible or intangible entity which serves to reduce uncertainty about some future state or event.

The basic functions of an information system reveal that the most important aspect is the user who interprets information. It is to be noted here that information is not just raw data. Rather, data are processed by selecting/collecting, organising including collating and summarizing to produce output which is interpreted as information by the user-decision maker.

Information systems have been there from the time people first inhabited in the earth. Early systems were quite rudimentary and subject to extensive distortion and delays. Individuals, organizations, and nations have always collected and processed information. Early information systems were highly informal, and involved the exchange

of news, stories and anecdotes with neighbours. As economies progressed beyond the subsistence level, information on the changing value of goods and services for barter and trade became important.

Formal organizations, from their inception, have required information systems to operate successfully. Production, accounting, financial and external data on consumers and markets are vital to the operations of most modern businesses.

Information systems existed long before the development of computers. However, the explosion of information and the need to process large amounts of data to extract small identical and of useful information and the capability of the computer have contributed to the importance and development of computer-based information systems. The organizations thus look for computer-based information systems to operate and process data and to effectively use the output after interpretation.

1.2.1 Components of an Information System

An information system has the following components:

Inputs
Processes
Data files
Outputs
Personnel, and
Hardware

All systems, including information systems and computer systems have inputs, processes and outputs. Processes transform inputs (data) into outputs (management information). Processes can be subdivided into computer programs and procedures. Computer programs are executed by the computer hardware, and the procedures are executed by people. For example, sometimes, data must be collected and checked manually before they are put into the information system. An information system also contains data files, which can be either computer-based or manual.

Personnel are the most important component of an information system. System analysts and programmers design, implement and maintain the programs and procedures, while computer operators run the computer-based portion of the system. Accounting, finance, marketing and manufacturing personnel performs other aspects of an information system, many times without the use of computer hardware. Besides the above, management personnel set the overall policies that govern the operation of an information system.

The core of an information is, thus, made up of inputs, processes, data files and outputs. These components are executed and controlled by hardware and personnel.

1.2.2 Types of Information Systems

Before computer applications came in a big way, information systems were classified as *data processing systems* and *management information systems* (MIS). *Data processing systems* were oriented towards capturing, processing and storing data, whereas MIS is oriented towards the generations of management information using the data. The *data processing system* performed transaction processing and was very much involved with collecting and storing of a large amount of detailed information. This information served as the database for the *management information system*.

With extensive use of computers and eventually, the development of computerised information systems, the term *data processing system* became out of date and was replaced with the term *transaction processing system*. Besides these two types of information systems, several new types of information systems started developing and began to be used widely. Let us study some of the important types of information systems.

Transaction Processing Systems

Transaction processing systems keep track of the daily activities of an organization. These systems collect and store data concerning various aspect of the activities of an organization, provide the information necessary for the day-to-day control of events, and serve as the database for higher-level information systems that may be used by managers and executives at the middle and upper levels of an organization.

Office Automation Systems

These systems use the computer to automate many of the routine tasks that are performed in a typical office. Besides word processing, other applications in the office include desktop publishing, electronic mail, facsimile transmission and image processing.

Executive Information Systems

Executive information systems provide for the communication of summary-level information to executives. The information in these systems are normally brief, meant exclusively for executives of the organization and updated frequently, usually on a daily basis. The systems also provide the capability to display more detailed information if an executive requires it. Many executives use these systems to keep track of pieces of information which are of importance to the organization.

Expert Systems

An expert system is a computer programme that enables a computer to take decisions which are usually made by humans with special expertise. These systems store facts and data that are necessary and are used to arrive at a judgment in a particular case.

Management Information Systems

The term management information system (MIS) applies to a system that provides information to the upper and middle level management about routine and other anticipated activities concerning an organization. MIS is in widespread use and form the backbone of information systems in business and industrial organizations. In many situations, all the other types of information systems-transaction processing, decision support, expert systems and other are parts of the MIS.

Database Management System

A database management system (DBMS) is a software application that stores the structure of the database, the data itself, relationships among data in the database, as well as forms and reports pertaining to the database. DBMS thus is a system that generates, runs and maintains databases, and as such the system must include all the software needed for the purpose. Stored with actual data is the description of a database, which enables the DBMS to retrieve information from the database, and to store new data in appropriate places in database, establishing relationships with other data if relevant. The DBMS in essence is data oriented with more importance on data modeling and data design.

A decision support system (DSS) is an integrated set of computer tools that allow a decision maker to interface directly with computers to create information which is useful in making semi-structured and unstructured decisions. MIS in the past has been most successful in providing information for routine, structured and anticipated types of decisions. Although MIS has succeeded in acquiring and storing large quantities of detailed data, it has been less successful in providing information for semi-structured or unstructured decisions, particularly when the computerised information system was designed. The basic idea underlying DSS is to provide a set of computer-based tools so that MIS can produce information to support semi-structured or unstructured decisions.

Self Check Exercise

1) What is an information system?

2) Enumerate the various components of an information system.

3) List the different types of information systems.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answer given at the end of this unit.

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1.3 GENERAL SYSTEMS THEORY

The area of systems analysis and design for information systems has its foundation in the general systems theory. The General Systems Theory emphasises the need to examine all parts of a system. Too often the analyst focuses only on one component of the system, and takes action which may sometimes lead to ineffectiveness of the system because some important components were ignored. In addition to focusing on all parts of a system, the General Systems Theory helps communications among specialist, in different fields. One field of study closely associated with The General Systems Theory is cybernetics, the field of communication and control in man-machine systems (including computer systems). Cybernetics represents a combination of the fields of physics, biology, electrical engineering, etc.

In the analysis and design of information systems, we have to apply also our knowledge from diverse fields. An information system involves people from different levels of an organization, computers, programs, procedures and, also, the personnel to operate the system. Fields like management, organizational behaviour, industrial engineering, computer science, communications, psychology and many others have important contribution to make to the study and design of information systems. Before

preparing for the study of the analysis and design of information systems let us briefly review the main elements of the general systems theory.

A system is an organized, interacting, interdependent, and integrated set of components or variables. A system has objectives or goals, and many times these goals are difficult to observe. The environment plays a vital role in the design of a system.

The environment is external to the system, it encompasses everything that is outside the system's control. The environment also determines in some way the performance of the system. So the system and its environment are interrelated and interdependent. Resources are all the means available to the system to execute activities necessary for goal attainment. In contrast to the environment, resources are inside the system and are under its control.

A system is made up of components such as the jobs, activities, missions or parts of the system that are required to realise the objectives. One should not look necessarily at the traditional components of a system such as a department. One's focus should rather be on thinking of the entire system. A focus on missions or activities makes it easier to understand a system.

A system may be a total system which may have different sub-systems as components. Individual sub systems may also be a system which may have different sub systems and so on. In the context of libraries, library automation may be a system where as acquisition, cataloguing, circulation etc. may be sub system. Similarly in the case of acquisition ordering, receiving, financial transaction may be sub-systems.

The management of the system consists of activities aimed at planning and control. Planning encompasses setting goals, the utilisation of resources, and the development of a programme undertaking different activities, implementation and a strategy for dealing with the environment. Control deals with the execution of plan, and associated with control is the flow of information and feedback so that the system can evaluate its plans.

The basics of the General Systems Theory as suggested by various theorists are as follows:

a) The components of a system are interrelated and interdependent, unrelated and independent components do not constitute a system. One of the important aspects in studying a system is to determine the relationships amongst the components.

b) A system needs to be viewed as a whole, it should not be usually broken down into constituent parts, as one might lose sight of the system in its entirely. However, the focus should be on subsystems that constitute a large system.

c) Systems are goal seeking in some way, the interacting components reach some final state or goal, an equilibrium position of goal attainment.

d) System have inputs and outputs, they are dependent on some set of inputs to process to attain the system's goals. All systems produce some output needed by other systems.

e) All systems transform inputs into outputs, usually the form of the output differs from that of the input.

f) Systems exhibit entropy. Entropy describes the state of a closed system (no inputs from outside the system) where all elements move towards disorganization

and the inability to obtain and process inputs as a result of which the system is unable to produce outputs. Information processing is critical to the survival of systems.

g) The system must have a mechanism to regulate its interacting components so that its objectives will be realised. Planning, control and feedback are associated with this regulatory function.

h) A system usually consist of smaller subsystems. The nesting of smaller systems within larger ones forms a hierarchy that is characteristic of the systems theory.

i) We usually find differentiation in complex systems, that is, specialised units perform specialised tasks.

j) Systems generally exhibit equifinality, that is, some final state that can be reached from several different paths or starting points. In other words, there are multiple ways to achieve the goals of the system.

Self Check Exercise

4) Discuss the basics of the general systems theory as suggested by various theoreticians.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this unit.

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1.3.1 The Systems Approach

The systems approach is an approach to the better understanding of systems so that analysis, design and evaluation may be carried out more effectively. It is an approach which has been usefully adopted in all areas, including those of libraries and in information centres. The systems approach, known also as systems thinking, is derived from the General Systems Theory (GST).

The systems approach has many facets of which some important ones are:

- All systems are composed of inter-related parts or sub-systems and a system can only be explained as a whole.
- System are hierarchical in that the parts of the sub-systems are made up of other smaller parts.
- The parts of a system cannot be altered without affecting other parts.
- The sub-systems should work towards the goal of their higher systems and not pursue their own objectives independently.
- Organizational systems contain properties that can be assessed in an objective way and also according to individual values.

The systems approach is a series of problem-solving steps which should ensure that the problem is first understood, alternative solutions are considered, and the selected solution works. These problem solving steps are grouped in three phases, namely,

— preparation effort which prepares the manager for problem solving by providing a system orientation,

— definition effort, which consists of identifying a problem to be solved and then undertaking it, and

— solution effort which, involves identifying alternative solutions, evaluating them, selecting the one that appears to be the best, implementing that solution, and following up to ensure that the problem is solved.

The approach is defined by five elements:

i) the total system objectives

ii) the environment and fixed constraints

iii) the resources of the system

iv) the components of the system, their activities, goals and measures of performance, and

v) the management of the system.

Of the above, the total system objectives is most vague and difficult to define as it is either impossible to discover what are they or they are laid down in a general manner. It is, therefore, essential for a system designer to have a thorough understanding of the nature of the organization he works for, its structure and the management style.

The term environment used in this context refers to what lies outside the system and is outside the control of the manager.

Self Check Exercise

5) List the elements of the systems approach.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this unit.

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1.4 SYSTEMS STUDY

Systems must be managed effectively if they are to give effective results. There is, thus, a need to examine some of the key issues and approaches associated with the management of the systems. Also required is a need to manage a system on a day-

to-day basis. It is vital for every organization to have objectives, goals and targets so that users of the system are regarded as an important component. These measures provide control data for the systems approach, that is for the management of the system. For all these, systems study is required.

The systems study provides the detailed basis for the design of the new system in terms of what it should do and how it should do it. It is a useful way to describe organizational phenomenan, including the information systems, features of application and development processes.

While carrying out a systems study, the initial concern should be to convey to the users of the system the reasons for carrying out the study and also how the new system will benefit both the organization and the users.

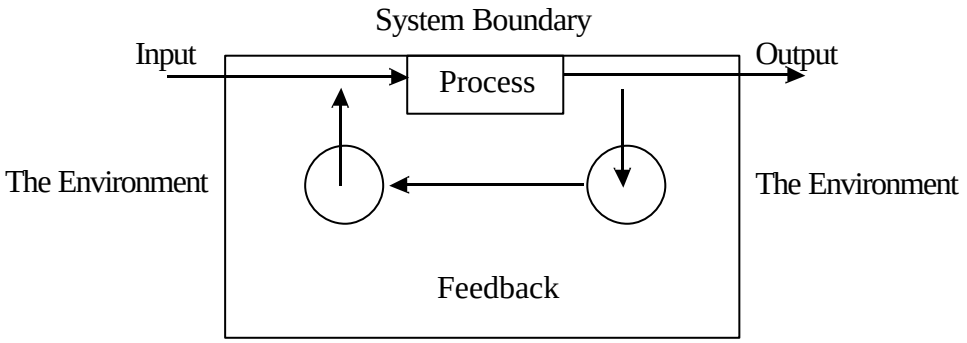
Systems may be open or closed. Parts of a system and its environment include the system's components, boundaries, inputs, outputs, and interfaces.

Let us study some of these concepts in the subsequent sections.

1.4.1 System

A system is defined as a set of interacting components that operate with a boundary for the purpose of achieving an objective. The boundary filters the types and flow rates of inputs and outputs between the system and the environment. The specifications of the boundary define both the system and the environment of the system.

The figure below provides an overview of a system. Essentially, a system accepts inputs from its environment and transforms them into outputs, which are discharged back into the environment.



Overview of a system

Within the confines of the definition of the system given above, it is possible to conceive of a system within a system. For example, National Institute of Science Communication and Information Resources (NISCAIR) and Indian National Scientific Documentation Centre (INSDOC) can be viewed as system and the parent body the Council of Scientific and Industrial Research (CSIR), as a suprasystem. Alternatively, the CSIR can be defined as a system and NISCAIR as a sub-system. To carry the example a step further, the CSIR can be viewed as a sub-system under the Ministry of Science and Technology. Finally, the Ministry of Science and Technology can be viewed as a subsystem under the Government of India.

Parts of a system and its environment include the system's components, boundaries, inputs, outputs and interfaces. Systems are also described by using the input-output

relationships, and a system may be open or closed. These are discussed in the subsequent sections.

1.4.2 Components

The components of a system are units (sub-systems) acting in combination with other units to modify inputs in order to produce outputs. Components within a system do not have to be homogeneous.

1.4.3 Boundary

A boundary is the area separating one system from another. In information systems, the boundary is not physical in nature. It is a region through which inputs and outputs pass during exchanges with the system's environment. Defining the boundary of a system is an important step in systems analysis.

1.4.4 Environment

The environment of a system is defined as anything outside the boundary of the system that influences the operation of the system and cannot be controlled by the analyst. The environment is of great importance to the organization as it is the very reason for its existence. The authorities controlling an organization see a need to provide products and services to meet specific environmental needs and they invest money so that the organization can perform this activity. The environment then provides the resources that are required to produce the products and services.

The environment of one organization differs from that of another. The various environmental elements include the users, suppliers of materials, financiers, community, competitors, geographical area, skilled and unskilled personnel of the organization and the government itself. These environmental elements exist in a larger system called society. The organization demonstrates its responsibility to the global community by respecting the natural environment, providing products and services that contribute to the quality of life and conducting its operations in an ethical manner.

1.4.5 Inputs

Input can be defined as the data received or to be received by a device or a computer programme. It is also the data to be processed. Inputs are the energies taken into the system and are classified as either maintenance or signal. Maintenance inputs energize the system and make it ready to operate. Signal inputs are the energies processed to produce the outputs. Usually computer programmes are maintenance inputs into a computerised information system and data are the raw materials or signal inputs, processed to produce outputs from the system.

1.4.6 Outputs

Output is defined as the information produced by a system after processing of the input. Outputs are the energies discharged from the system into the suprasystem. They are generally classified as products useful to the suprasystem or as waste. Outputs are generally in the form of reports and can also be seen on computer screens.

1.4.7 Interface

Interface is a term frequently used in systems analysis. The interface is the region between the boundaries of systems and is also the medium for transporting the

output from one system to become the input of another system. It does not alter the output of one system that is input to another system.

1.4.8 Open and Closed Systems

Open systems accept inputs from the environment, closed system are assumed not to interact with the environment. All systems are open to some degree, but it is often convenient to assume that a system is closed in order to simplify the analysis process.

Open and closed systems differ in terms of entropy. Entropy is a measure of disorder with a system. In an open system, order is maintained by maintenance of inputs. Depending on the quantity of the maintenance inputs, entropy can decrease, remain constant, or increase in an open system. In a closed system, entropy never decreases because maintenance inputs do not enter into the system.

The term open systems is widely used today in information systems. It refers to those systems that can interoperate directly with hardware and software from multiple vendors. Closed systems are those systems that can only use hardware and software from a single vendor. Open systems are more flexible, they can grow and adapt more readily than systems whose components are supplied by a single vendors. The use of the terms open and closed systems is derived from the general systems theory.

1.4.9 Feedback

Systems survive and adapt to their environment through feedback. Feedback is a process by which the output of a system is measured against a standard. The difference between the two is corrected by altering the inputs. Feedback improves the system performance. Output from the feedback in an information system is used in decision making. If the output is not relevant to the decisions, then the system is of little use to the management. Therefore, feedback loops are incorporated into a system to determine the relevance of output to the environment.

Self Check Exercise

6) Define environment in a system and describe its usefulness.

7) Differentiate between open and closed systems.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this unit.

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1.5 SYSTEMS AND INFORMATION PROCESSING

As discussed above, an information system is a formalised computer system that can collect, store, process and report data from various sources to provide the information necessary for management decision making. The information systems

can operate only when the processing of information takes place. Information is knowledge concerning such things as facts, concepts, objects, events, ideas and processes, which within a certain context has a particular meaning. Information processing becomes meaningful to a decision maker for use in a particular decision.

The traditional approach to information processing is file-oriented. Before the advent of database management systems, each application maintained its own master file and generally had its own set of transaction files. Files are custom designed for each application and generally there is little sharing of data among various applications. Here, programmes are dependent on the files and vice versa, that is, when the physical format of the file is changed, the programme also has to be changed. The traditional approach is file oriented because the primary purpose of many applications is to maintain, on the master file, the data required to produce management information. Therefore, the master file is the centerpiece of each application.

Although the file-oriented approach to information systems is still widely used, it does have some disadvantages that include:

- Data redundancy
- Lack of data integration
- Programme/data dependence
- Lack of flexibility

To overcome this traditional approach to information processing, the database approach to information processing is being suggested by systems analysts. A DBMS (Database Management System) provides the capabilities for creating, maintaining and changing a database.

In traditional data storage techniques, the programmer needs to be aware of the physical layout of data records on storage devices and, thus, needs to understand the technical characteristics of many kinds of hardware. A DBMS overcomes this problem by providing two views of data, that is physical and logical. The physical view is similar to the traditional file system, whereas, the logical view represents data in a format that is meaningful to the user and the application programmer.

Thus, for information processing it is recommended that the DBMS be opted for, as the database approach integrates the data into one large storage structure that may be used by many different users and application programmes of the system.

Self Check Exercise

8) Distinguish between the traditional data storage technique and DBMS.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this unit.

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1.6 SYSTEMS ANALYSIS

As stated earlier, systems and systems analysis are, respectively, a philosophy and a methodology for viewing complex wholes at a manageable level of abstraction. Systems analysis is also a method for dealing with complex systems. It presents systems abstractly, using just enough detail to allow the analyst to identify and specify alternatives for the design and modification of a system. Another reason for studying systems is that many of their characteristics are similar and the strategies for analyzing and improving them are therefore similar. When one begins to view complex phenomena as systems, analogies can be drawn between systems that initially might seem to be unrelated.

1.6.1 Conceptual Strategy

System analysis can be defined as a conceptual strategy for problem solving. This broad functional definition of system analysis indicates that the term refers to the structuring of a methodology of an objective, namely, the articulation and resolution of a problem.

System analysis is the inquiry to assist decision-makers in choosing preferred future courses of action by:

a) systematically examining and re-examining the relevant objectives and the alternative policies or strategies for achieving them, and

b) comparing quantitatively, where possible, the economic costs, effectiveness (benefits), and risks of the alternatives.

From the above it can be concluded that system analysis is a process that analyses and compares alternative courses of action to achieve stated objectives, employing quantitative variables for comparison where possible.

1.6.2 Procedural Components

System analysis consist of the following procedural components:

1) Problem definition in the system context

2) Statement of objectives

   — overall system objectives

   — outcomes desired of the problem solution

   — performance indicators

3) Specification of resources and constraints on possible courses of action (i.e. problem solution)

4) Formulation of alternative courses of action

   — estimation of their advantages and disadvantages

   — rejection of the less feasible or desirable alternatives

5) Collection and analysis of data on promising alternatives

6) Selection of the most promising alternative (i.e. decision making)

7) Implementation of the most promising alternative

8) Performance monitoring, measurement and evaluation

9) Correction or modification of the implementation as needed

10) Performance monitoring, measurement and re-evaluation.

System analysis helps to decide what is the motivation for a system. Why is a new system desired ? Whatever may be the specific reasons for a new system, there must be some dissatisfaction with the existing system, its information processing procedures or there would be no demand for a new system. Either current or expected demands for information processing cannot be met from the existing one, so a new system is needed, and therefore the effort to change existing information processing procedures and improve them in some way by designing a new system.

In systems analysis, the existing information processing procedures are documented in detail. During analysis, it is learnt what the users expect the system to do. One major task during this phase is to define the boundaries of the system. Data are also collected during analysis. All this leads to the design of the new system. You will study the system design aspects in Unit 2 of this block.

Self Check Exercise

9) List the procedural components of systems analysis.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this unit.

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1.7 ROLE OF SYSTEMS ANALYST

We are entering the information age because of the emergence of computer-based information systems. A great percentage of the work force is being employed as information workers. A Large amount of information has to be made instantly available to decision-makers and this information can be easily made available by the computers or activities applicable with the help of computers. The largest impact of this computer revolution is seen on information systems carriers. The various kinds of information systems specialists include systems analysts, programmers and computer operators.

A systems analyst analyses and designs application systems. In carrying out this responsibility, the analyst is heavily involved with the systems development life cycle from analysis through implementation. Often the analyst is looked upon as an intermediary between the users and the programmers. Most analysts do not perform programming and they do not have to be highly skilled programmers too. However, the analyst should be familiar with the features of several different computer languages.

It is important that the systems analysts have more competence in the application area in which they are working than in programming The analyst must deal directly with users and must understand their applications in order to design a new system. For these reasons, an analyst sometimes has a formal education in areas such as marketing, economics, accounting or management. But the best combination is to have an education in one of these application areas plus an information systems education. In fact, systems analysts often are employed by and report to the user organization rather than the information systems function. They analyse and design new systems and then turn the specifications over to the information systems organisation for programming.

Whereas programmers often work with machines and programme code, systems analysts work directly with people that is the end-users and programmers) most of the time. A good systems analyst has highly developed communication skills. Listening, persuasion, teaching and consulting skills help ensure success for a systems analyst.

The job outlook for systems analysts is bright. They can initially pursue a career in systems analysis and then decide whether to remain in the information systems organization or to move into management in the application area in which they are trained, such as finance or marketing. They are usually actively recruited by end-user organizations because of their computer expertise. Even if end users develop their own applications in the future, they will need individuals with the expertise of systems analysts to guide them in the use of new software such as application generators and database management systems.

The role of a systems analyst is different from that of a database administrator or an information systems consultant.

A database administrator (DBA) is responsible for the design and control of an organization's database and holds a management position. The major duties of the DBA are designing databases; developing database dictionaries; designing and implementing procedures that will ensure the accuracy, completeness and timeliness of data stored in the database; and advising programmers, analysts and users about the efficient use of the database.

An information systems consultant is very much like a systems analyst. This individual may be employed with an organization's information department or by an outside management consulting firm. The consultant's role ranges from helping a user develop an application to performing a complete analysis, design and implementation of a system. These persons usually are information specialists having a high level of technical knowledge both in computer systems and computer applications.

Self Check Exercise

10) What are the skills needed to be a systems analyst?

11) How are database administrators and information systems analysts different from a systems analyst?

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this unit.

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1.8 SUMMARY

The purpose of this unit is to help the students learn about the concepts of information systems. Information system are crucial to the functioning of modern organizations. An information system is a formalised structure that can collect, store, process and report data from various sources so that it is able to provide the information necessary for management decision-making.

The information systems have inputs, process and outputs. An information system also contains data files that can be either manual or computer-based. The unit also discusses various types of information systems.

The field of systems analysis and design for information systems has its foundations in the General Systems Theory. General systems theory emphasises the need to examine all parts of the system. A system is made up of components that are the jobs, activities, missions or parts of the system that are performed to realize objectives.

A systems analyst analyses and designs application systems and is involved with the systems development life cycle from analysis through implementation. He acts as a link between users and programmers.

The analyst draws the boundary around the proposed information system to help isolate the problem with which he or she is dealing.

1.9 ANSWERS TO SELF CHECK EXERCISES

1) An information system is a formalized structure that can collect, store, process and report data from various sources to provide the information necessary for management decision making. Not all information systems and structures are formal, nor do information systems have to be computer-based. Thus an information system is a set of organized procedures which, when executed, provides information to support decision-making. Here, information is considered as a tangible or intangible entity which serves to reduce uncertainty about some future state or event.

2) An information system has six components:
   Inputs
   Processes
   Data files
   Outputs
   Personnel, and
   Hardware

3) Different types of information systems are Transaction processing system, Office automation system, Decision support system, Expert system, Executive information system, and Management information system.

4) The basics of the general systems theory as suggested by various theoretician are as below:

   a) The components of a system are interrelated and interdependent, unrelated and independent components do no constitute a system. One of the important aspects in studying a system is to determine the relationships among components.

   b) A system is viewed as a whole, it is not usually broken down into constituent parts one might lose as sight of the system in its entirely. However, the focus should be on subsystems that constitute a large system.

   c) Systems are goal-seeking in some way, the interacting components reach some final state or goal, an equilibrium position of goal attainment.

   d) System have inputs and outputs, they are dependent on some set of inputs to process to attain the system's goals. All systems produce some output needed by other systems.

   e) All systems transform inputs into outputs, usually the form of the output differs from that of the input.

   f) Systems exhibit entropy. Entropy describes the state of a closed system (no inputs from outside the system) where all elements move towards disorganization and the inability to obtain and process inputs so the system is unable to produce outputs. Information processing is critical to the survival of the systems.

   g) The system must have a way to regulate its interacting components so that its objectives will be realised. Planning, control and feedback are associated with this regulatory function.

   h) Systems usually consist of smaller subsystems. The nesting of smaller systems within larger ones forms a hierarchy that is characteristic of the systems theory.

   i) We usually find differentiation in complex systems, that is, specialised units perform specialised tasks.

   j) Systems generally exhibit equifinality, that is, some final state that can be reached from several different paths or starting points. In other words, there are multiple ways to achieve the goals of the system.

5) The systems approach is defined by five elements:

   a) the total system objectives

   b) the environment and fixed constraints

   c) the resources of the system

   d) the components of the system, their activities, goals and measures of performance, and

   e) the management of the system

6) The environment of a system is defined as anything outside the boundary of the system that influences the operation of the system and cannot be controlled by the analyst. The environment is of great importance to the organization as it is the very reason for its existence. The authorities controlling an organization see a need to provide products and services to meet specific environmental needs and they invest money so that the organization can perform this activity. The environment then provides the resources that are required to produce the products and services.

7) The term open systems refers to those systems that can interoperrate directly with hardware and software from multiple vendors. Closed systems are those that can only use hardware and software from a single vendor. Open systems are more flexible, they can grow and adapt more readily than systems whose components are supplied by a single vendors. The use of the terms open and closed systems is derived from the General Systems Theory.

8) In traditional data storage techniques, the programmer needs to be aware of the physical layout of data records on storage devices and thus needs to understand the technical characteristics of many kinds of hardware. A DBMS overcomes this problem by providing two views of data, that is physical and logical. The physical view is similar to the traditional file system, whereas the logical view represents data in a format that is meaningful to the user and the application programmer.

9) System analysis consists of the following procedural components:

   i) Problem definition in the system context

   ii) Statement of objectives

      — overall system objectives

      — outcomes desired of the problem solution

      — performance indicators

   iii) Specification of resources and constraints on possible courses of action (i.e. problem solution)

   iv) Formulation of alternative courses of action

   v) estimation of their advantages and disadvantages

      — rejection of the less feasible or desirable alternatives

      — Collection and analysis of data on promising alternatives

   vi) Selection of the most promising alternative (i.e. decision making)

   vii) Implementation of the most promising alternative

   viii) Performance monitoring, measurement and evaluation

   ix) Correction or modification of the implementation as needed

   x) Performance monitoring, measurement and reevaluation

10) It is important that systems analysts have competence in the application area in which they are working than in programming The analyst must deal directly with

users and must understand their applications in order to design a new system. For these reasons, an analyst sometimes has a formal education in areas such as marketing, economics, accounting or management. But the best combination is to have an education in one of these application areas plus an information systems education. In fact, systems analysts often are employed by and report to the user organisation rather than the information systems function. They analyse and design new systems and then turn the specifications over to the information systems organization for programming.

11) A database administrator (DBA) is responsible for the design and control of an organization's database and holds a management position. The major duties of the DBA are designing databases; developing database dictionaries; designing and implementing procedures that will ensure the accuracy, completeness and timeliness of data stored in the database; and advising programmers, analysts and users about the efficient use of the database. An information systems consultant is very much like a systems analyst. This individual may be employed with an organization's information department of by an outside management consulting firm. The consultant's role ranges from helping a user develop an application to performing a complete analysis, design and implementation of a system. These persons usually are information specialists having a high level of technical knowledge both in computer systems and computer applications.

1.10 KEYWORDS

Closed Systems : A closed system is one that is isolated from its environment. Closed systems are self contained so that the external environment does not influence the behaviour of the system, nor does the system influence its environment.

Data Flow Diagrams (DFD) : Data flow diagrams are a structured analysis technique the systems analyst can use to put together a graphical representation of how data flows through an organization. The data flow approach includes describing the existing system, and then describing the logical data flow as it would occur in the improved system.

Entropy : It is a measure of disorder within a system. Entropy describes the state of a closed system (no inputs from outside the system) where all elements move towards disorganization and the inability to obtain and process inputs so the system is unable to produce outputs.

General Systems Theory : The concepts of systems are collectively referred to as the General Systems Theory. Besides focussing on all parts of a system, it helps communication among specialists in various fields.

Information System : A formalised system (usually computer) that can

collect, store, process, and report data from various sources to provide the information necessary for management decision making.

Interface : A point of communication between two or more processes, persons or other physical entities.

Management Information System : A system for providing information for decision making to all levels of the management.

Open Systems : In General Systems Theory, a system that interacts with its environment by accepting inputs and producing outputs. These are also computer hardware and software, that can interact without modification with hardware or software obtained from other vendors.

System : People, machines and methods organized to accomplish a set of specific functions.

System Analysis : In system development, the systematic investigation of a real or planned system to determine the functions of the system and how they relate to each other and to other systems.

System Analyst : A person whose responsibility is to analyse, design, and develop information systems.

System Development Life Cycle : The different phases that a typical computer -based information system goes through in its development and use.

1.11 REFERENCES AND FURTHER READING

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