BLOCK 2

SYSTEM DEVELOPMENT

This block attempts to give you an understanding of the various aspects of system analysis, design, development and implementation of various kinds of computerised systems.

Unit 4 describes various kinds of systems, the steps involved in system analysis and how to design a system.

Unit 5 on System Development Life Cycle explains the system development life cycle and stresses the importance of each stage.

Unit 6 on Designing On-line and Distributed Environments explains the system design features of an on-line system and how the various computer system concepts are related to it.

The seventh and the last unit in this book on Implementation and Control of Projects describes the various options which can be adopted in implementing a system and the related problems of security and control.

UNIT 4

OVERVIEW OF SYSTEMS ANALYSIS AND DESIGNS

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

- understand the concept of System
- understand what and why of Systems Analysis
- develop a broad appreciation of Systems Design.

Structure

4.1 INTRODUCTION

You have already received a fairly good idea of System in Unit 17 of MS-7. If you have forgotten about it, you will need to recollect it. This unit, apart from briefly repeating some of the ideas, further builds upon them.

Some definitions:

- Webster unabridged dictionary describes system as a set or arrangement of things so related or conneted to form a unity or organization
- A system is an organized, interacting, interdependent and integrated set of components variables parts. A system has objectives or goals (Lucas, 1985, p.5)
- A system is a set of elements forming an activity or a processing procedure or a scheme, seeking a common goal or goals by operating on data/and/or energy and or matter (inputs) in a time reference to yield information and/or energy and/or matter (output) (Murdic Ross and Claggett, 1990, p. 15).

4.2 SYSTEMS CONCEPT

There are several ways of classifying systems. Three such classificatcns are: (1) natural of man-made; (2) closed or open; and (3) conceptual or physical.

NATURAL SYSTEMS occur in nature e.g., solar system. On the other hand **man-made systems** are deliberately created for specific objectives. For example, Defence System, Disposal System, Organizations etc.

Closed systems theoretically, are self-sufficient and have no interaction with their environment. In practice, those, which are relatively cut off from the environment are termed as closed. For example, Dry Battery Cell.

Whereas **open systems** exchange information and or energy and or material with their environments. As members (parts) of a system they receive from the environment as inputs and give to the environment as outputs. For example, Man, Living Beings, Business Organizations.

Conceptual systems are theoretical in nature and deal with concepts which may or may not physically exist. Somtimes it may be possible to convert a conceptual system to a physical system, for example, Social System, Econimic Theory etc. In contrast **physical systems** physically exit in real world. They are generally man made, e.g., Production System, Power Generating System, Fire Control System etc.

These classifications are not exclusive. For example, there can be a system which is man made, open and physical.

Characteristics of a System as outlined by Schroderbek are:

1) A system is a whole.
2) Components of a system interact.
3) Systems are goal seeking.
4) Systems have input/output.
5) Systems transform inputs to yield output.
6) Systems exhibit entropy.
7) Systems must be controlled.
8) Systems form a hierarchy.
9) Systems exhibit differentiation.
10) Systems exhibit equifinality.

In subsequent sections, we will be particularly interested in open, physical man made systems such as Organizations an Mangement Information Systems.

4.3 SYSTEMS ANALYSIS – WHAT AND WHY

What is Systems Analysis?

Harry Goode and Robert Machol's view of Systems analysis is quoted below:

For more than a decade, engineers and administrators have witnessed the emergence of a broadening approach to the problem of designing equipment. This phenomenon has been poorly understood and loosely described. It has been called **Systems design, Systems analysis** and often the **Systems approach.** Rarely does the speaker using these terms intend to convey those concepts which are brought to the minds of his hearers, nor for that matter are any two hearers likely to be in agreement.

Analysis of the system means identification, understanding and critically examining the systems and its parts (sub-systems) for the purpose of achieving the goals (objectives) set for the system as a whole, through modifications, changed interrelationships of components, deleting or merging or separating, or break up of components. It may also involve upgrading the system as a whole.

The methodology of systems analysis involves (1) identification of the system (setting system boundary), the system objectives, the system elements (components); and (2) understanding the role and interrelationship of elements with other elements of the same system.

Through this identification and understanding process; (1) the capability (or background) to analyse and compare various alternatives regarding components and (2) system functioning vis- a- vis the system objectives, is generated. Outcome of the systems analysis job is a set of recommendations towards creating a system which best meets its objectives giving due regard to cost-effectiveness and the risks.

Systems analysis, thus, emerges as a means through which the total system is conceived, designed, implemented and made operational to achieve the desired objectives. The basic objective of systems analysis is to understand and modify the system in some way to improve its functioning. The modification may require one or more of the following : change the outputs, change the goals of the system, make it more efficient, have different set of inputs of improve in some other way or even create a new system.

Why Systems Analysis?

The understanding of what systems analysis is in itself provides an insight into its importance and why it is needed. Systems analysis basically is an approach towards viewing the processes, activities and complex problems in their totality. Thus specifically:

- It offers a means to greater understanding of the complex structures
- It is a means to trade off between functional requirements of a subsystem (component) and its immediately related subsystems.
- It helps in understanding and comparing functional impacts of subsystems to the total system
- It helps in achieving inter-compatibility and unity of purpose of **subsystems**
- It helps in discovering means to design systems where subsystems may have apparently conflicting objectives
- Finally, it heps in placing each subsystem in its proper perspective and context, so that the system as a whole may best achieve its objectives with minimum available resources. It thus creates synchronization between systems and objectives.

Thus, systems analysis is one of the important techniques that provides a systematic and broader outlook to understanding, examining and creating or modifying systems to meet specific objectives. Systems analysis and design is an interactive and creative process.

4.4 OVERVIEW OF SYSTEMS DESIGN

Having seen what is systems analysis and why it is done, let us examine how the objectives of the organization influence the objectives of Systems Design and then examine in stepwise manner how it is done in this section.

4.4.1 Objectives of Systems Design vs Objectives of the Organisation

Many authors have discussed the term and the process of system design from the viewpoint of developing specific computer applications or programs. Though the broad steps are basicaly the same, the magnitude of the task is much larger when viewed from the point of developing MIS for the organization as a whole. Usually the steps follow what is termed as 'life cycle stages'. Since basicaly a Management Information System is expected to help the organization and the management in the discharge of their functions it is imperative that the MIS system development effort begins by understanding the organizations's objectives. For these are required to be translated to constitute objectives of the MIS.

The following schematic diagram (Figure 4.1) gives an overview of the broad steps involved in MIS design/ development process. For better understanding of the design process, it has been divided into these broad categories. Essentially a designer will have to think of all stages simultaneously irrespective of the fact at which stage he is. He doesn't proceed by completing one stage and moving on to the next stage and not considering previous or subsequent stages.

Overview of MIS Development

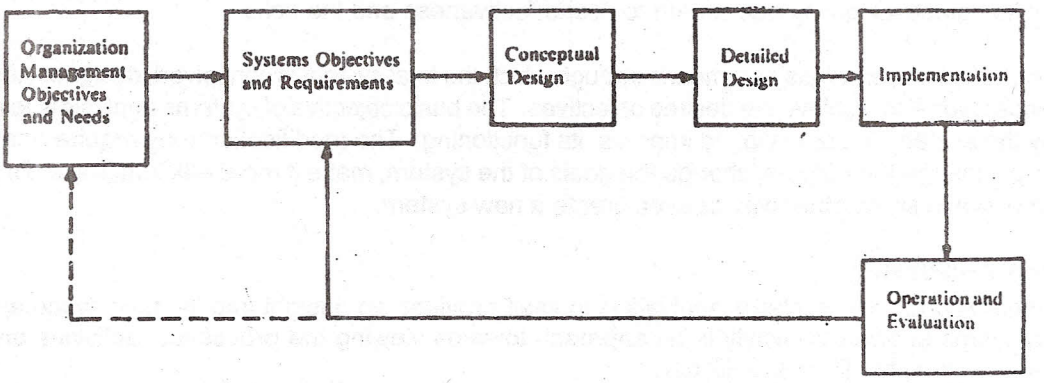

Figure 4.1

The broad stages involved in MIS development as depicted in Figure 4.1 are : Organization, Management objectives and needs, which are converted to systems objectives (and corresponding broad requirements to meet these objectives are estimated) followed by a conceptual design, feasibility of various alternative ideas for each of the system elements in the light of the systems objectives and the resources available is tried out at this level. This conceptual design is converted into detailed design specifying each action in precise and physical context for each element of the system. Finally system implementation and evaluation takes place, which continues over a period of time. If need be, the whole process from stage 2 is repeated. In exceptional circumstances, generally when major changes at organizational level, or technological level or in the environment take place the connection to stage I is shown through dotted lines. This would mean that a new system is to be designed and the whole process repeated.

In the first stage, the understanding of the organization's and management's objectives leads to appreciation of key areas or the thrust areas of the organization and is helpful in setting broad objectives for the MIS such as major reliance on models, development of forecasting techniques, or large storage and retrieval capability, or faster on line requirements, or may be in some cases the major activity would be routing reporting and storage. Any one or combination of these broad objectives of MIS would be possible, only through management and organization objectives. These broad objectives would be further refined and specified in detail running through various levels of management and various functions of the organization.

MIS objectives must be consistent with the corporate plans. A set of corporate strategic guidelines will help generate MIS objectives and should coincide with the corporate operational schedules with respect to timings.

4.4.2 Study of Existing System

Unless it is entirely a new activity or new organization for which MIS is to be developed, there is always some existing system, formal or informal or even trivial. As such there is need for intensive study and critical examination of the existing system.

Since the need for a new system has arisen either because of some type of dissatisfaction with the existing system, or the objectives and need of organization as well as MIS have been drastically changed, change in the existing system or a new system is required.

There are two schools of thought regarding whether, for development of a system, the old system should be studied or not? One school of thought is for and the other against. The argument against is that it inhibits the

generation of new ideas and may bias the designer towards the same logic which is contained in the old system. Whereas the other school argues that through study of existing system one learns about its shortcomings and may use this knowledge to avoid committing the same mistakes again. Both arguments are valid. We suggest the study of the existing system, if any, to learn more about the total system.

The study of the existing system should cover its objectives, processing procedures, equipment and facilities, organization, system documentation, conduct of operations, files and records, volume and types of information processing, and inputs and outputs and their frequencies. All these need to be studied in detail in relation to the objectives of the existing system and also in relation to the revised objectives which have been framed as discussed in the previous section. It should create intimate understanding of the existing system - to what extent it was able to meet the existing objectives, what were its shortcomings and what more is required (modifications/comeplete change) to meet the revised objectives.

4.4.3 Conceptual Design/Feasibility Study

The term conceptual design has been interchangeably used with gross design, feasibility study, high level design, and in some cases, even with preliminary design by various authors. The use of these different terms gives a broad idea of the fuctions performed in this phase of conceptual design.

These functions, at this stage, are at a very general level. Finer and finer details are taken up as we progress through detailed design/physical design implementation, evaluation etc. Here we consider various broad alternatives to match the system objectives, user's requirements with due regard to cost and saving factor. The outcome of this stage is in the form of broad suggestions e.g., central data base/distributed data base; batch processing/on-line processing; etc. It could also specify upper and/or lower limits of peak and average processing loads. Thus the accent is on comparing, analysing, matching various alternatives and combinations.

Even though system objectives in relation to managenent/organization objectives have already been discussed, they are again reviewed and made more specific with respect to peak level processing loads, complexity of processing, time frame for various types and categories of output, frequencies of occurrences, communication needs etc.

On the other side,assessment is also made of the restrictions or constraints on the freedom to develop MIS. These restrictions may be external or internal and may be with respect to content, processing requirements, procedures, inut/output formats,data frequency; data accuracy, units of measurement etc.

External constrains may be due to government, customers, suppliers, unions, social groups etc. Internal constraints can be due to the areas of operations of the organization, its policies, attitude and support of top management, the prevalent work culture within the organization, cost and resources for the proposed system, willingness of the user employees, availability of required skilled manpower, internally and externally, etc.

Identification, recognition and understanding of both internal and external constraints is **curcial** to designing a viable system. As part of the design effort, the designer provides for these restrictions and knows to some extent what he can do and what he cannot do to attain the stipulated objectives of the system. In the process, sometimes he may have to review/or prune the systems objectives or he may try to overcome some of the restrictions. This exercise is also a basic part of feasibility analysis at a general level.

The systems objectives are transformed into specific information needs of the organization or, for that matter, of the manager users. A clear understanding and aggregative view of management's information needs is the base on which the whole structure/design of MIS is erected. Thus information needs which can really help the management in discharge of their functions are identified.

Special efforts are needed for assessment of organization as well as user manager's information needs. Various approaches are recommended:

i) Detailed study of existing output reports, processings, records, memos, files etc. with respect to important positions in the organisations;

ii) Analysis of existing organization structure of the company to understand the job responsibilities and job functions performed by each position in the company; this knowledge is later converted to information needs. The understanding of organization struture is supplemented by study of nature of the company, the business the company is in and its critical areas of operation;

iii) Interview of individual managers, to understand their specific requirements. This approach may prove to be by far the most ticklish because usually managers are not in a position to pin-point what they need and when they need it. The MIS designer/analyst has to approach and interview managers with utmost caution and after having done thorough homework.

iv) Circulate questionnaires to get an idea of information needs.

There are several other approaches, but the designers have to take a judicious decision regarding an approach or a combination of approaches to understand clearly the management's information needs.

These information needs are required to be evaluated to ascertain the sources of information (for identifying input data--what, from where, when,what format etc.) and storage pattern and requirements. Also information needs are required to be translated and matched to processing requirements and capacities.

For determining sources of information, almost same approaches are applicable as have been discussed for need assessment; but not necessarily the same combination is applicable here. The internal records, files, books, blueprints, statistical and accounting documents, and understanding of the internal operations of the company are all helpful in this regard.

Preparation and use of input-output charts, information flow charts, activity flow charts, operation flow charts, multidimensional flow charts are helpful and add to the understanding of sources flow and information processing requirements. **External** sources vis-a-vis management requirements are also a critical avenue for investigation. These are vital at the highest level of management for policy planning and strategic functions. Figures 4.2 and 4.3 are examples of input-output charts and information flow charts.

The repeated identification and analysis of sources and processes requirements iteratively **leads to a match** against previously determined information needs. All these steps and the use of various techniques discussed so far, also help in identifying origins and destination of information and help in establishing progression of information through the organization. They also help in arriving at better understanding and estimates of frequency, volume, time processing, storage, cost and communication requirements.

In the context of understanding generated with respect to MIS objectives, information needs, sources and processings; the conceptual design development activity is taken up. Conceptual design is a sketch of the structure of MIS listing broad guiding policies as well as restrictions within which the detailed design development can be undertaken.

The conceptual design, or for that matter any design, is a creative activity. It should come out with broad viable alternative combinations of input, storage, processing, communication and output to be able to generate various conceptual designs of MIS. viz.

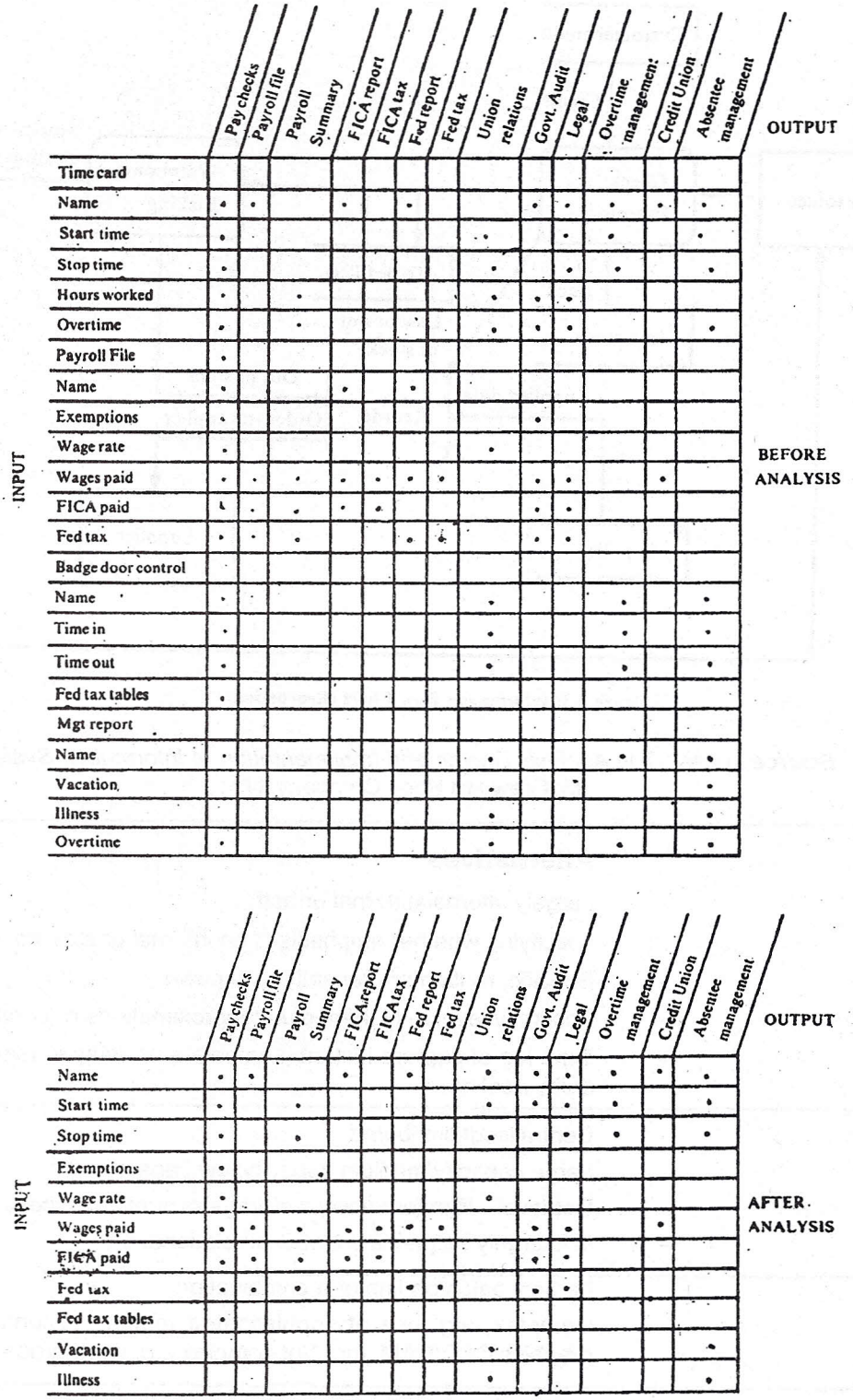

Fig. 4.2 : Input/Output Chart (Payroll System)

Source : Murdic and Ross, **Information System for Modern Management.** Prentice Hall of India, N. Delhi

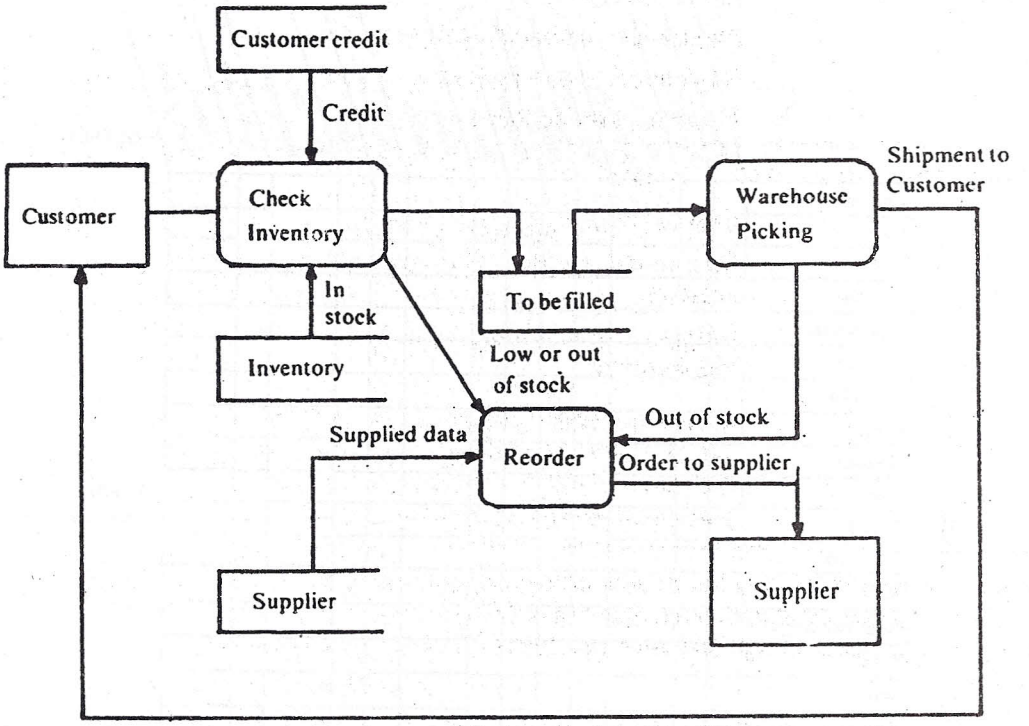

Figure 4.3: Information Flow Chart (Reordering)

Source Lucas : *The Analysis Design and Implimentation of Information System.* McGraw Hill Book Company. N.Y.

Element		Alternatives
Inputs	-	Largely internal/external or both, specifying whether emphasis is on internal or external sources.
	-	Specific, routine or presently not known
	-	Accuracy levels - high/medium/approximations or combinations
	-	Time lag of capture-instant, immediate or delayed (say,per shift, hourly, daily, weekly).
Data base	-	Centralised/distributed
	-	Large capacity/medium capacity/low capacity
	-	Retrieval - Random access storage/sequential access storage
	-	Is it largely sequential/relational/relational/etc.?
Processing		Largely batch/on-line/or a combination
	-	Complex, e.g. use of sophisticated models/ scientific requirements/ graphics/CAD/CAM etc; Not complex e.g. word processing
Communication and output	-	Instant/time lag/specified intervals
	-	Written/verbal/visual (VDU) / Graphic etc.

- Direct/routed through
- Frequency - instant/daily/weekly etc.
- Routine/ad hoc/on demand
- Reports/query/dialogue, etc.

For example, one of the outcomes could suggest:

Input	-	Internal, highly accurate, instant
Data base	-	Distributed, random & sequential access, medium capacity at each location.
Processing	-	Complex, scientific application. on-line printing as well as graphic requirements
Communication and output	-	On-line between various depts: text and VDU, both. direct; routine and ad hoc both: reports, query and dialogue but more emphasis on query and dialogue between de partments as well as man machine.

Thus, for the same match of information needs, processing and source (input) requirements, there could be several such alternative combinations, each alternative being viable. These alternatives need to be compared to choose one so that detailed design and later on implementation could be started. The basis of comparison could be:

1) **Anticipated performance** : Each alternative should be objectively assessed at conceptual level as to what extent it meets the MIS objectives stated earlier and to what extent it meets the company requirements.

2) **Cost-effectiveness** : Some type of cost-benefit analysis is performed for each alternative. Rough projections of equipment requirments and costs, operational, costs, manpower costs, maintenance costs etc. need to be made. Projections of potential tangible as well intangible benefits are also needed to be made. For example, tangible benefits can result from such modes as reduction in present or future manpower requirements, savings resultant to a particular alternative such as reduced inventory, reduced scrap, faster receipts faster reconciliation, reduction in loss due to frauds e.g., in banking etc. Some intangible benefits are ability to obtain information which was previously not available, faster or timely receipt of information, improved or better decision making, improvement in planning and control etc.

3) **Operational Basis** : For each alternative, analyasis required to assess the strong and weak points in respect to quality of data base, quality of information, ability to withstand peak loads of storge as well as processing, ability to anticipate preparedness to take up ad hoc demands, avoidance of duplication etc. Broadly, what needs to be assessed is, "will it work when implemented and to what extent?"

4) **Technical Basis** : It is also important to project each alternative with respect to technological requirements in storage, processing, commuication, output etc.,and assess: Are they easily available? Will they be within the budget? Does it match the present and future needs? Is it too sophisticated for the staff of MIS to handle and accept? Is it too complicated for the users? These are some of the questions, that need to be asked and answered to compare various alternatives on technical basis.

The final chosen conceptual alternative, is meticulously documented in specific terms. It also contains as attachments the charts, forms,and comparison analysis which has been performed to arrive at the final outcome. The top management of the company reviews it in consultation with systems people. If approved, then detailed design activity is undertaken.

4.4.4 Detailed Design and Implementation - Brief Description

These two phases of the total system design activity will be discussed at length in later units. specially implementation phase in unit 7. A brief description is felt necessary at this point, so that you appreciate that the conceptual design in itself is not the end of the design activity.

The basic task of a detailed design task is to convert the broad concepts of the earlier phase into very specific and detailed description of all the activities needed to produce a physical system that actually operates. Thus the outcome of this activity is specific unlike earlier phase i.e.. conceptual design/ feasibility study which gave vague broad guidelines.

Thus, detailed design phase will provide detail specifics with reespect to:

Input/out put forms: What information, from where, when, in what format would be entered; similarly for outputs.

Data Bank: It includes the exact description of storage of input information including the equipments, the input devices and procedures and output devices and procedures. On the whole, the Data Bank Management in its totality would also include detailed file descriptions and design.

Processing: Description of models, procedures and handling/ manipulation of information to come out with adequate outputs.

Equipment (Hardware): Computer capabilities, capacities, requirements, input devices, output devices, communication devices, and other supporting devices.

Procedures (Software) : Rules, standards and procedures, application and systems programs.

Internal Organization: Organization structure to operate and maintain the system department should include job descriptions, number of personnel at each level and the skills, may be payment packages etc.

The final outcome is in the form of a completely documented report which on implementation results in a real physical operating system. It is like an engineering specification of blueprint of products made available to production shops for manfacturing.

When detailed design specifications are available the implementation activity phase starts. The basic function of this phase is to transform the specifications into physical realities- to come up with a physically operating system. as per specification, on schedule, within stipulated costs, to match the system and company requirements.

Briefly the activities performed in implementatin phase are:

- prepare the implementation plan-use or Gnatt Charts of CPM/PERT networks advisable.
- acquire and layout floor space.
- recruit personnel.
- train the operating and user people.
- obtain and install hardware equipment.
- develop and test software including programs, design of forms (input as well as output). files, data base etc., and
- finally testing and re-testing various components of the system before the operation maintenance phase.

All these would be discussed in greater detail in Unit 7.

4.5 SUMMARY

There are three types of systems:(1) natural or man-made (2) closed or open; and (3) conceptual or physical. In this unit we referred to open: physical man-made systems such as Organizations and Management Information Systems. After examining the 'what' and 'why' of systems analysis, it was seen that analysis of the system involves identification, understanding and critically examining the system and its parts (subsystems) for the purpose of achieving the objectives set for the system as a whole, through suitable modification of its components. Finally, actual system design is done by identifying system objectives and boundaries, conducting feasibility study, developing the system design in detail and the implementing it at the user site.

4.6 SELF-ASSESSMENT EXERCISES

1) Explain a system. why is systems view justified towards organizational information needs?

2) Why analyse a system?

3) Describe the major phases in MIS design. Can you compare these phases with Research and development projects?

4) Why is conceptual design also sometimes called feasibility study?

5) Prepare an information flow chart for a major/minor activity that you are performing in your job or you are familiar with.

6) Prepare a complete list of information requirements related to your job - also specify timings, that is, when do you need them.

7) Is it possible to design and implement a mini MIS related to your job activities? Try to design one.

4.7 FURTHER READINGS

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