UNIT 1 STRUCTURED SYSTEM DESIGN

Structure

1.0 INTRODUCTION

The systems objectives outlined during the feasibility sludy serve as the basis from which the work of system design is initiated. Much of the activities involved at this stage is of technical nature requiring a certain degree of experience in designing systems, sound knowledge of computer related technology and thorough understanding of computers available in the market and the various facilities provided by the vendors. Nevertheless, a system cannot be designed in isolation without the active involvement of the user. The user has a vital role to play at this stage too. As we know that data collected during feasibility study will be utilised systematically during the system design. It should, however, be kept in mind that detailed study of the existing system is not necessarily over with the completion of the feasibility study. Depending on the plan of feasibility study, the level of detailed study will vary and the system design stage will also vary in the amount of investigation that still needs to be done. This investigation is generally an urgent activity during the system design as the designer needs to study minutes details in all aspects of the system. Sometimes, but rarely, this investigation may form a separate stage between Feasibility Study and Computer System Design. Designing a new system is a creative process which calls for logical as well as lateral thinking. The logical approach involves systematic moves towards the end-product keeping in mind the capabilities of the personnel and the equipment at each decision making step. Lateral thought implies encompassing of ideas beyond the usual functions and equipment. This is to ensure that no efforts are being made to fit previous solutions into new situations.

1.1 OBJECTIVES

At the conclusion of this unit, you should be able to :

- define the system design considerations
- list out various design methodologies
- know the brief outlines on structured design
- explain modularisation, computer system design process and syslem specifications
- understand the importance of prototype design

1.2 SYSTEM DESIGN CONSIDERATIONS

The system design process is not a step by step adherence of clear procedures and guidelines, Though, certain clear procedures and guidelines have emerged in recent days, but still much of design work depends on knowledge and experience of the designer.

When designer starts working on system design, he will face different type of problems. Many of these will be due to constraints imposed by the user or limitations of the hardware and software available in the market. Sometimes, it is difficult to enumerate the complexity of the problems and solutions thereof since the variety of likely problems is so great and no solutions are exactly similar. However, following considerations should be kept in mind during the system disigning phase :

1.2.1 Design Objectives

The primary objective of the design, of course, is to deliver the requirements as specified in the feasibility report. In general, the following design objectives should be kept in mind:

(a) Practicality: The system must be stable and can be operated by people with average intelligence.

(b) Efficiency: This involves accuracy, timeliness and comprehensiveness of the system output.

(c) Cost: It is desirable to aim for a system with a minimum cost subject to the condition that it must satisfy all the requirements.

(d) Flexibility: The system should be modifiable depending on the changing needs of the user. Such modifications should not entail extensive reconstructing or recreation of software. It should also be portable to different computer systems.

(e) Security: This is very important aspect of the design and should cover areas of hardware reliability, fall back procedures, physical security of data and provision for detection of fraud and abuse.

System design involves first logical design and then physical construction of the system. The logical design describes the structure and characteristics of features, like the outputs, inputs, files, databases and procedures. The physical construction, which follows the logical design, produces actual program software, files and a working system.

1.2.2 Constraints

The designer normally will work under following constraints:

Hardware	:	The existing hardware will obviously affect the system design.
Software	:	The available software (operating system, utilities, language etc.) in the market will constrain the design.
Budget	:	The budget allocated for the project will affect the scope and depth of design.
Time-scale	:	The new system may be required by a particular time (e.g. the start of a financial year). This may put a constraint on the designer to find the best design.
Interface with other systems	:	The new system may require some data from another computerised system or may provide data to another system in which case the files must be compatible in format and the system must operate with a certain processing cycle.

1.2.3 Processing Techniques

The processing options available to the designers are:

- Batch processing
- Real-time processing
- On-line processing

— A combination of all the above

You are already aware of these techniques. It is quite interesting to note, however, that a combination of these is often found to be ideal in traditional data processing applications. This increases through-put of the system as also brings down the response time of on-line activities. In most of the business applications, 24-hour data is acceptable enough and hence it is possible to update voluminous data after office-hoursin batch mode.

1.2.4 Operation

Typically, the flow of data through a system has been shown in Figure 1. Throughout the design process as described in the next section, the system designer must consider and specify the requirements of each of these operational areas.

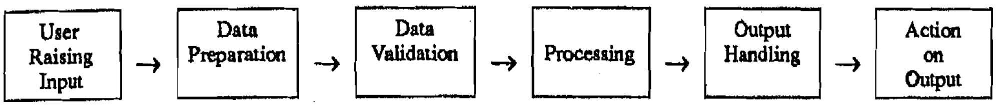

Figure 1: Data Flow

1.3 DESIGN METHODOLOGIES

The scope of the systems &sign is guided by the framework for the new system developed during analysis. More clearly defined logical method for developing system that meets user requirements has led to new techniques and methodologies that fundamentally attempt to do the following:

— improve productivity of analysts and programmers

— improve documentation and subsequent maintenance and enhancements.

— cut down drastically on cost overruns and delays

— improve communication among the user, analyst, designer, and programmer.

— standardize the approach to analysis and design

— simplify &sign by segmentation.

1.4 STRUCTURED DESIGN

Structured design is a data flow based methodology. The approach begins with a system specification that identifies inputs and outputs and describes the functional aspects of the system. The specifications, then are used as a basis for the graphic representation. The next step is the definition of the modules and their relationships to one another in a form called a structure chart, using a data dictionary and other structured tools.

Logical design proceeds from the top down. General features, such as reports and inputs are identified first. Then each is studied individually and in more detail. Hence, the structured design partitions a program into small, independent modules. They arc arranged in a hierarchy that approximates a model of the business area and is organized in a top-down manner. Thus, structured design is an attempt to minimize the complexity and make a problem manageable by subdividing it into smaller segments which is called Modularisation or decomposition. In this way, structuring minimizes intuitive reasoning and promotes maintainable provovable systems.

A design is said to be top-down if it consists of a hierarchy of modules, with each module having a single entry and a single exit subroutine. The primary advantages of this design are as follows:

- Critical interfaces are tested first.
- Early versions of the design, though incomplete, are useful enough to resemble the real system.

- Structuring the design, perse, provides control and improves morale.
- The procedural characteristics define the order that determines processing.

1.4.1 Major System Design Activities

Several development activities are carried out during structured design. They are data base design, implementation planning, system test preparation, system interface specification, and user documentation.

(a) Data base design: This activity deals with the design of the physical database. A key is to determine how the access paths are to be implemented.

(b) **Program design:** In conjunction with database design is a decision on the programming language to be used and the flowcharting, coding, and debugging procedure prior to conversion. The operating system limits the programming languages that will run on the system.

(c) **System** and **program test preparation:** Each aspect of the system has a separate test requirement. System testing is done after all programming and testing are completed. The test cases cover every aspect of the proposed system, actual operations, user interface and so on. System and program test requirements become a part of design specifications - a pre requisite to implementation.

In contrast to the system testing is acceptance testing, which puts the system through a procedure design to convince the user that the proposed system will meet the stated requirements. Acceptance testing is technically similar to system testing but politically it is different. Acceptance testing is conducted in the presence of the user, audit representatives, or the entire staff.

1.4.2 System Interface Specification

This phase specifies for the user how information should enter and leave the system. The designer offers the user various options. By the end of the design, formats have to be agreed upon so that machine- machine and human-machine protocols are well defined prior to implementation., Before the system is ready for implementation, user documentation in the form of a operator's manual must be prepared. The manual provides instructions on how to install and operate the system, how to provide input, how to access, update, or retrieve information, how to the display or print output, in what format, and so on.

1.4.3 Audit Considerations

A well designed system should have controls to ensure proper operation and routine auditing. A proposed system's failure often results from a lack of emphasis on data control. When designing the system, standards of accuracy, consistency, and maintainability musl be specified to eliminate errors and control for fraud. A system design introduces new control elements and changes the control procedures. In a manual system, internal control depends on human judgement, personal care, and division of labour. In a computer-based system, the number of persons involved is considerably reduced. A software packages is an effective substitute for human judgement in processing routines and error checks.

1.4.4 Audit Control and Documentation Control

An important function of system controls is to provide an audit trail. An audit trail is a routine designed to allow the analyst, user, or auditor to verify a process or an area in the new system. In a manual system, the audit trail includes journals, ledgers, and other documents that the auditor uses to trace transactions through the system. In a computerized system, record content and format frequently make it difficult to trace a transaction completely. The systems analyst must be familiar with basic auditing or work closely With an auditor to ensure an effective audit trail during the design phase. For auditing a system in a proper way, documentation is required. Documentation is the basis for the review of internal controls by internal or independent auditors. It also provides a reference for system maintenance. Analyst take lot of time in preparing the documentation.

Thus the main aim of auditing is to check that controls built into the design of proposed systems ensure its integrity. Audit considerations must be incorporated at an early stage in the system development so that changes can be made in time.

1.5 MODULARISATION

In structure design (already explained in section 1.4) a program is segmented into small, independent modules. These are arranged in a hierarchy that approximates a model of the business area and is organised in a top-down manner with the details shown at the bottom. Thus, in structured design, we try to minimise the complexity of the problem and make it manageable by sub-dividing it into smaller segments which is called modularisation or decomposition. This has been shown in Figure 2.

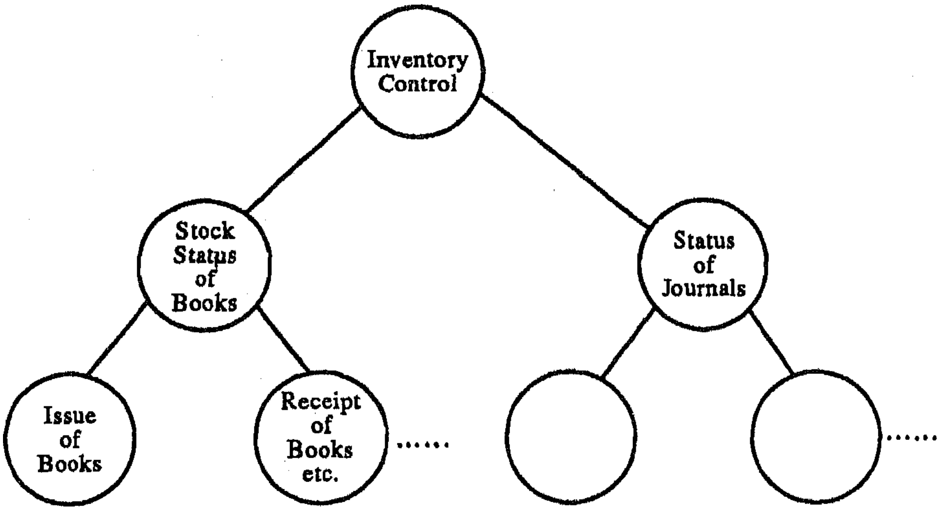

Figure 2: Decomposition - A Framework

Check Your Progress 1

1. Name the five objectives of system design

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2. List out some of the constraints under which a system designer has to work

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3. List out various processing techniques.

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4. What do you understand by structured design?

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So structured design arises from the hierarchical view of the application. The top level as shown in the Figure 2 shows the most important division of work; the lowest level at the bottom shows the details.

1.6 DESIGN PROCESS

The computer system design process is an exercise of specifying "how" the system will work. It is an iterative process which is based on "what" the system will do as shown in the feasibility report.

Mainly, following five parts have been included in the system design process:

(i) Output design: The starting point of the design process is the proper knowledge of system requirements which will normally be converted in terms of output.

(ii) Input design: Once the output requirements have been finalised, the next step is to find out what data need to be made available to the system to produce the desired outputs. The basic documents in which these data are available need to be identified. If necessary, these documents may have to be revised or new documents may have to be introduced.

(iii) File design: Once the input data is captured in the system, these may have to be preserved either for a short or long period. These data will generally be stored in files in a logical manner. The designer will have to devise the techniques of storing and retrieving data from these files,

(iv) Procedure design: This step involves specifications of how processing will be performed. In this, there are two aspects:

- Computer procedure
- Non-computer procedure

The computer procedure will specify what functions will be carried out on computer. what will be different programs and in what sequence the programs will be run. The non- computer procedure will specify the manual procedures for feeding input data, receiving outputs etc.

(v) Control design: The control design indicates necessary procedures which will ensure correctness of processing, accuracy of data, timely output etc. This will ensure that the system is functioning as per plan.

Generally, these steps as mentioned above are inter-dependent and some of them may have to be used together and traversed many times until a satisfactory design is prepared. It is just like the situation of "Two-step forward - one step backward" kind. In the Figure 3 we have tried to present an ideal situation about the progress of a project. But this situation occurs rarely in day-to-day life. Mast of the time progress of a project takes different shape which is shown in Figure 4.

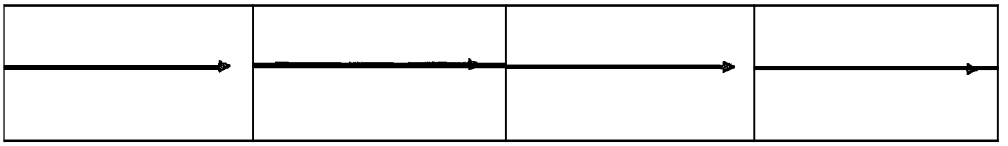

Figure 3: "Ideal" **Project Progress**

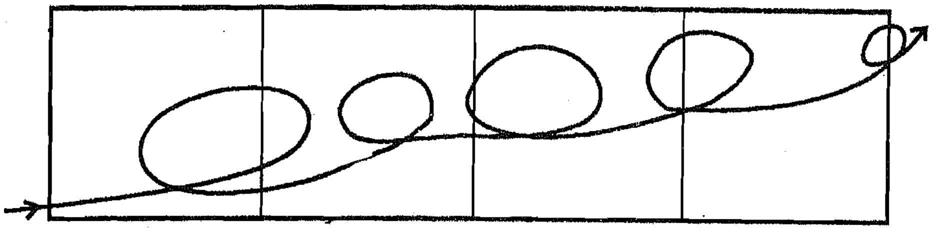

Figure 4; "Reality" of Project Progress

The system design process is, therefore, an iterative process where decisions made or changed at one step will have a **"ripple effect"** on other **steps.** For example, if an output report is **modified,** it may necessitate changes in input **design,** file &sign and control design.

In designing a system, if one tries to design a perfect **system,** it is his wrong conception. He may perhaps land up with no system at all. What is to be aimed at is the most satisfactory **a.ıd** operable design of a system and then gradual improvements over **time.**

1.7. SYSTEM SPECIFICATIONS

The result of the system design process is a document known as "system specifications". The complete details of **design** about the proposed system have been included in it. It serves as a blue print and helps in developing and implementing the new system. This also **forms** the primary documentation on which the system maintaining persons will fall back upon after the system is in use. Later on, this document is normally divided into different parts for easy reference. Thus we get system manual, user manual, operational manual, Since the system specifications are prepared as a plan, it **becomes** sometimes necessary to modify it after taking into consideration the practical difficulties or bottlenecks or errors found during later stages of development. System specifications should include all the details necessary to implement the system and to understand the whole working of the system.

1.8 PROTOTYPE DESIGN

Prototype is a **working** system that is developed to test ideas and assumptions about the new system. Like any computer-based system, it consists of working software that accepts input, **performs some** operations on it and gives the output. It is the first version of an information system - an **original** model.

The prototype is **actually** a pilot or test model. It is designed to be easily changed. Information gained through its use is applied to a modified design that may again be used **as** a **prototype** to reveal still better design information. The **process** is repeated as many times as necessary to reveal essential design requirements. In **general,** prototypes are **considered** to be most useful under the following conditions:

- No system with the characteristics of the one proposed has yet been **constructed** by the developers.
- The **essential** features of the system are only partially known; others are not identifiable **even** through careful analysis of requirements.
- Experience in using the system will significantly add to the list **of requirements the ,** system should meet.

- Alternate versions of the system will evolve through experience and additional development and refinement of its **features.**

  The system users will participate in the development process.

The underlying principle of **prototyping** is as under:

  Users can point out features they like or dislike and so indicate short-comings in an existing and working system more easily than they can describe them in a theoretical or proposed system. Experience and **use** produce more meaningful comment than analysis of charts and narrative proposals.

- Systems prototyping is an interactive process. It may begin with only a few functions and be expanded to include others that are identified later. It may also start with what both analyst and user believe is a complete set of functions that may **ex**pand or contract through **use** and experience.

Typically, these are the steps .in the **prototyping** process:

- Identify the user's known information requirements and features needed in the system.
- **Develop** a working prototype.
- **Use** the **prototype,** noting **needed** enhancements and changes. These expand the **list** of known system requirements.
- Revise the prototype based on information gained through user experience.
- Repeat these steps as needed to achisve a satisfactory system.

As **these** steps suggest, **prototyping** is not a **trial-and-error** development process. Before **starting** the system design work, user and system analyst sit together and discuss to identify the requirements. These discussions form the basis for the **construction** of the prototype. System analyst is fully responsible for the development of the working prototype.

Check Your Progress 2

1. List out the various parts of system design process.

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2. Define "system specifications" briefly.

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3. What do you know about "Prototype Design "?

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1.9 SUMMARY

The role of system analyst is considered to be very significant in designing of system.

During this stage, he applies his understanding of the procedures and converts them into an efficient system. The design is a solution-translation of requirements into ways of meeting them. The design phase focuses on the detailed implementation of the system recommended in the feasibility study. Emphasis is on translating performance specifications into &sign specifications. The design phase is a transition from a user-oriented document to a document oriented to the programmers or data base personnel. System design is not an exact science like programming where a set of instructions would lead to a desired result. As the subject involves lot of interaction with the users, it has to be flexible and dynamic to meet the changing needs of the users over a period of time.

1.10 MODEL ANSWERS

Check Your Progress 1

1. Five objectives are:

   (i) Practicability (ii) Efficiency

   (ii) Cost (iv) Flexibility

   (v) Security

2. Some of the constraints are:

   (a) Hardware (b) Software (c) Budget

   (d) Time-scale (e) Interface with other systems

3. Various processing techniques are:

   (i) Batch Processing

   (ii) Real-time Processing

   (iii) On-line Processing

   (iv) A combination of all the above

4. Structured design is a data flow based methodology. This approach begins with a system specification that identifies inputs and outputs and describes the functional aspects of the system. The next step is the definition of the modules and their relationships to one another in a form called a structured chart, using a data dictionary and other structured tools.

Check Your Progress 2

1. Five parts of system design process are:

   (i) Output design

   (ii) Input design

   (iii) File design

   (iv) Procedure design

   (v) Control design

2. The result of system design process is a document known as system specification. The complete details of design about the proposed system have been included in it. It serves as a blue print and helps in developing and implementing the new system.

3. Prototype is a working system that is developed to test ideas and assumptions about the new system. It is actually a pilot or test model. It is designed to be easily changed.