4.2 What is SSADM ?

Structured systems analysis and design is a well defined approach in the form of methodology. It is not new. SSADM is in fact a modified form of SDLC. Hence we can also call SSADM as SDLC using structured techniques.

SSADM consists of :

1) System Survey
2) Structured Analysis
3) Structured Design
4) Hardware Study
5) Implementation and
6) Maintenance

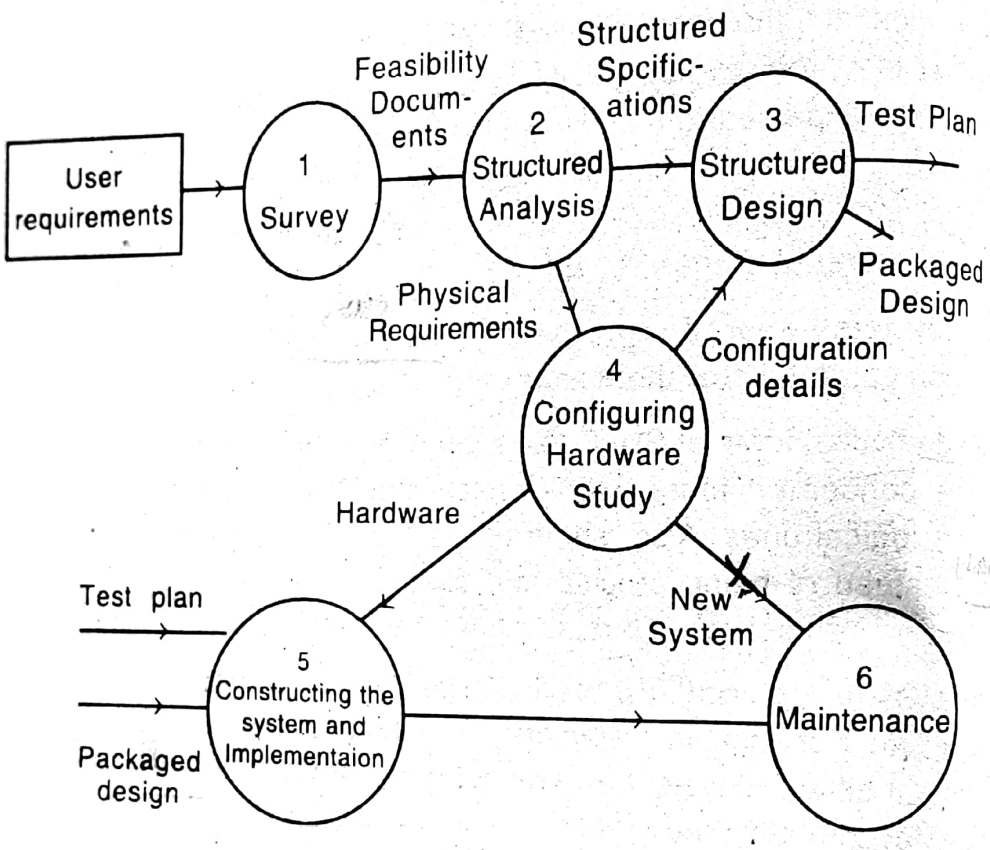


Fig 4.1

The structured analysis uses symbols instead of narrative descriptions and creates a graphic model of the system.

The SSADM involves data flow diagram (DFD) method of showing the movement of data through a system. The DFD's are free of unnecessary details and are therefore very useful in providing an overview of the system.

The structured analysis uses other tools like

1. Data Dictionary
2. Structured English
3. Decision Trees
4. Decision Tables

** [For Tools and Techniques refer chapters 6 to 20]

The term structured is borrowed from Structured Programming. The word structured generally imposes a structure or a disciplined approach on the design of the system.

SSADM Methodology

1. System Survey

The first step in SSADM is system survey. The subactivities in survey are

1. Identify the scope of the current system.
2. Identify and list the deficiencies in the current system by taking into consideration the user requirements.
3. Establish new system goals and identify the constraints.
4. Prepare a document consisting of
   - goals and objectives
   - customized project life cycle
   - constraints regarding technical and procedural aspect
   - cost benefit analysis

This phase is similar to feasibility study in SDLC

2. Structured Analysis

The second stage in SSADM is Structured Analysis which is the most important part. Structured Analysis is a set of techniques and graphical tools. They allow the analyst to develop a new kind of system specifications that are easily understandable to the user. Here the analyst uses graphic symbols, Data Flow Diagrams (DFDs) and Data Dictionaries (DDs) to represent the system.

Note :

1. The DFDs are graphic representation of data movement, process and files (Data Store) used in support of an information system.

2. The Data Dictionary contains a list of terms and their definitions for all data items and data stores of a system.

In preparing the model, the analyst concentrates on 'What' occurs rather than on 'How' it is accomplished. Thus, the focus is on 'logical' rather than 'physical' aspect of the system.

The step 2 in figure 4.1 is exploded in a detailed manner in figure 4.2 to explain clearly what happens in the structured analysis step.

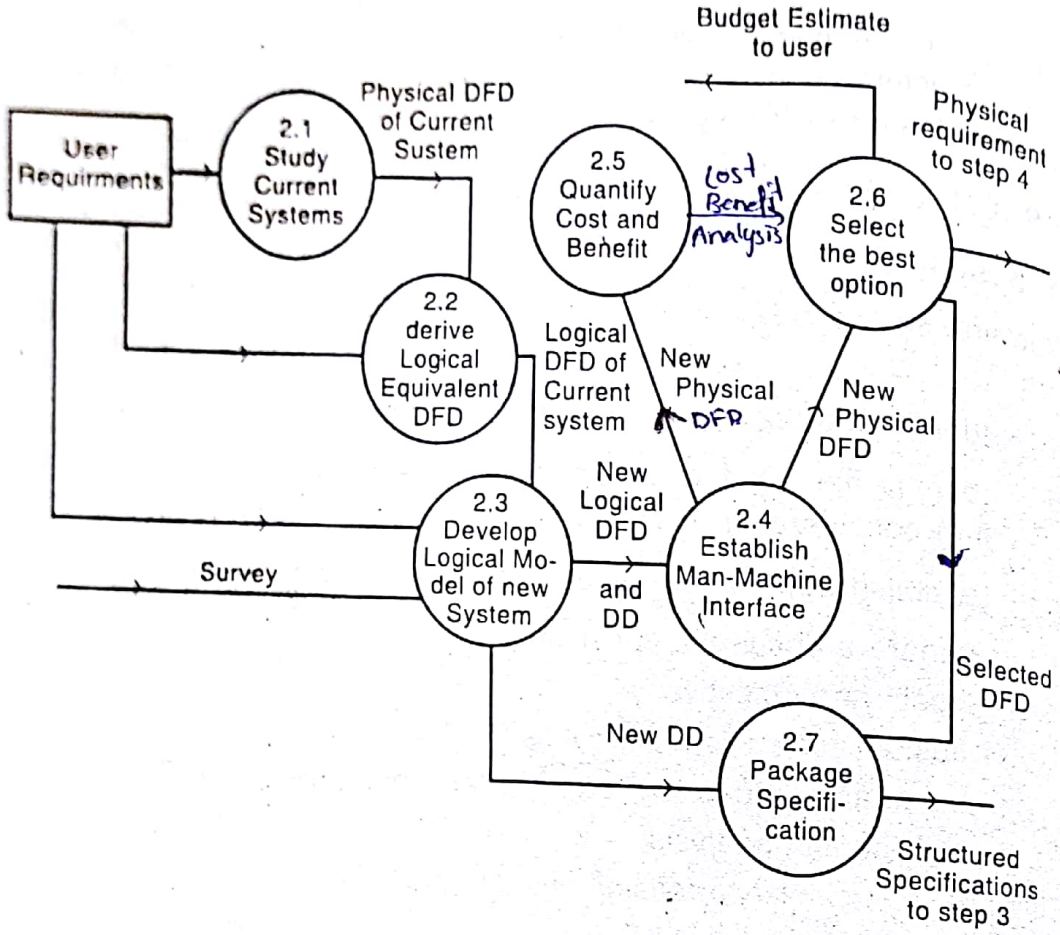


Fig 4.2

The reader will notice clearly the progression from modeling of existing system to modeling of new system in structured analysis. The progress is graphically shown in figure 4.3

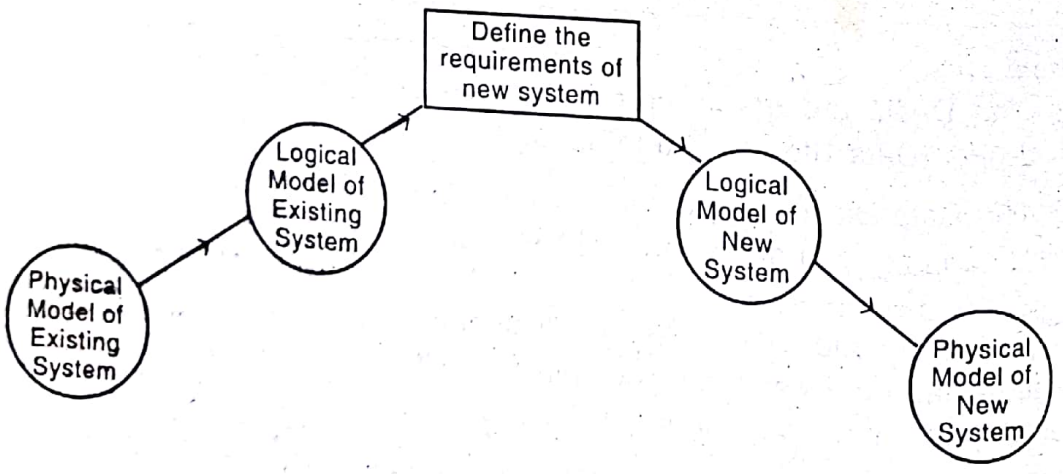


Fig 4.3

We shall discuss the sub processes shown in figure 4.2 to understand the structured analysis.

Subprocess 2.1 : To study current system : Here while studying the current system, the analyst identifies

1. The external entities
2. The list of processes performed in the current system
3. Sequence of these processes
4. Data used for the processes
5. How the processes are performed etc.

Ultimately, a physical model of the existing system in the form of a DFD evolves.

Subprocess 2.2 : To derive logical equivalent DFD

A physical model is a pictorial representation showing how the job is performed physically. This includes the sequence of operations, people, computer processing, paper forms etc. But to understand the information system properly it is necessary to know where from the data emanates? How does it move ? Where does it end ? etc.

This requires a pictorial representation of the system that shows what processes must be performed, the flow of the data through the system and the data stores (files) that are required. That is a logical DFD of the working of the current system is needed. This is what exactly the subprocess 2.2 does.

Subprocess 2.3 : Develop logical model of new system

The logical DFD obtained in 2.2 is modified on the basis of the survey conducted and according to users requirements. This new DFD will inform the user which requirements of his will be met. The output of this subprocess is a new logical DFD of the proposed system. The output will also include data elements, files, outputs, inputs etc. i.e. a new data dictionary.

Subprocess 2.4 : Establish man-machine interface

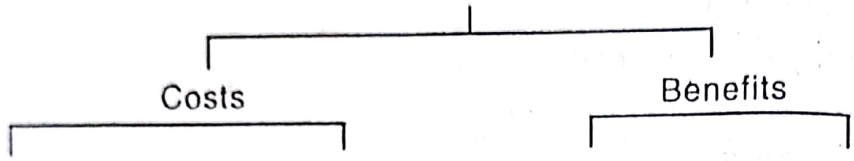
The output of 2.3 is the logical DFDs and DDs for the proposed system. But to bring this conceptual idea to the real life world, we need DFDs relating physical things like people, forms, computers and their relationships. This is done by preparing physical DFDs for proposed system in this subprocess. The activities in this subprocess include identifying

1. How will the new system work ?
2. Processes, sequence of processes, data used for the processes etc. and
3. The interaction between manual and automated process

The output of this subprocess is the new physical DFDs which will serve as the input for the sub processes 2.5. and 2.6

Subprocess 2.5 : Quantify Costs and Benefits :

Here, the various options are identified in terms of costs and benefits



One time cost	Recurring Cost	Tangible Benefits	Intangible Benefits
1.Cost of converting from present system to proposed system. 2.Construction or remodeling of existing facilities. 3.Hardware cost.	1. Salary of personnel 2. Supplies 3. Equipment maintenance.	1. Reduction in cost of operation. 2. Increased value in sales and net income. 3. Reduced time in completing the tasks.	1.Customer satisfaction 2.Better employee morale due to better facilities. 3.Better company image. 4.Satisfaction to management about entering into newer information technologies

The life span of the new system has to be decided by taking into consideration Net Present Value and Internal Rate of Return of the future cost benefits. The output of this subprocess will be the cost benefit analysis report which will serve as the input for subprocess 2.6.

Subprocess 2.6 : Select the best option

The inputs for this subprocess are cost benefit analysis report and physical DFD of proposed system. In this subprocess, the most important activity of taking the decision of selecting the best option is carried out. This selection outlines the hardware and software requirements.

The estimated budget for the proposed system is worked out. The outputs of this subprocess are

1. Estimated budget
2. Physical requirements and
3. DFDs for the selected option.

Subprocess 2.7 Package Specifications

Now that all the conceptual thinking of the analysis phase is over, the only remaining task is to collect the products of analysis and organize them into finished structured specifications. This process is called "Packaging". The final result of this is the structured specifications which consists of an interpreted set of DFDs, DDs and process descriptions. This is done through the usage of Structured English, Decision Tables and Decision Trees.

Step 3 : Structured Design

Structured Design is a data-flow based methodology. The input for structured design is structured specifications which is the output of structured analysis. It also receives input from the hardware study (Step 4)

What we do in the system design process is to convert the logical design specifications (i.e. structured specifications) into technical design specifications. In short, system design involves transforming a logical design into a physical design. This step is much more exacting than designing logical design specifications. Here the important activity is "Software Packaging". The Software Packaging includes

1. Input-output design
2. Files and Database design
3. Program design and
4. Control Design

Activities that run parallel to this detailed design steps of software packaging are

1. Equipment specifications
2. Test specifications and
3. User interface specifications

In fact, these parallel activities have their roots in structured analysis part. Here we refine and expand their specifications to make each one as concrete as possible. The process 3 in figure 4.1 is exploded into detailed subprocesses in fig 4.4

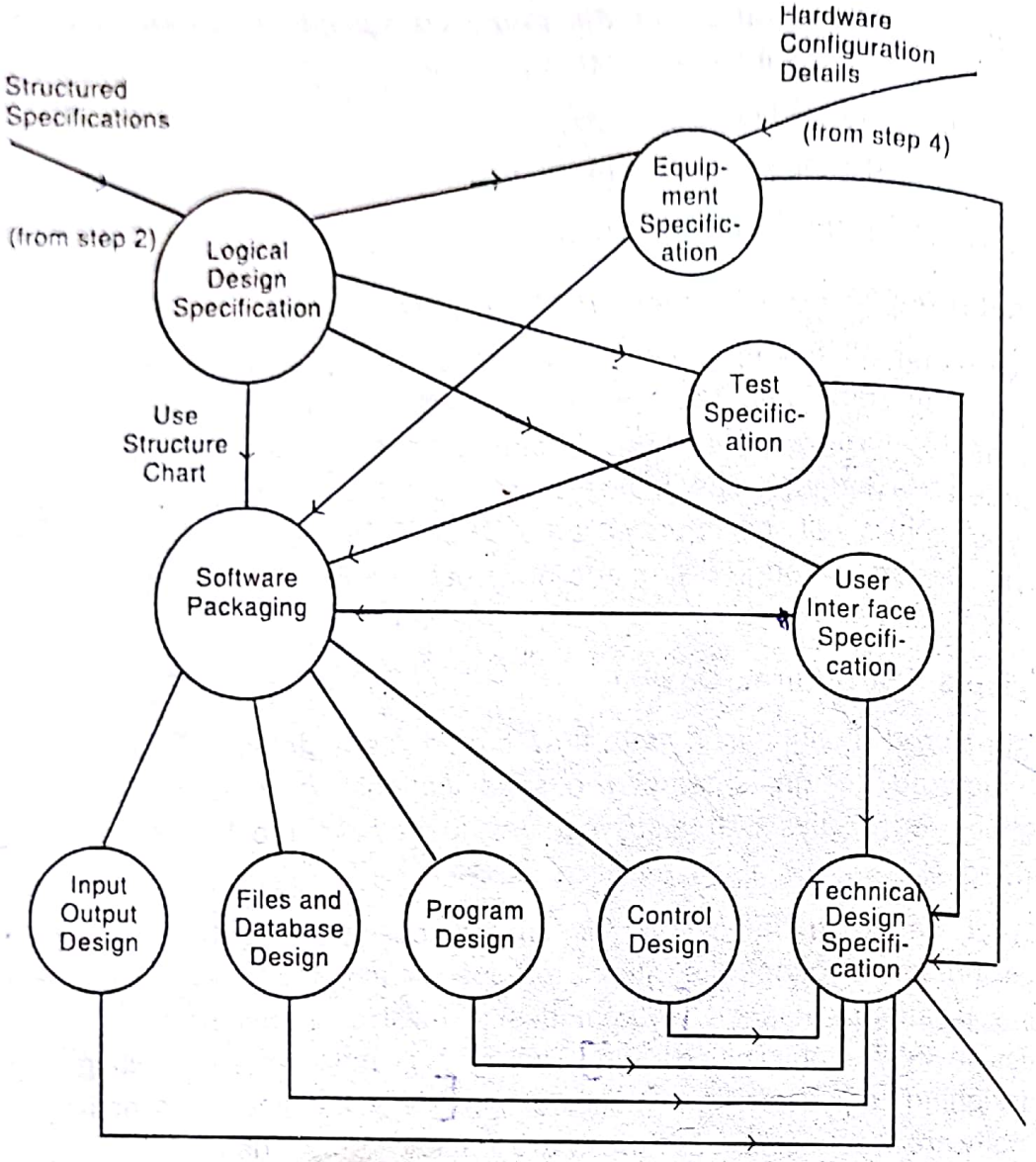


Fig. 4.4 The System Design Process

The main input, structured specifications (i.e. logical design specifications) is used to derive structure charts. The most difficult step in SSADM is that of converting DFDs of structured specifications into software packages. To do this, we need to construct what is called *Structured charts*. A *Structured chart* is a documentation technique. It shows the hierarchy of modules and their interrelationships in a program or a system.

While a DFD considers a sequential order of processes the structured chart begins with the most important process (BOSS) and then goes on to its subordinate processes. The top level of structured chart shows the most important division of work, the lowest level at the bottom shows the details. This is essential to divide the total design

process into smaller independent modules which in turn help to have flexibility in the design, i.e. any changes made in one particular module will not affect the other modules. Hence this technique provides a top-down, flexible design which is easier to maintain.

To maintain a dialogue with users during the process of system design is often difficult. Wise designers make it a point to involve users at several stages in the design and more particularly in the earlier stages of the design itself. For this, they use a technique called Structured Walk through. A Structured Walk through is an organized step by step tracing through of a design by a group of people. The group may be peer group or users. The purpose of Walk through is to find where improvement can be made in the system or in the development process. There are two types of Structured Walk throughs

1. A Preliminary Design Walk through
2. A Detailed Design Walk through

In addition a Pseudocode Walk through is performed just before a design is coded.

Walkthroughs are conducted

1. To catch design errors in advance
2. To improve communication and
3. To fine tune a design

Step 4 : Configuring Hardware Study

This step considers the physical requirements of the proposed system. It is based on the new physical DFDs, DD of Step 2.

Here we should specify the details of the configuration to be used in the implementation stage. These configuration details go as input for equipment specification process in Step 3. The cost involved and the present worth of the benefits to be incurred are considered here for hardware specifications.

Step 5 : Constructing the System and Implementation

The implementation process begins after the management has accepted the new system. System implementation consists of five components

1. System Acquisition
2. Programming
3. Testing
4. Conversion
5. Documentation

1. System Acquisition : It involves the purchase of hardware, packaged software and software services. Here the systems analyst and designer

work together to determine the best place to make these outside purchases. Another important part of system acquisition is the actual purchase of goods and services.

2. Programming : It is the writing of instructions to be read and executed by a computer. Programming is performed by computer programmer or programmer/analyst rather than by systems analyst or designers. Normally a team of programmers work under the direction of lead programmer-typically a system designer. Tasks in programming include writing the coded instructions, testing each segment of the code and testing the entire computer programme once it is completed.

3. Testing : It consists of putting together the various coded pieces of a design, testing them and correcting the parts of the code or the design that are not correct. At this stage some errors are introduced purposely to test whether they will be spotted by the program.

4. Conversion : Once the system has been tested successfully then the part which remains is that of putting them into the operation. The conversion team must manage the smooth changeover from the old system to the new system. This requires

1. Training of personnel
2. Modifying parts of the old system
3. Running parallel system or dual system until everything goes as planned.

5. Documentation : Documentation means putting it in the written form about how a system is designed or functions. The documentation includes

1. Design Documentation : It describes the overall system design and includes system flowcharts, all input/output formats, file description, control requirements and report specifications.
2. Program Documentation : It consists of programming specifications like program logic, graphic aids, input-output formats etc.
3. Training Documentation : It includes user training manuals and materials to be used in the conversion and the installation of new system.
4. Operations Documentation : It contains instructions for normal operations as well as directions for handling problems and breakdowns.
5. User reference Documentation : It carries on after training is over and the system is installed. It should provide quick, clear answers like a dictionary.

Step 6 : Maintenance : This is the last step in the system life cycle. However it takes the longest duration. Maintenance may be corrective, adaptive or perfective. In corrective maintenance errors or bugs are rectified. In the adaptive maintenance the user requirements if any are still considered and the necessary changes are made. In perfective maintenance efforts will be constantly going on to perfect the system in terms of response time and resource requirements.

4.3 Advantages of SSADM

Some of the important advantages of SSADM are :

1. Good Documentation : In the structured methodology well defined documentation takes place. Hence it is easy for the analysts, users and programmers to understand and use.
2. Better Communication : Since structured methodology is graphic it provides easy to understand presentation of the application. The DFD, for example, presents a better picture than any other comparative tool.
3. Standardization : Before the emergence of the structured methods, the systems analyst used to have their own methods of designing computerized system. But structured methodology offers very little scope for individual approach.
4. Modularisation : The process is partitioned so that we have clear picture of the smaller modules which is essential to understand the system thoroughly.
5. Logical Design : The SSADM is more logical than physical. The elements of the system do not depend on vendor or hardware.
6. User oriented : The SSADM consults user at every stage of development thereby leaving no scope for rejection after the system is implemented.
7. Maintainability : The need for maintenance arises due to errors, modified user requirements and enhancements. The structured methodology takes into account this aspect, hence maintenance becomes cheaper.

REVIEW QUESTIONS

1. State the limitations of SDLC.
2. What is SSADM ?
3. List the stages of SSADM.
4. Discuss in brief :
   a) Survey in SSADM
   b) Structured Analysis
   c) Hardware Study

"A picture is worth a thousand words"

CHAPTER 7

FLOW CHARTING

7.1 What are Flowcharts ?

A graphical picture of the sequence of operations of a Program or an Information System is called a flowchart.

Flow charting is the most common method of describing procedures in a computer- based system.

7.2 Types of Flowcharts:

The following types of flowcharts are required to describe a system completely.

1. System Outline Chart : This presents a list of all inputs, files, processes and outputs in a tabular form without bothering about the sequence of operations. It helps in checking for duplication and discrepancies in operations/events. The system flowchart which will be described next must be consistent with the system outline chart.

2. System Flowchart : A system flowchart depicts the flow of data through all parts of a system with minimum of details. Generally, it shows where the input enters the system, how it is processed and controlled and how it leaves the system in the form of storage or output.

In a system flowchart emphasis is placed on input documents and output reports. Only limited details are furnished about how a work station or machine converts input data into the desired output.

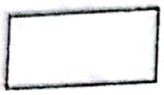
However, it should be noted that system outlines and system flowcharts can be drawn for a complete system or a sub-system only.

3. Computer Run-Chart: It can be regarded as a master plan of the computer sub-system. They are prepared in EDP environment. The computer run-chart depicts the interrelationship and where relevant, sequence of the computer routines to be performed showing inputs, files and outputs. This is required in the design of the computer aspects of a new system.

4. Computer Procedure Flowchart or Program Flowchart : A computer procedure flowchart depicts in more detail the process and symbols shown on a computer run chart. In short, they show the sequence of

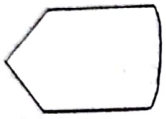
instructions in a single program (Program Logic). Hence it is also known as Program Flowchart. Program Flowchart provides complete and detailed sequence of logical operations to be performed in the central processing unit of the computer for executing the program. It is used to portray various arithmetical and logical operations of steps which must be accomplished to solve the problem. Generally, the programmers use this to translate the elementary step of a procedure into a program of coded instructions.

7.3 Flow Charting Symbols :



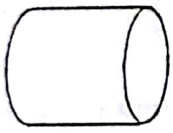
Punched card :
used to show any data punched into cards

Document :
used to show any printed document input or output .

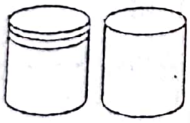


Online display :
used to represent any data or information displayed by the computer system

Paper tape :
used to represent any data stored on paper tape

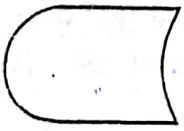


Magnetic drum :
used to represent any data stored on magnetic drum

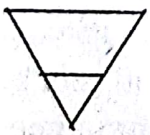


Magnetic disk :
used to represent any data stored on magnetic disk

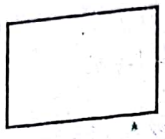
Magnetic tape :
used to represent any data stored on magnetic tape



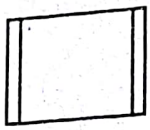
Online storage :
used to represent any online storage device



Office storage :
used to represent any data stored offline

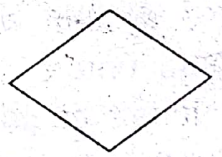


Computer processing :
used to indicate any processing performed by a computer system



Predefined-processing
used to indicate any process not specifically defined in the flowchart (but perhaps defied elsewhere in another flowchart)

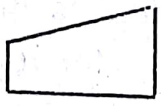
input/output :
used to show any input/output operation



Decision :
used to show any point in the process where a decision must be made to determine further action

Sorting :
used to show any operation that involves sorting or ordering data

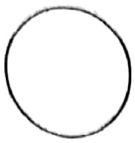
Manual operation :
used to indicate any operation performed offline that does not require mechanical devices



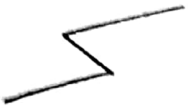
Manual input :
used to indicate any input operation that is not mechanical

Auxillary operation :
used to indicate any mechanical process that supplements the main computer processing

Descriptive Symbols
Directional flow :
used to show the direction or sequence of processing and other events

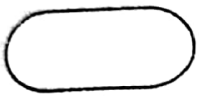


Connector :
used to connect different entry and / or exit points in the flowchart



Communication link :
used to show any transmission of data by communication methods

Offpage connector :
used to connect parts of flowcharts continued on separate pages



Terminal :
used to show the beginning and end of a set of computer related processes

7.4 Principles of Flowcharting :

It is necessary to keep the flowchart clear and easy to follow. This can be done by :

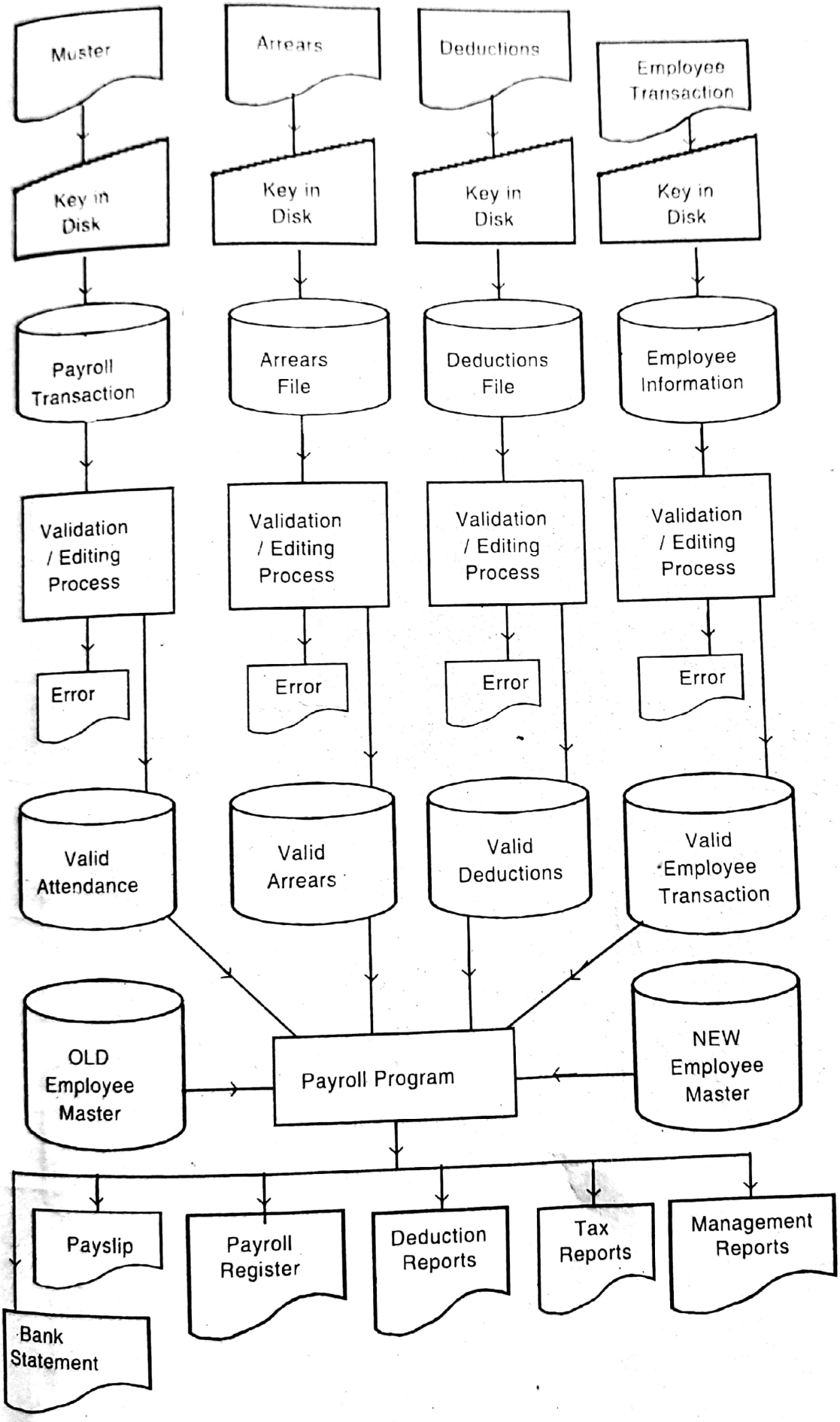
1. Ensuring that the flowchart has a logical start and finish.
2. Use standard symbols and templates.
3. Write the operations within the symbols in a precise manner.
4. Avoid crossed flow lines wherever possible.
5. Use simple yes or no decisions.
6. Try to keep the direction of flow of the chart down the page and left to right.
7. Use connector symbols wherever necessary.
8. Finally check whether the flowchart is logically correct and complete.

Illustration 5: College Payroll System

1) System outline chart :

<table>
<tr><td colspan="2">Title-College Payroll System</td><td>System
Payroll</td><td>Document
No.
D-01</td><td>Name
Payroll
Process</td><td>Sheet
1</td></tr>
<tr><td colspan="3">Inputs
1. Muster
2. Leave Applications
3. New Employee Details
4. Arrears Details
5. Deductions Details
6. Norms and Parameters</td><td colspan="3">Processes
1. Prepartion of Attendence and Leave Statements
2. Preparation of Payroll Register
3. Prepare Bank Statements and Deduction Reports</td></tr>
<tr><td colspan="3">Files
1. Employee Master File
2. Attendance File
3. Leave Record File
4. Leave Summary File
5. Arrears File
6. Deduction Summary File
7. Current Payroll File</td><td colspan="3">Outputs
1. Payslips
2. Payroll Register
3. Deduction Reports
4. Tax Reports
5. Management Reports
6. Bank Statements</td></tr>
<tr><td colspan="6">Date :
Sign :</td></tr>
</table>

2) System Flow Chart :



"If the rules are crystal clear, decisions become routine"

CHAPTER - 8

DECISION TABLES AND DECISION TREES

A Decision Table (DT) is a visual means for showing how a rule (or set of rules) applies to repetitive situations. The DT is a tool of the programmer as well as that of the systems analyst. It can be used either as a substitute for the flowchart or used to supplement the flowchart.

8.1 What is a Decision Table ?

When the solution to a problem involves substantial logical decisions, the various conditions and possible actions involved can be represented in the form of a Table. This table is known as Decision Table.

The physical layout of a DT is as given below :

Header (H)	Rule (R) Identifiers					
Condition Statements or Condition (CS)			Condition Entry Stub (CE)			
Action Statements or Action Stub (AS)			Action Entry (AE)			
Notes: (NB)						

8.2 We shall understand the decision table by means of an illustration:

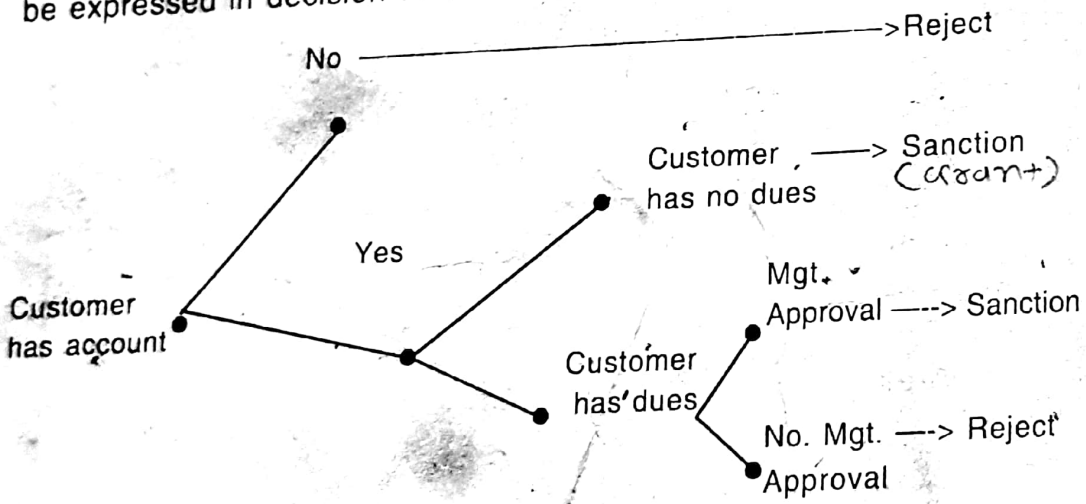
Illustration CASE STUDY - 1

A Co-operative bank XYZ will grant loans under the following conditions :-

1. If a customer has an account with the bank and has no loan outstanding, loan will be granted.
2. If a customer has an account with the bank but some amount is outstanding from previous loans, then loan will be granted if special management approval is obtained.
3. Reject loan applications in all other cases.

Before going to decision tables, we shall get an idea about the utility of decision trees. Decision trees are a graphical representation of decision tables. Their purpose is to aid the construction of decision tables. In fact decision tables and decision trees are means of expressing process logic. They may therefore, be used in conjunction with or in place of flow charts or pseudo code.

Decision Tree :- For example, the above mentioned illustration can be expressed in decision tree form as given below :



We can translate this into a decision table.

Method to draw Decision Table :

Step -1 List all conditions and actions.

Conditions : 1. The existence of a bank account with the Bank XYZ.
2. a) The customer's previous loan status.
b) Management approval.

Actions : 1. Grant loan.
2. Reject loan application.

Step - 2 : Combine conditions which only describe the only two possibilities of a single condition.

There are four possible combinations in this case :

Rules	Condition	Action
1.	Customer has account and no dues from previous loan	Grant loan
2.	Customer has account and some dues are there from previous loan and he has mgt. approval.	Grant loan
3.	Customer has A/c and some dues are there from previous loan and he has no management approval.	Reject loan application
4.	Customer has no A/c	Reject loan application

Note :

The maximum number of rules is in general 2^n where n is the number of conditions. e.g., one condition leads $2^1 = 2$ rules, two conditions lead to $2^2 = 4$ rules and so on.

However, an analysis of the conditions and actions depicted in a decision table often shows that many rules are irrelevant. One has to use his own judgment to ward off irrelevant rules.

Placing these in our Decision Table, we have :

(H)	Decision Table No.1	R1	R2 (R)	R3	R4
(CS)	C1 : Customer has bank A/c C2 : Customer has no dues C3 : Customer has mgt. approval	Y Y - (CE)	Y N -	Y N -	N - -
(AS)	A1 : Grant loan A2 : Reject loan application	X - (AE)	X -	- X	- X

Note 1 : Y stands for "Yes", N stands for "No" and X stands for' Applicable'.

Note 2 : Now we can understand the layout of a decision table in a better way.

H This gives the decision table name or number.

R This gives you the rule entry such as Rule 1, Rule 2, Rule 3, Rule 4, etc.,

NB In case any additional information is to be provided then it is useful.

CS Condition Stub: These are statements which introduce one or more conditions. These can be identified as C1, C2, C3, ...

CE Condition entry: Entries that complete condition statements. Generally symbols used for condition entries are :

Y (Yes), N (No), > (Greater than), = (Equal to), - (Blank)

AS Action Stub : statements which induce one or more action. Actions can be identified as A1, A2, A3,.....

AE Action Entries : Entries that complete the action statements. Symbols used are :
X (applicable)
- (blank)

Illustration CASE STUDY - 2

A Manufacturing company has stated the following rules to prepare an invoice:

On the orders booked on or before 15-2-1992, offer a discount of 10% on the items listed and displayed in the advertisements. Additional 2% discount is offered to the appointed dealers.

If the customer is within Maharashtra State and has sales tax exemption certificate no sales tax is levied; otherwise 8% sales tax is charged on the sales value. If the customer is outside Maharashtra State, 4% central sales tax in place of sales tax, is charged.

For charging excise duty there are categories. Category 1 attracts 10% excise duty while category 2 is exempted from excise duty.

Form three independent decision tables respectively for discount, sales tax and excise duty to represent these rules.

(1) Decision Table for Discount.

Conditions

1. a. The date of order is on or before 15-2-92.
   b. Whether the items are listed and displayed in advertisements
2. Customer Type :
   Dealer or Non-Dealer.

Decision Table for Discount	R1	R2	R3	R4
C1 1. Whether the date of order is on or before 15-2-92 and item is listed	Y	Y	N	N
C2 2. Customer is a dealer	Y	N	Y	N
A1 10%	-	X	-	-
A2 12%	X	-	-	-
A3 No Discount	-	-	X	X

(2) Decision Table for Sales Tax

Decision Table for Sales Tax	R1	R2	R3
C1. Whether the customer is from Maharashtra	Y	Y	N
C2 Whether customer has sales tax exemption certificate	Y	N	-
A1 No S.T.	X	-	-
A2 8% -	X	-	-
A3 4% -	-	X	-

(3) Decision Table for charging Excise Duty.

Condition 1

C1 = Whether category 1 or not.

Decision Table for Excise Duty		R1	R2
C1.	Whether belonging to category 1	Y	N
A1	10%	X	-
A2	Nil	-	X

Illustration CASE STUDY - 3

Income tax deduction is made in the month of March from the salary using the following rules. Prepare the decision table.

a) If the total income is less than Rs. 22,000, then no tax is deducted.

b) If total income exceeds Rs. 22,000 but does not exceed Rs.30,000, then the deduction is 20% of the amount which exceeds Rs. 22,000.

c) If the total income exceeds Rs. 30,000 but does not exceed Rs. 50,000 then the deduction is Rs. 1600 + 30% of the amount which exceeds Rs. 30,000.

d) If the total income exceeds Rs. 50,000 but does not exceed Rs. 1,00,000 then the tax is Rs. 7600 + 40% of amount which exceeds Rs. 50,000.

e) If the total income exceeds Rs. 1,00,000 then the tax is Rs. 27,600 + 50% of the amount which exceeds Rs. 1,00,000.

f) 20% rebate in tax of the face value of the investment under section 80 C is available. The rebate is subject to a maximum of Rs. 6000.

Decision Table for Tax Calculation	R1	R2	R3	R4	R5
C1. Is the total Income X < 22000	Y				
C2. 22000 < X <= 30000		Y			
C3. 30000 < X <= 50000			Y		
C4. 50000 < X <= 100000				Y	
C5. X > 100000					Y
A1. No Tax	X				
A2. (X - 22000) * 20/100 - 20/100 * I		X			
A3. 1600 + 30/100(X - 30000) - 20/100 * I			X		
A4. 7600 + 40/100(X - 50000) - 20/100 * I				X	
A5. 27600 + 50/100 (X - 100000) - $\left(\frac{20}{100}\right)$ * I					X

NB :I = Investments up to Rs 30000.
(Rebate in tax is available up to Rs. 6000)

X = Total Income of a person.

8.3 Types of Decision Tables :

Decision Tables are mainly of two types:

1. Limited Entry Decision Table.
2. Extended Entry Decision Table.

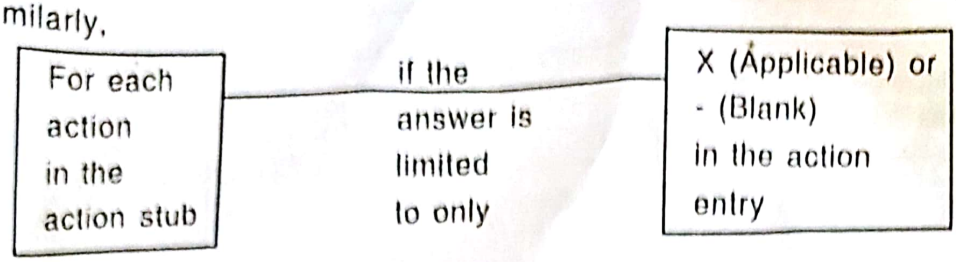
8.3.1. Limited Entry Decision Table :

In a limited entry table, the entries give simple 'Yes' and 'No' answers to condition and action statements.

For each condition in the condition stub — if the answer is limited to only — Yes (Y) or No (N) or Irrelevant (-) in the condition entry

then it is ' Limited Condition Entry D.T. '.

Similarly,



then it is ' Limited Action Entry D.T. '.

If the reply in both the condition and action entry parts are limited as mentioned above the D.T. is known as ' Limited Entry DT '. If you refer back to the illustrations 1, 2, 3, you will observe that those tables are all Limited Entry Decision Tables.

Note : With a limited entry table the statement of condition or action is completely contained in the appropriate stubs themselves.

8.3.2. Extended Entry D.T. :

In an extended entry decision table, the statements made in the stub portions are incomplete. Both the stub and entry portions of any particular row in the table must be considered together to decide if a condition or action is relevant to a given rule. An extended condition entry is either descriptive or in quantified form.

Let us consider an illustration to understand the distinction between Limited Entry Decision Table and Extended Entry Decision Table.

Illustration CASE STUDY - 4

The discount policy of a manufacturer producing two products :-

1. Mechanical Typewriter and
2. Electronic typewriter and who has three types of customers (R) Retailers, (D) Dealers, (I) Institutions is given below.

Rules : In the case of Mechanical Typewriter

1. If the order is from retailer for amount up to Rs.5000/- he allows 6% discount.
2. If the order is from dealer for amount up to Rs. 5000/-, 7.5% discount is given.
3. On retail order exceeding Rs. 5000/-, 7.5% discount is given.
4. If the order is from dealer for an amount exceeding Rs. 5000/-, 11% discount is allowed.
5. In all the above cases a flat discount of 7.5% is given to institutions.
6. In the case of electronic typewriter a flat discount of 6% is given regardless of amount or customer.

Limited Entry Decision Table for Discount Policy.

Decision Table for Discount Policy	R1	R2	R3	R4	R5	R6
C1 : PRODUCT = 1 ?	Y	Y	Y	Y	Y	N
C2 : CUSTOMER = R ?	Y	-	Y	-	-	-
C3 : CUSTOMER = D ?	-	Y	-	Y	-	-
C4 : CUSTOMER = I ?	-	-	-	-	Y	-
C5 : ORDER AMOUNT <= 5000 ?	Y	Y	N	N	-	-
A1 : DISCOUNT 6 %	X	-	-	-	-	X
A2 : DISCOUNT 7.5 %	-	-	-	-	X	-
A3 : DISCOUNT 7.5 %	-	X	X	-	-	-
A4 : DISCOUNT 11 %	-	-	-	X	-	-

Extended Entry Decision Table for Discount policy.

Decision Table for Discount Policy	R1	R2	R3	R4	R5	R6
C1 : PRODUCT CODE	1	1	1	1	1	2
C2 : CUSTOMER CODE	R	D	R	D	I	-
C3 : ORDER AMOUNT	<= 5000	<= 5000	> 5000	> 5000	-	-
DISCOUNT	6%	7.5%	7.5%	11 %	7.5%	6%

Mixed Entry Decision Table For Discount policy

Decision Table for Discount Policy	R1	R2	R3	R4	R5	R6
C1 : PRODUCT CODE=1 ?	Y	Y	Y	Y	Y	N
C2 : CUSTOMER CODE	R	D	R	D	I	-
C3 : ORDER AMOUNT <= 5000	Y	Y	N	N	-	-
DISCOUNT	6%	7.5%	7.5%	11%	7.5%	6%

Note 1 : As one can verify, limited entries inevitably mean, that more details are needed in the stubs as compared to extended entry DT. Also, more rows appear in the action part of the limited entry DT.

Note 2 : The advantage of the extended entry method is a saving in space. However, it should be noted that an extended entry table can always be converted to a limited entry form.

Note 3 : Linked Decision Tables or Problems. These are tables wherein action of some rules or all rules may tell you to go to another table and gives the name and number of that table.

Note 4 : Limited entry format and extended entry format can both be used in a single table for individual conditions or actions. Where a table contains both types of format, it is called a 'MIXED ENTRY D.T.'.

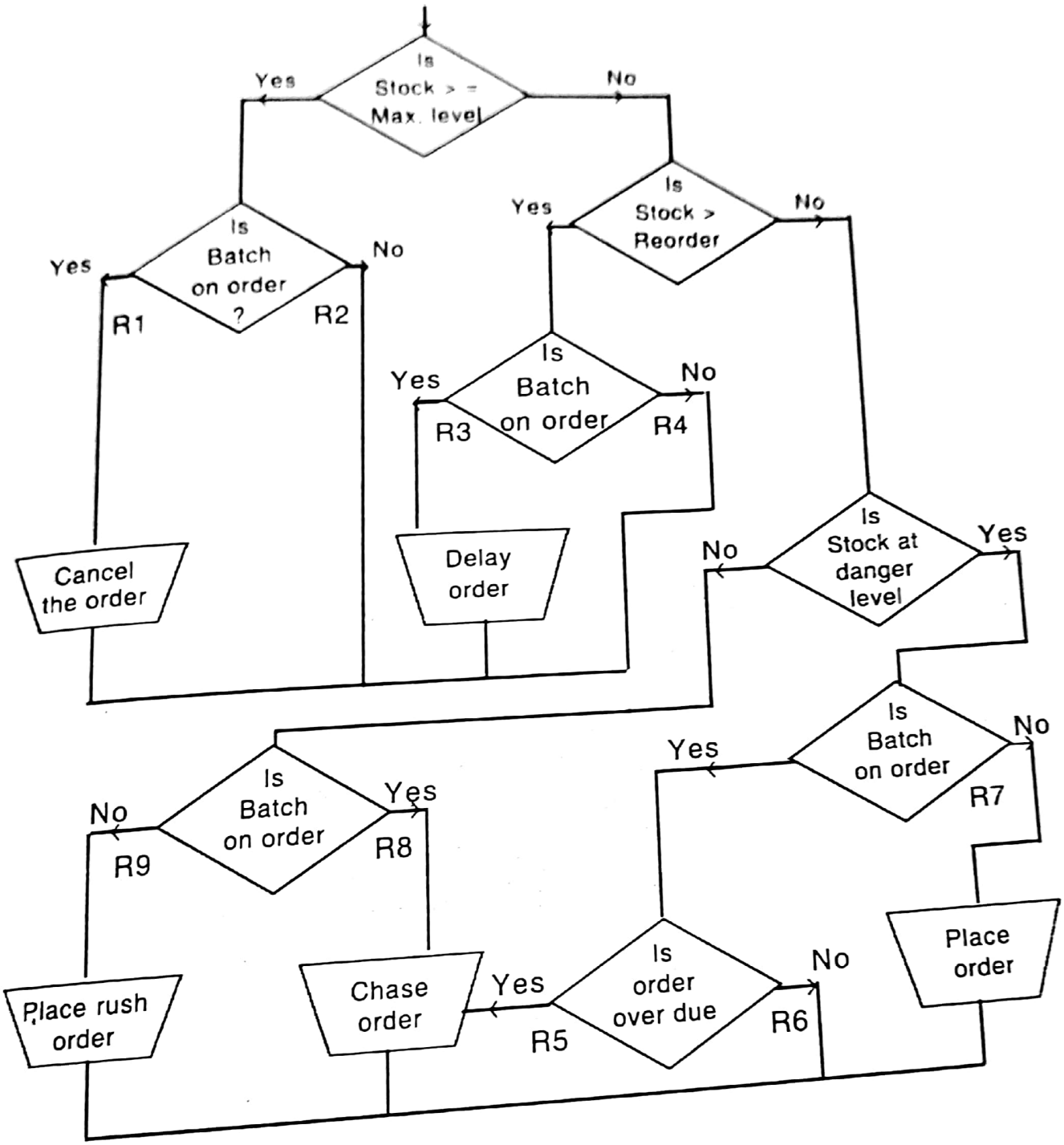
Illustration 5 : An inventory control procedure rules are given below :

1. If the stock-in-hand is >= Maximum level, then any batch on order is cancelled.
2. If the stock-in-hand has dropped to or below the re-order level, an order is placed unless a batch is already on order, in which case it is chased if overdue.
3. If re-order level stock-in-hand < maximum level, any batch on order is delayed.
4. When the stock in hand has dropped to the danger level any batch on order is chased otherwise a rush order is placed.

Solution :

We draw a flowchart indicating all the possible rules. This will facilitate the preparation of DT.

Flowchart :



One can easily verify that the table is a limited condition entry/limited action entry DT.

Inventory Control Decision Table	Rule Numbers								
	1	2	3	4	5	6	7	8	9
C1 : Is stock >= Max Level	Y	Y	N	N	-	-	-	-	-
C2 : Is stock > Reorder Leve	-	-	Y	Y	N	N	N	-	-
C3 : Is stock > Danger Level	-	-	-	-	Y	Y	Y	N	N
C4 : Is batch on order ?	Y	N	Y	N	Y	Y	N	Y	N
C5 : Is order overdue ?	-	-	-	-	Y	N	-	-	-
A1 : Cancel the order	X								
A2 : Delay the order			X						
A3 : Do nothing		X		X		X			
A4: Chase the order					X			X	
A5: Place an order							X		
A6: Place the rush order									X

8.4: Decision Table - A Tool :-

DTs are not new. They were in use in other fields like production engineering for quite sometime before finding in roads into data processing. Unfortunately, DTs don't get enough respect ! In fact, it is a very useful tool if used properly.

Advantages of DTs

1. Managers can be relieved from decision making for routine matters where decision rules can be clearly structured.
2. Complex decision rules may be structured and even the classifications for the basis of the decisions will be very clear.
3. Also, there will be consistency in decision making. The typical example is that of Life Insurance Corporations providing tables showing premium amounts for different types of policies. Whether you take policy in Delhi or Nasik or Madras the premium amount quoted for similar policy will be same.
4. Another use of DT is to make the communication between the manager and the system analyst or programmer easier. The manager can represent his decision process through DT to the system analyst in a form that can be readily converted to flow diagrams for Computer programming.

5. Also DT is a method of documentation that is easily prepared, changed and updated.
6. Since DT is in summary form and standardized format, it is easier to use.

Disadvantages of DT. :

1. The use of both flowchart and DT may impose an additional burden.
2. DT does not depict the flow by logic of a solution to a given problem.
3. When there are too many alternatives, DT cannot list them all.
4. It is not easy to translate it into source program.

REVIEW QUESTIONS

1. What is a decision Table ? How is it useful in drawing a decision table ?
2. Explain (i) Condition Stub (ii) Condition Entry
   (iii) Action Stub (iv) Action Entry
3. Distinguish between Limited Entry and Extended Entry Decision Tables ?
4. State the merits and demerits of decision tables.

CASE PROBLEMS

CASE PROBLEMS

Exercise No. 1.

1. KLM International Airlines initiated a special incentive scheme for its passengers. The awards were based on a certain number of miles flown in a year or being a regular passenger for at least four years.

(1) The passenger must be paying in cash for the ticket to become eligible to participate in the scheme.

(2) The incentive is a free round the world trip in KLM on the designated route during January, February and March months.

(3) The passenger must have flown at least 125000 miles in any year by KLM.

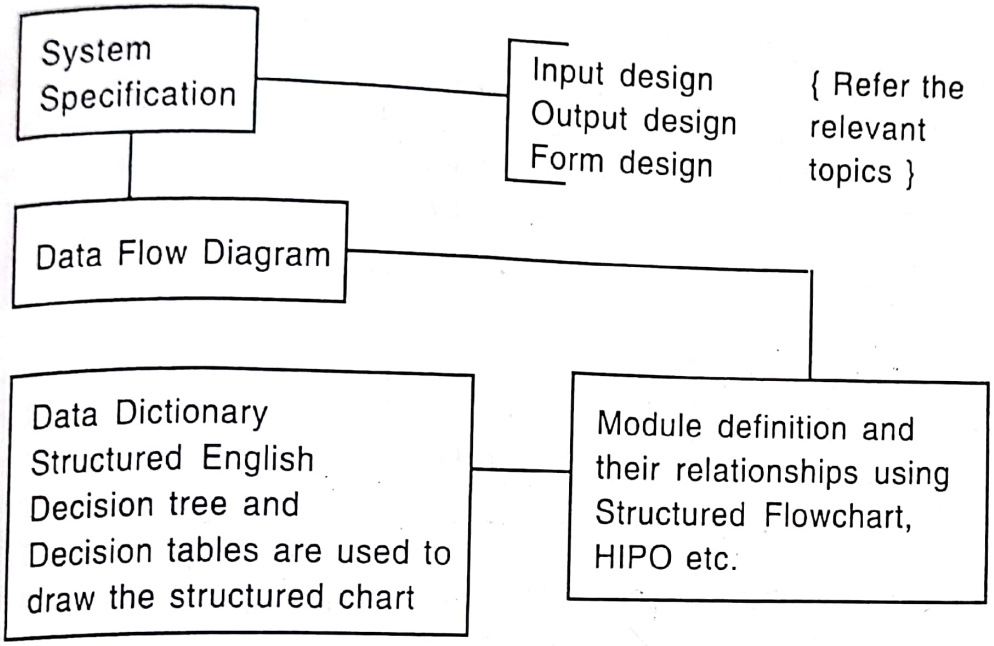
(4) The passenger is eligible if he has flown at least one trip per year by KLM in the last four years.

"For better documentation, divide and rule".

CHAPTER - 9

STRUCTURED CHARTING TECHNIQUES

Structured design partitions a program or a system into small independent modules. In the structured design method, the approach proceeds as given below :



In structured design, the following charting tools are used :

1. Structured Flow Charts.
2. Hierarchical Input Process Output (HIPO) Chart including Visual Table Of Contents (VTOC) and Input Process Output Charts (IPO).
3. Warnier-Orr Diagrams.

These are important tools in the system and software design. They are graphical and/or visual displays having a top down approach.

9.1. Structured Flow Charts : { Nassi-Schneiderman Charts }

They are graphic tools for the designer to structure software that is both modular and top down. There are three basic elements in structured flow charts : a) Process b) Decision and c) Iteration.

Structured chart is shown on a single sheet of paper. They are used

by systems analyst to combine function diagram and data flow diagram. They identify the functions contained in a process. Also they show the flow of data and flow of control during processing.

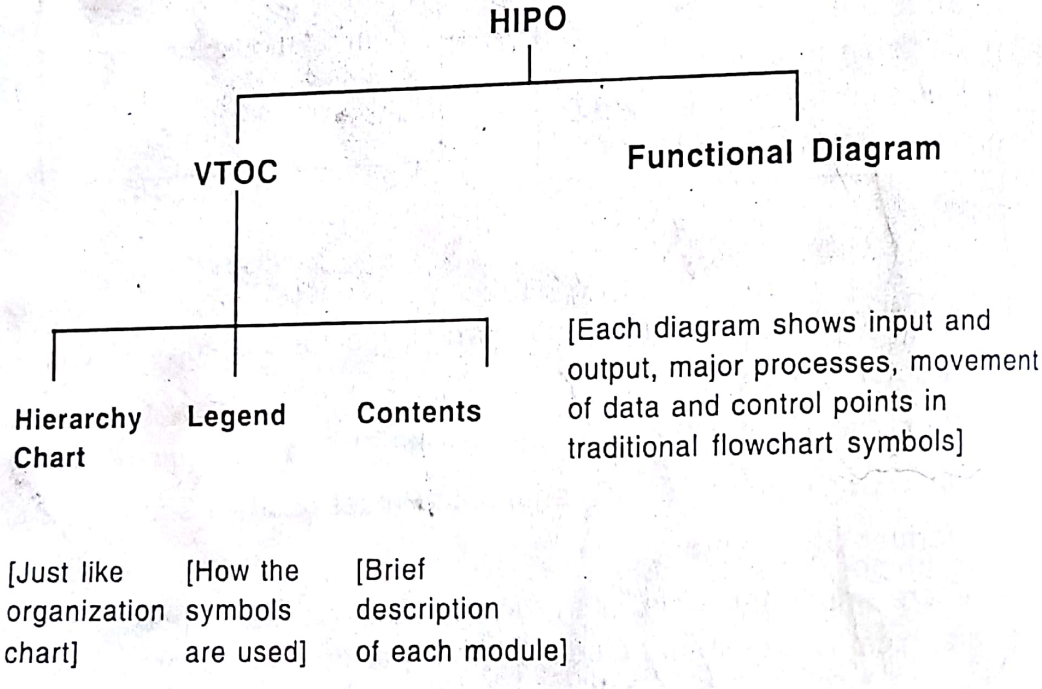
9.2. Hierarchical Input Process Output Chart [HIPO]

This is commonly used tool for developing system software. They are used in documenting information. It was first developed by IBM as a design aid. They are graphic rather than narrative. HIPO emphasizes on functions of the system rather than structure, logic or organization.

The components of a HIPO package are :
1) Visual Table Of Contents. 2) Functional Diagrams.

The input-process-output portion of a HIPO chart identifies for each program module what inputs, processing takes place and outputs are involved. The functional diagrams represent this IPO charts in traditional flowchart symbols showing movement of data and control points.

HIPO Charts has the following components :



We shall see how each of these components are depicted.

The visual Table Of Contents (VTOC) for sales/inventory system overview

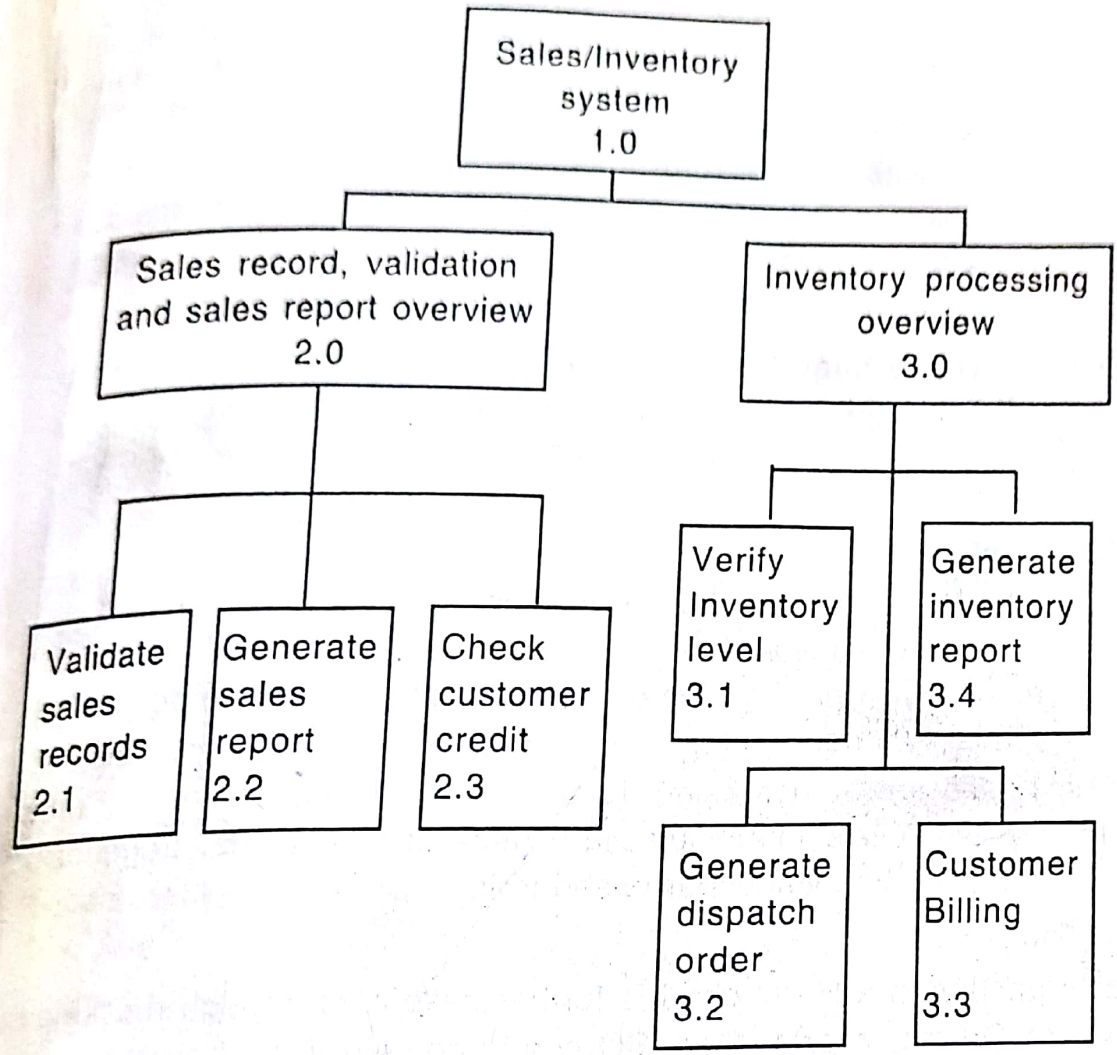


Fig. Hierarchy Chart

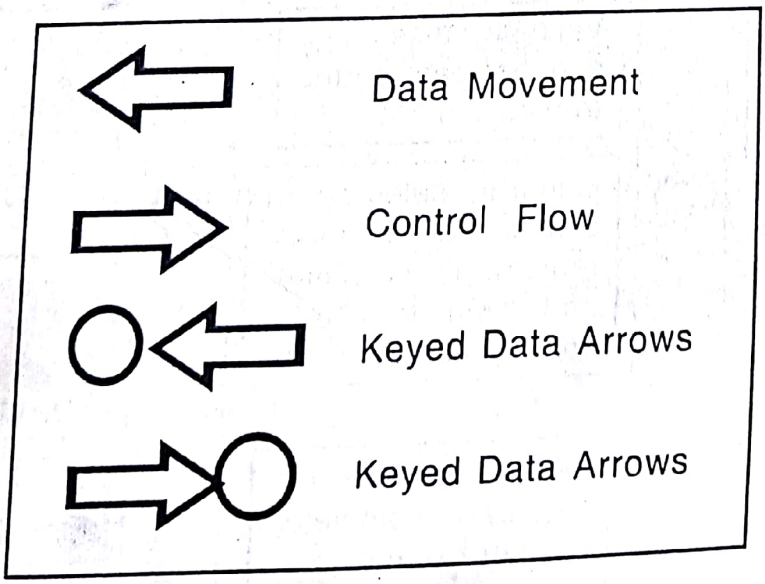


Fig. Legends

CONTENTS

1.0 Sales/Inventory system :
Controls all processing. Invokes programs to handle data entry. Validates records. Generates reports and Performs customer billing.

2.1 Validate sales record :
Makes data entry, checks sales record, checks customer credit worthiness and generates sales reports.

{Similarly description of all system modules can be provided }

VTOC : The Visual Table Of Contents (Also known as Vertical Table Of Contents) has the format as shown in the figure. VTOC gives the relationship of the functions in a hierarchical manner.

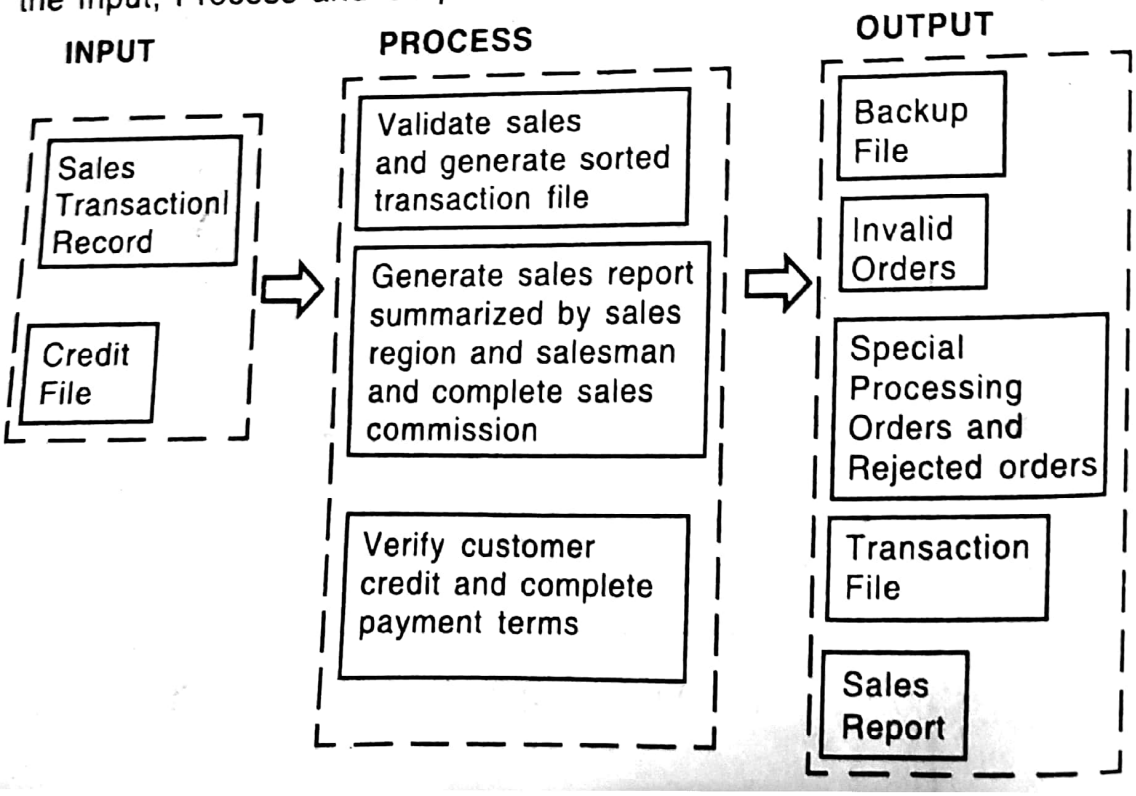
VTOC contains :

1) A hierarchy chart of modules.
2) Legends and
3) Contents giving brief description of each module. This is optional.

The modules are in increasing detail in a top down, left to right form. Three to five levels of modules are generally identified. Legends in VTOC tell how the symbols are used in it.

IPO Chart :

Each function in a HIPO chart is further described through IPO (Input-Process-Output) charts. Now IPO charts contain three boxes showing the Input, Process and Output.



Thus HIPO chart is VTOC plus IPO charts or functional diagram.

HIPO answers :
1. What does the system or module do ?
2. How does it do it ?
3. What are the inputs and outputs ?

Advantages of HIPO :

1. HIPO allows a program or a system to be easily understood.
2. HIPO is design, development and documentation tool.
3. HIPO packages provide a common, visual base for education and communication.
4. HIPO has less duplications on information and more information can be obtained in a glance.
5. It is a top-down approach with successive levels going for greater details.
6. In HIPO, errors can be detected and isolated on a functional basis.
7. HIPO indicates clearly what inputs, processing and outputs are involved in each programming module.
8. HIPO designs computer programs in modules that can be individually assigned, designed and tested.
9. HIPO is a management tool because the functional approach allows planning and scheduling to be made accurately and early in the system development life cycle.

Disadvantages of HIPO :

1. HIPO concentrates more on what is to be accomplished rather than how it is to be accomplished.
2. Requires extra documentation beyond flowcharts or coding.
3. Necessitates some training for programmer before use.

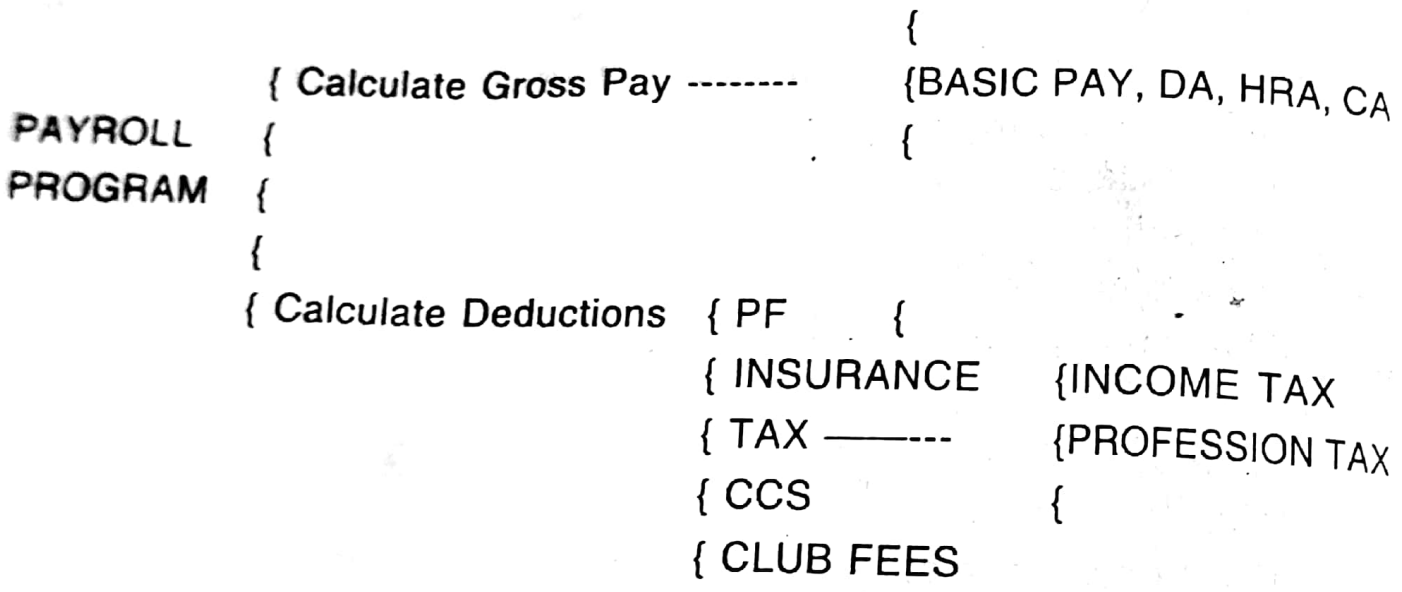
9.3 Warnier-Orr Diagram :

W-O diagrams were first developed by Jean-Dominique Warnier, a Belgian mathematician and later extended by Kenneth Orr, an American. W-O diagram technique is a system design and program design technique.

Its approach is a structured, hierarchical methods using brackets that flow from left to right. Like all structured design methodologies, the basic building blocks are : 1) Process 2) Decision and 3) Iteration. The W-O techniques consist of several steps that end in the programming

of the system. The first step in W-O technique is to identify system outputs (Reports and files). These are then developed in to data or functions in a hierarchical manner.

An illustration of W-O diagram for processing taxes in a payroll program



REVIEW QUESTIONS

1. What are the main components of HIPO Chart ?
2. Write notes on :
   i) Nassi-Schneiderman Charts
   ii) IPO Charts
   iii) VTOC
   iv) Warrier-Orr Diagram.
3. State the advantages and disadvantages of HIPO.
4. Outline some differences and similarities between Structured Systems Analysis and HIPO.

"Output design directs system flow"

CHAPTER - 16

DESIGN OF OUTPUT

The output generally refers to the result and information that are generated by the system. One of the most important features of an information system from the point of view of users is the output it produces. If the output is of poor quality, the whole system is in peril because the users will then avoid using it. Hence, the design of output assumes greater importance. In any system the output is largely dependent on input. However, no system can be designed properly without knowing what output is exactly required. This principle is known as "Principle of starting with output". This means that organizations output needs should be considered first before devising appropriate methods and procedures, database, planned inputs and effective internal control.

16.1 Design Principle Of Output

A system designer should try to incorporate the following design principles for output:-

1. Principle of starting with output.
2. Principle of acceptability of reports.

   The end user has to accept these outputs since they are the people who will be using it for their desired purposes. Hence it is ideal to have their participation in the output design phase for the greater success of the system.
3. Principle of timely output.

   A stitch in time saves nine. This is very true for information output. An output in time can help to make better decisions.
4. Principle of enhancing the decision making process.

   After all, the systems are designed for the manager and other personnel to make better decisions. Naturally the output report must be prepared keeping this principle constantly in mind.
5. Principle of practicing "Management by Exception"

   Management controls through completed tasks. The report should be designed not only for what has happened but for what deviations were there from actual plans. Significant deviations as and when it occurs be brought to the notice of the management through exception reports of the system.

6. Principle of duplication reduction in reports.

   Duplicate or unnecessary information in the reports should be minimized to the extent possible. This automatically reduces the cost of processing.

7. Principle of simplicity in reports.

   Report should be concise, simple and self explanatory.

16.2 Output Objectives : Before designing output, the objectives of each output must be clear. Simply because the output is very attractive or it has used the latest computer technology, output cannot be regarded as 'good'. It must accomplish one or more of the following objectives.

An output must

1. Convey information about
   a) Past Activities - Personnel File, Vendor History
   b) Current Status - Inventory On Hand, Cash On Hand
   c) Future Projections - Sales or Cost of manufacturing a new item.
2. Confirm an action - Completed task.
3. Trigger an alarm - Rush purchase, Market loss
4. Signal events - Through exception reporting or report on lurking opportunities etc.

16.3 Types of Output :

There are various types of output required by most systems. The main types of output are as below :

1. External Outputs : Those intended to go outside the user's organization e.g. Invoices, Pay slips, Tax returns etc.
2. Internal Outputs : Those used within the user's organization and it requires careful design because they are user's main interface with computer.
3. Operational Outputs : The use of this is in general within the computer department. e.g. Program listing.
4. Interactive Outputs : This involves the user communicating directly with the computer (DIALOGUES).
5. Turnaround Outputs : The data will be added to this document before they are returned to the computer for further processing.
   (Re-extract documents)

Meter cards are produced for collecting readings from gas meter, photocopiers, electric meters, are filled in by the customer and then return to the

16.4 Output Considerations :

While designing outputs, systems analyst must consider the following points :

(a) Determine what information is to be present.

(b) Decide whether to display, print, or "speak" the information and select the output medium.

(c) Arrange the presentation of information in an acceptable form.

(d) Decide how to distribute the output to intended users.

After considering all the above questions, the analyst and the user can define output more clearly in terms of :

1. Types of output.
2. Contents (Heading? Numeric? Alphanumeric? Totals? etc.)
3. Format (Hard copy? Screen? Microfilm? etc.)
4. Location (Local? Remote? Transmitted? Transported? etc.)
5. Frequency (Daily? Weekly? Hourly? etc.)
6. Response (Immediate? With a period? etc.)
7. Volume (Number of documents? Growth? etc.)
8. Sequencing (Account no.? Within sales area? etc.)
9. Action required (Bursting? Error detection? etc.)

The content of the output must be designed in detail.

16.5 Output Media :

Output from a computer system can take a variety of forms. The systems analyst has to determine the most appropriate medium for the output. The most common media are :

1. Printed Output :

The device used for printed output may be line printer, dot matrix printer, laser printer or plotter.

2. Visual Output :

With the increasing emphasis on the design of interactive management information systems, the CRT (Cathode Ray Tube) unit is becoming a widely used form of output. The most common use of CRT unit is inquiry whether hard copy is not required. For example, Order entry system, Account payable/receivable enquiries, Airlines and Hotel reservation systems may find this medium most useful.

3. Turnaround Document Output :

In order to reduce the input workload at a later date, turnaround documents in the form of punched cards are widely used. The applications

include Credit Card Billing and Employee Time Cards. Additionally OCR (Optical Character Recognition) forms can be prepared as output which at a later date serves as input to the computer system.

4. Secondary Storage Output :

This generally includes magnetic disk, magnetic drum, magnetic tape.

5. Microfilm or Microfiche Output :

Microfilms are photographically reduced documents on films. Here output is written on to a magnetic tape which is then fed into a machine called a Microform recorder. The information can subsequently be inspected by using a viewer which projects on to screen. The technique is used in big libraries. This is usually referred to as COM (Computer Output on Microfilm or Microfiche).

6. Audio Response Output :

A newer form of output is the audio response unit. The unit is capable of providing on-line inquiry into the systems where output is restricted to short messages. This system consists of message handling unit, touch tone telephone unit and standard telephone lines for an on-line mode. e.g. In the banking system the customers can get balance in his/her accounts.

REVIEW QUESTIONS

1. State the design principles of output.
2. What are the different types of output required by most systems?
3. What are various forms of output media available with computer systems? For a large library having hundreds of research journals and science magazines what type of output media you would advice.
4. What is the main difference between the design of an output screen and the page layout for a printer?
5. Write short note on :

   Report generator facility available in software packages like COBOL and FOXPRO
6. Design the layout of salary slip for the employees of ABC Co. Ltd. The salary slip should contain all relevant information about the employee, leave particulars, all earnings and deductions and also the date of payment of salary.
7. Design the layout of mark sheet for any one of the following examinations.

   (1) Higher Secondary Certificate

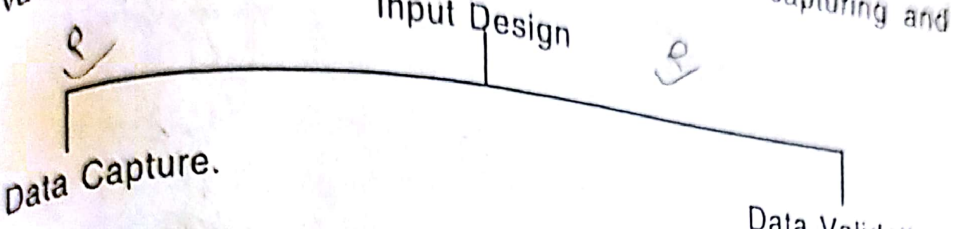
   (2) Third Year B.C.S.

   (3) Master in Computer Management Course (MCM).

CHAPTER - 17

INPUT DESIGN

Input design involves capturing of data as well as inputting it to the computer. Accordingly input design consists of data capturing and data validation.



17.1 Data Capture:

There can be no information system without "Data". Data are the facts which describe events and entities. Data are communicated by various types of symbols such as letters of the alphabets, numbers, speech patterns, dots and dashes, hand signals, pictures and so forth. The processed data with specific purpose are called information. Data obtained in general are not suitable for directly feeding into the computer. To get the data into the computer the analyst has to design the form, design the input record and design methods for getting the data into the computer. The computers will only accept those data which are in machine sensible form. If its original form is unacceptable, then it has to be brought into the acceptable form.

Note:

We clarify certain terms which appear to be similar but have subtle differences in System Design.

1. Data Collection : The process of getting data to the computer in a machine sensible form for processing.
2. Data Capture : Sometimes used as a substitute term for data collection but more specifically refer to data 'Captured' in a machine sensible form at its source (Source Document).
3. Data Entry : Is the process of translating the source document into the machine readable format.
4. Data Input : To the computer comes only after the data has been entered into one of the machine readable formats.
5. Data Base : A collection of data fundamental to a system.

This part of the work i.e. collection of data and its input to the computer assumes greater importance. This work of the analyst is complex, time consuming and expensive but unavoidable.

17.1.1 What is Data Capture ?

Data Capture covers all the stages from the recording of basic data to the feeding of this data into the computer for processing. The basic steps in this process are :

. Original Recording.
. Data Transmission.
. Data Preparation.
. Verification.
. Sorting.
. Control.
. Computer Input.

In any particular application these functions may not all exist or they may take place in a different sequence from that listed above. The data capturing process will also depend on the type of input data, type of application and the hardware configuration available.

17.1.2 Data Capture Objectives :

If the data input is bad then output will be worse. This calls for clear data capture objectives such as :

1. Reduction in the volume of input to the extent possible.
2. Lesser manual preparation.
3. An input design which will ease the work of the person engaged in input preparation.
4. Minimizing the number of steps practicable in the data capturing process.

17.1.3 Basic steps in Data Capture

Here we shall discuss in brief the general steps involved in data capturing.

a. Original Recording : This is the collection of data at its source. This involves clerical preparation of source documents including manual checks.

For example :

1. Preparing an examination mark list.
2. Filling out job application form giving details of name, address, qualification and experience. In recent years there has been a tendency to reduce human intervention in the recording procedures. In on line systems, the use of bar codes and optical character records etc, for automatic recording have come into use in shops and super markets.

b. **Data Transmission :** The data moves from the point of origin to the data processing center. For example :

1. The group of related mark list are bunched into batches and sent to data processing center.
2. If a main processor has many terminals the transfer of data from a particular terminal to the main processor can be regarded as data transmission.

c. **Data Preparation :** The transcription of source document on to an input media such as magnetic tape, magnetic disk, magnetic drum etc., is data preparation. In the off line system the transfer of data from mark list to magnetic floppy disk is the case of data preparation.

d. **Verification :** It is to verify that the transcription has been done correctly. This is vital because it can result in wrong output.

e. **Sorting :** Sorting is the process of arranging data into some desired sequence. Sorting may be done manually or mechanically.

e.g. In the erst while system punched cards have to be arranged in a logical order for the production of particular input or output. The cards are sorted out and arranged in the desired sequence.

f. **Control :** Throughout all the stages listed above it is essential that checking, verifying and validity controls are maintained. This is to ensure that all the data collected, transmitted and input are correct.

g. **Computer Input :** The data is read by the input device like magnetic disk drive and transferred to the internal store where it undergoes validity checks. Invalid data will pass back to go through the entry stages again.

17.2 Data Validation :

The objective of a data validation system is to detect errors at the earliest possible stage before costly activities are performed on invalid data. Some data validation is done by way of manual verification in data capture stage itself. In spite of this, still there may be incorrect batches of input data, missing data, duplicated data and incorrect file records etc.

Therefore, it is necessary that before data is first input to the computer for processing different checks are carried out. These checks will classify valid and invalid data. This is generally done with the help of a DATA VET Program. This process is often referred to as DATA VALIDATION OR DATA VET. The objective of this data vet procedure is to allow only valid data to be written on the media which will be used in subsequent processing. Invalid data is also identified and recorded separately. This invalid data is checked manually for low casting errors. After correcting these errors the data is again subjected to above data validation process of accurate input.

Validation checks : There are various categories of checks which can be applied to data during a validation run

a. Field checks : Includes the following :

1. **Limit check** : May be applied to each field (data item) of a record to ensure that its contents lie within predefined size.
2. **Picture check** : May be applied to each field to detect entry of incorrect characters in the field.
3. **Valid code check** : To validate input against predefined transaction codes. These predefined codes may either be embedded in the programs or stored in files.
4. **Check digit** : It is used to detect transposition errors when recording "key" fields.
5. **arithmetic checks** : are used to ensure the validity of the results by performing arithmetic operations in different ways.
6. **Cross checks** : may be applied to verify fields appearing in different files to verify that result fully.

b. Transaction checks : include the following :

1. **Sequence checks** : are applied to detect any missing transaction (e.g. off serially numbered vouchers).
2. **Format completeness** : are used to check the presence and position of all fields in a transaction.
3. **Redundant data checks** : are employed to check the validity of codes with reference to description.
4. **Combination checks** : may be applied on various fields of a file.
5. **Probability checks** : are used to avoid unnecessary rejection of data.
6. **Pass words** : may be exercised to check entry of data by unauthorized persons in on line system.
7. **Checks** : may be incorporated to ensure that transaction pertains to the current period.
8. **Batch total** : Can be used to ensure that transaction have been transcribed correctly. A total of some common component of a batch of data so as to enable a control to be maintained over the validity of data.
9. **Hash total** : A control total i.e. the sum of values in a particular field or record area of a file, to ensure that transactions have been transmitted currently.

Data Validation Examples

Example - 1 :

File -> PAY-CHEQUE.
Record -> 1000.

Field	-> as given below, total 8 fields.
1. EMPLY-NO	AAA 9999.
2. EMPLY-NAME	A (30).
3. EMPLY-ACC-NO	9999.
4. AMT-IN-FIGURES	99999.99.
5. AMT-IN-WORDS	A (40).
6. DATE	99'99'9999.
7. CHEQUE-NO	999999.
8. EMPLY-CATEGORY	A.

e.g.:

Picture check : PIC of EMPLY-NO is AAA 9999. An EMPLY-NO PRD24N6 would be rejected as there is a letter in the sixth position and this should be only numeric.

Limit check (Range check) : The amount of salary can be form 00000.00 to 15000.00 for an employee. If the amount is beyond these limits then withholding of cheque for further correction becomes necessary.

Sequence check : This is exercised to detect any employee being missed out from payment of salary.

Combination check : This may be exercised on various fields of a file. For e.g. To check the amount written in figures and in words.

Validity code check : This may be applied to validate input against predefined transaction codes. These predefined codes may be either be embedded in the program or sorted in the file. For e.g. Contents EMPLY-CATEGORY field A,B,C,D,E are only valid and any other letter coming in that field will be rejected.

Example 2. CHECK DIGIT (Example of check digits)

Check digit enables a number to be self checking. The most common type of data entry errors are transcription errors (i.e. 54786 is entered as 54789) and transposition error (i.e. 54786 is entered as 54768).

We shall consider an example to understand one of the popular check digit method known as Modulus-11 check digit method.

For example consider Student Permanent Registration number with the University :-

4 2 5 8 6

(each student will have a unique number for all matters related to University)

Weight 6 5 4 3 2

(we assign weights to each digit from the low order (right) position in the data using values 2 through 10 and moving to the left)

	4	2	5	8	6
	6	5	4	3	2
Numbers x Weight =	24	10	20	24	12

Sum the results (24+10+20+24+12 = 90)

Divide by modulus number 90/11 = 8 with remainder 2.

Subtract remainder from modulus number to get check digit (11 - 2 = 9)

Attach the check digits to the original registration number at the right hand side end.

4 2 5 8 6 9

Let us see how the check digit program will find out whether the permanent registration number entered is correct or not. We shall enter wrong permanent registration number. Say 5 2 5 8 6

	5	2	5	8	6
Weights	6	5	4	3	2
Weight * Number	30	10	20	24	12

Sum = (30+10+20+24+12 = 96)

Divided by modulus 96/11 = 8 with remainder 8.

Check Digit = (11 - 8 = 3)

But the check digit given is 9 .

Therefore permanent registration number entered is wrong.

NOTE :

1. In the first place check digits are calculated by a computer and are generally used in conjunction with fixed data (e.g. permanent registration number). As a result of test done on modulus 11, it was discovered that it detected all transcription and transposition errors and 91% of random errors.
2. An original code giving rise to the check digits 10 is normally written as 'X'.

REVIEW QUESTIONS

1. What is data capture ? State its objectives.
2. "If the data input is bad then output will be worse". Opine.
3. What do you understand by Data Validation?
4. Explain in brief the basic steps in data capturing process.
5. Explain the following terms
   a) Field check
   b) Transaction check
   c) Batch total
   d) Hash total