System Analysis and Design (Course no: CSC-252)

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- Introduction to system analysis and design
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Text book:-

Modern System analysis and design (7th edition)

Unit 1: Overview of System analysis and design

Content on this chapter:
- Introduction to system analysis and design
- Types of information system
- System development life cycle
- System analysis and design tool.

System:-

The term 'system' derived from Greek word 'systema', which means an organized relationship between any set of components to achieve some common objectives. A system is defined as an orderly grouping of inter-dependent component linked together according to plan to achieve specific goal.

Constraint of a system:

A system must have 3 basic constraints:

i) A system must have some structure and behaviour which is designed to achieve a pre-defined objectives.

ii) Interdependence and interconnectivity must exists among system component.

iii) The objective of organization have higher priority than the

objective of its sub-system.

Example of systems are traffic management system, payroll system, automatic library system, human resource information system, etc.

Characteristics of System (Properties of system):-

The system has following characteristics:

I) Organization:-

Organization implies structure and order. It is the arrangement of component that help to achieve pre-determined objectives.

II) Interaction:-

Interaction refers to the manner in which each component of the system functions with other component of the system. For example:- In an organization, purchasing department interact with production department, advertising interact with sales, etc.

III) Interdependence:-

Interdependence means that part of the system depends on one-another to achieve a specific goal the component of the system must be properly integrated i.e. the output of one sub-system is

required by another sub-system as a input.

iv) Integration:-

Integration is concerned with how a system component are connected together. It means that the part of the system work together within a system even if each part perform a unique function.

v) Central objective:-

The objective of a system must be central. It is not uncommon for a organization to state one objective and operate to achieve another.

Element of System:-

The following diagram shows the element of the system:

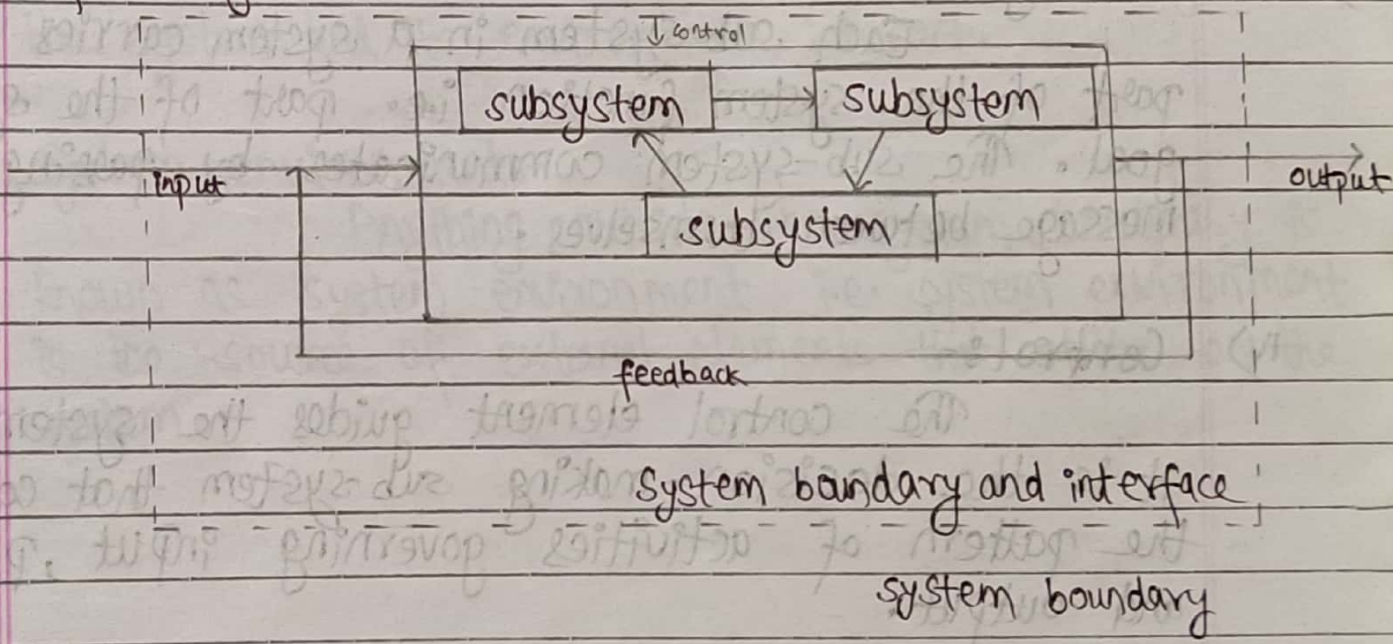


Fig:- Basic System Model

I) Input and Output :-

Input are the information that enter into the system for processing. Output is the outcome of processing. The input to the system are anything to be captured by system from its environment and output are anything produced by the system and sent it into its environment.

II) Processor :-

The processor is the element of system that involves the actual transformation of input into output. It is the operational component of the system that modify the input either totally or partially depending on the output specification.

III) Sub-system :-

Each sub-system in a system carries out part of the system function i.e. part of the system goal. The sub-system communicates by passing the message between themselves.

IV) Control :-

The control element guides the system i.e. it is the decision-making sub-system that controls the pattern of activities governing input, processing and output.

v) Feedback:-

It is the idea of monitoring the current system output and comparing it to a system goal. Feedback provides the control in dynamic system. Positive feedback encourages the performance of system and negative feedback is informational in nature that provide the controller with information for action.

vi) System boundaries and interfaces:-

It defines the components that make up the system and those component can be changed during system design. Each system has a boundaries that determines its sphere of influence and control.

Interfaces is the media or channel through which the system and its environment interact.

vii) System environment:-

Anything outside the system boundary is known as system environment i.e. system environment is the source of external elements that strike on the system.

Information System analysis and design:

- Information system analysis and design is a complex, challenging organizational process used by the team of business and system professionals to develop and maintain computer based information system.
- The main goal of information system analysis and design is to improve organizational system.
- The analysis and design of information system is based on understanding of organization's objectives, structure, processes as well as knowledge of how to exploit information technology for advantage.
- An important result of system analysis and design is application software i.e. the software designed to support a specific organizational function.

System analysis:-

System analysis is the process of collecting and interpreting facts, identifying the problem and using the information for improving the system.

- System analysis is conducted for the purpose of studying a system or its part inorder to identify the problem and recommend a alternative solution.
- System analysis specifies what the system should do.

System design:-

System design is the process of planning a new business system or replacing existing system by defining its components or modules to satisfy the specify requirements.

- Before planning, we need to understand the old system thoroughly and determine how computer can best be used inorder to operate efficiently.

Software engineering process:

Software engineering is an engineering disciplined that is concerned with all aspect of software production from early stage of ~~the~~ system specification to maintaining the system after it has gone into use.

- Software engineering uses proven methodologies, techniques and tools to assist the people during system analysis and design.
- Methodologies are step-by-step approaches to the system development that will guide to develop information system.
- Techniques are the processes that the analysts will follow to ensure complete and comprehensive analysis and design
- Tools are typically computer programs that aids in applying a technique.

Importance of System analysis and design :-

System analysis and design is the collection of important activities that takes place when new information system are being built or existing one are changed.

- The importance of system analysis and design are :-

i) The system developed by using system analysis and design activity fulfill the requirement of organization's personel.

ii) We can develop information system easily and rapidly because there are lots of supporting methodologies tools and techniques.

iii) Information system can be built in most effective way and system also fit in existing environment and will be very easy to use and maintain.

iv) By following the activities involved in System analysis and design, we can develop high quality information system within allocated budget and time.

Information System :-

A system that provides information to people in an organization is called information system.

- Information system is an arrangement of people, data, processes and information technology that interact to collect, process, store and provide as output the information needed to support the organization.

- Information system in an organization capture and manage data to produce useful information that support an organization and its employees, customers, suppliers and partners.
- Information system produce the information by using the data about significant peoples, places and things from within the organization or from external environment.

Types of information system:-

There are several different types or classes of information system. The information system are classified according to function they serve.
The following are four major type of information system used in an organization:

i) Transaction Processing System (TPS):-

Transaction Processing system is an information system that captures and processes the data about business transaction.
- These system serve at the operational level of the organization
- TPS are aimed at improving the routine business activities on which all organization depend. TPS assist in carrying out the ~~ca~~ day-to-day high volume activities or transactions of the organization.
- The goal of transaction processing system development is to improve transaction processing by speeding it up using the fair people, improving the efficiency and

accuracy.
- Some example of transaction processing system includes airline reservation system, banking system, accounting system of large companies, employee record keeping system, etc.

ii) Management information system :-
- Management information system is an information system at management level of organization that provides management oriented reporting based on transaction processing and operation of the organization.
- These systems are specially developed to support planning, controlling and decision making function of middle-level manager.
- MIS extract the transaction data from underlying TPS, compile them and produce the information in the form of report.
- MIS takes data available through TPS and convert them into meaningful form that the manager needed to fulfill their responsibilities.
- Usually, management information system are used to produce reports on monthly, quarterly or yearly basis. If the manager want to view daily or hourly data, MIS enables them to do so.
- To develop a MIS, we need a good understanding of what kinds of information manager requires and how the manager use information in their job.

Example of MIS are sales reporting system, annual budgeting system, salary analysis system, etc.

iii) Decision Support System:-

Decision support system is an information system also serve at the management level of organization designed to help the organizational decision makers to make a decision.

- In contrast to MIS, DSS processes information to support the decision making process of manager.
- For example; a decision support system in a bank enable a manager to analyze the changing trend in deposits and loan inorder to ascertain the yearly target.
- DSS have more analytical power as compared to other information system.
- They employ a wide variety of decision models to analyze the data or summarize the data into a form that makes the comparison and analysis of data easier to manager.

iv) Expert system:-

An expert system is an extension of decision support system that are developed to solve complex problem in particular domain at the level of extra-ordinary human intelligence and experties.

- Expert system are implement with Artificial Intelligence

technology that captures, stores and provides access to the reasoning of the expert.

Besides these main four types of information system, there are some other type of information system; they are:

i) Office automation System
ii) Communication and collaboration system
iii) Executive support system.

Information System Stakeholders:-

- Stakeholder is any person who has an interest in an existing or proposed information system.
- Stakeholders may include technical or non-technical workers. They may also include internal or external workers.
- Stakeholders of information system are also called information workers and information workers involves in creating, collecting, processing and using information.
- There are six groups of stakeholders and each group has a different role in the same information system. But in practice, any individual person may play more than one role. for example a system owner might also be the system user.

- The six group of stakeholders are:
  i) System owners
  ii) System users
  iii) System designers
  iv) System builders
  v) System analyst and project manager
  vi) External service providers (Information technology venders and consultant).

1) System owners :-
- System owners are the information system's sponsor and executive advocate usually responsible for funding the project of developing, operating and maintaining the information system.
- System owners usually come from the rank of management for medium to large information system, system owners are usually middle or executive managers.
- System owners tend to be interested in - how much will the system cost? How much value or what benefit will the system return to the business?

11) System users :-
- System users are the people who will use or is affected by the information system.
- Unlike the system owners, system users tend to be less concerned with costs and benefits of the system instead they are concerned with the functionality the system

provides to their jobs and systems ease of learning and ease of use.

- A system user may capture, validate, enter, respond, store and exchange data and information.
- There are many classes of system users. Each class should be directly involved in any information system development project that affect them.

a) Internal system users:-

Internal system users are employee of the organization for which most information system are built. Example include:

- service workers
- Technicals and professional staffs.
- Supervisor, middle managers and executive manager.

b) External system users:-

The internet has allowed traditional information system boundaries to extend to include other organization or direct customer as a system users. Example include:

- customer
- suppliers
- partners
- Employees.

III) System designers :-

- System designers are technology specialists who translate system user's business requirements and constraints into technical solutions.
- They design the computer databases, input, outputs, screen, network and software that will meet the system user's requirement. These design guide the construction of final system.
- System designers are interested in information technology choices and design of a system within the constraint of choosen technology.
- System designer may have following specialities :-
  - Database administrators
  - Network architects
  - Web architects
  - Graphic architects
  - Security expert
  - Technology specialists.

IV) System builders :-

- System builders are the technical specialist who construct information systems and component based on the design specifications generated by the system designers.
- In small organizations, or with small information system, system designers and system builders are often the same people. But in large organization and information systems they are often separate jobs.

- Some one specialize in one of the following specialities may become a system builders.
  - Application programmers
  - System programmers
  - Database programmers
  - security administrators
  - Web Masters, etc.

v) System analyst and project Manager:-

- System analyst is the person who is involved in analyzing, designing and implementing computer based information system to support the decision making and other operation of an organization.
- The primary role of system analyst is to study the problems and needs of an organization inorder to determine how people, method and information technology can best be combined to bring improvement in the organization.
- System analyst identify problems and needs and also ensure that technical solution fulfills these problem and needs.
- Some stakeholders are non-technical and some are very technical. This presents a communication gap between those who need computer based solution and those who understand information technology. The system analyst bridges that gap.

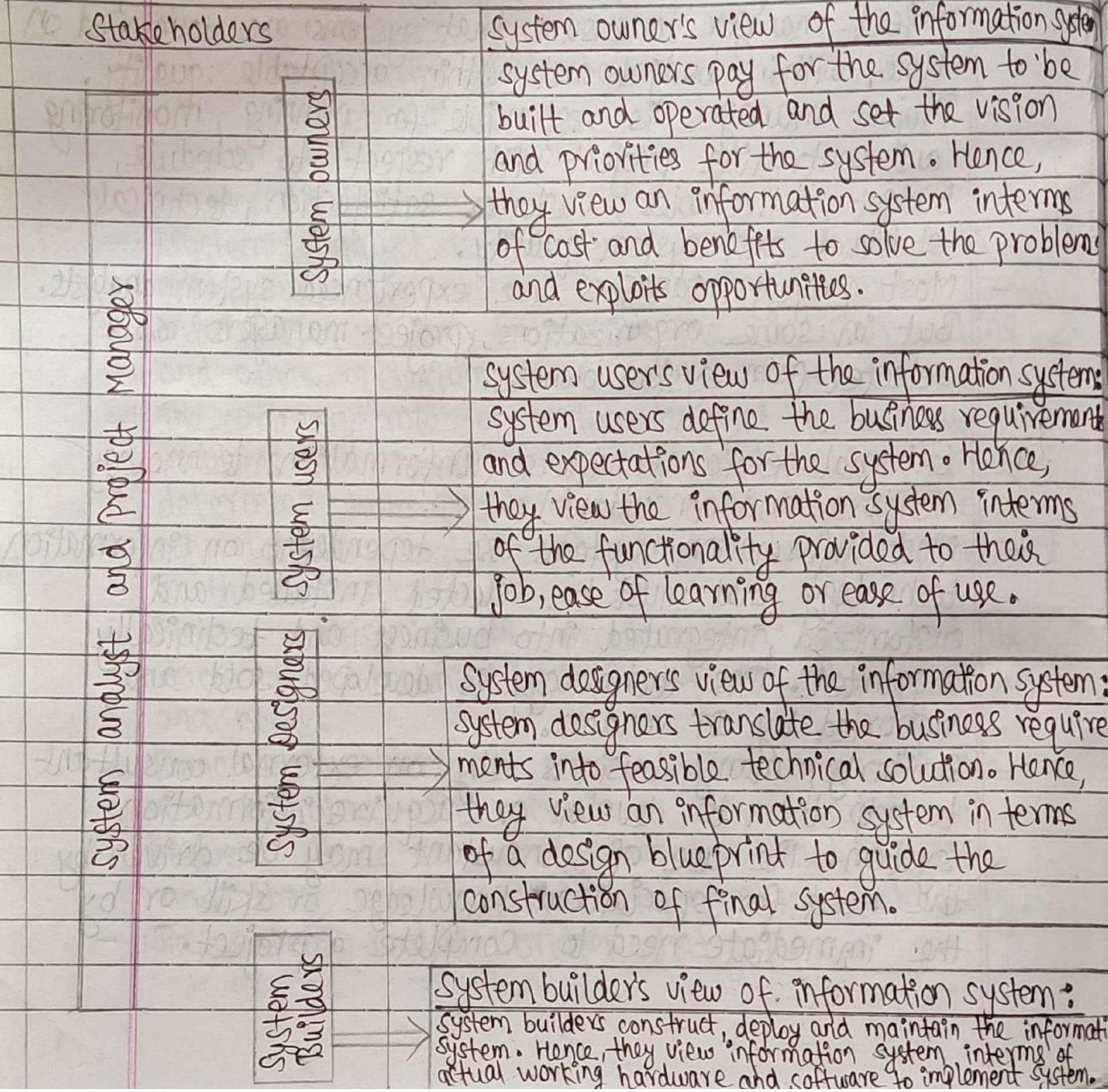
- To build a good information system and application, all the stakeholders must work together as a team.
- Team requires leadership, for this reason, usually one or more of these stakeholder takes on the role of project manager to ensure that systems are developed on time, within budget and within acceptable quality.
- Project manager is responsible for planning, monitoring and controlling project with respect to schedule, budget, deliverables, customer satisfaction, technical standard and system quality.
- Most project managers are experienced system analysts. But in some organizations, project managers are selected from system owners.

VI) External service Providers (Information technology vendors and consultant):-

- Most information systems are dependent on information technology that must be selected, installed and customized, integrated into business and technically supported. This technology is developed, sold and supported by IT vendors.
- Similarly, many business rely on external consultant to help them to develop or acquire information system. The use of consultant may be driven by the need for specialized knowledge or skill or by the immediate need to complete a project.

Stakeholder's perspective of an information system:

The following figure shows stakeholder's perspective of an information system:



- Each stakeholder group has a different perspective of the same information system. The system analyst is a unique stakeholder that serves as a facilitator or coach, bridging the communications gap that can naturally develop between the non-technical ~~solutions~~ system owners, users and technical system designers and builders.

Developing information system and system development life cycle:

System development Methodology:

- It is the standard process followed in an organization to conduct all the steps necessary to analyze, design, implement and maintain information system.
- The system development methodologies being selected for the development of the system depending on the system's aims and goals.

Imp.. System development life cycle (SDLC):-

- System development life cycle (SDLC) is the traditional methodology used to develop, maintain and replace information system.
- It has the several phases that marks the progress of system and design effort.
- Each phase has specific outcomes and deliverables that feed the important information to other phases.

- The lifecycle can be thought of as a circular process in which the end of the useful life of one system lead to the beginning of another project that will develop new version or replace an existing system altogether.
- The phases of SDLC are shown in figure below:-

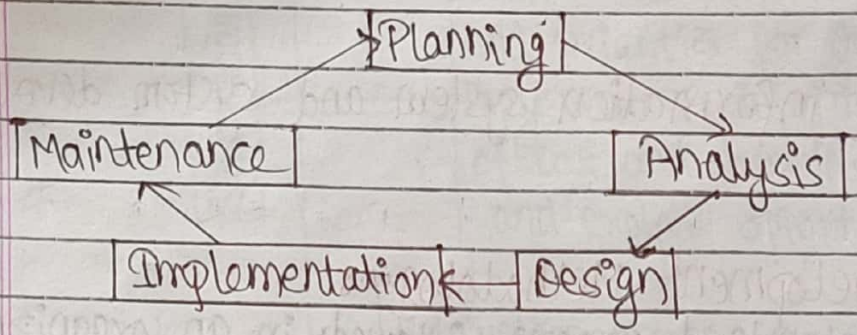


Fig:- The system development life cycle.

▷ Planning:-

- Planning is the first phase of SDLC. In this phase, someone identifies the need for new or enhanced system.
- The organization's information system needs may result from requests to deal with problems in current procedures, from the desire to perform additional task or from the realization that information technology could be used to capitalize on an existing opportunity.
- These needs can then be prioritized and translated into plan for the information systems department, including a

schedule for developing new major system.
- The two major activities performed during the planning phase are: preliminary investigation of the system problem and presentation of reasons why the system should or should not be developed by the organization.
- At this phase proposed system is explained and detailed plan is also developed for conducting remaining phases of SDLC.

II) Analysis:-
- Analysis is the second phase of SDLC in which system requirements are studied and structured.
- During this phase, the analyst thoroughly studies the organization's current procedures and information system used to perform the organizational tasks.
- Analysis has two subphases. The first is requirement determination. In this subphase, analyst work with users to determine what the user want from proposed system.
- The second is requirement structuring, in which analysts study the requirements and structure them, according to their inter-relationship and eliminate the ~~...~~ redundencies.
- The output of the analysis phase is description of the alternative solution recommended by the analysis teams. Once the recommendation is accepted by owners, the analyst can begain to make a plan to acquire any hardware and system software necessary to build a proposed system.

iii) Design :-

- Design is the third phase of SDLC in which the description of the recommended solution is converted into logical and then Physical system specification.
- In this phase, the analyst must design all aspects of the system, from input output screen to report, databases, etc. The analyst must then provide the physical specification of the system they have designed either as a model or as detailed documentation to guide those who will build the new system.
- The design phase consist of two subphases, logical design and physical design.
- Logical design is the part of design process that is independent of any specific hardware or software platform. Logical design concentrates on the business aspect of the system and tend to be oriented to a high level of specificity.
- Physical design is the part of design process in which logical specification of the system are transferred into technology specific details. As a part of physical design, analysts design the various parts of the system to perform a physical operations necessary to facilitate data capture, processing and information output.
- During the physical design, analyst team must determine many of the physical details necessary to build the final system, from the programming language the system will be written in, to the database system that will

store the data to hardware platform on which the system will run.
- The final product of the design phase is the physical system specifications in a form read to turned over to programmers and other system builders for construction.

IV) Implementation:-

- Implementation is the fourth phase of SDLC in which the information system is coaded, tested, installed and support in the organization.
- In this phase, the physical system specification, whether in the form of detailed model or as detailed written specifications are turned over to programmers as a first part of the implementation phase.
- Implementation turns system specifications into a working system that is tested and then put into use. The implementation consist of coding, testing and installation.
- During coding, programmers writes the programs that make up the system. During testing, programmers and analysts test individual programs and entire system inorder to find and correct errors. During the installation new system becomes part of daily activities of the organization.
- Implementation activities also include initial user support such as finalization of documentation, training programs and ongoing user assistance.

v) Maintenance :-

- The fifth and final phase in SDLC is maintenance. In maintenance phase, programmer makes the changes that the user ask for and modify the system to reflect the changing business conditions.
- These changes are necessary to keep the system running and useful.
- The amount of time and effort devoted to maintenance depends a great deal on the performance of the previous phases of life cycle.

Waterfall Model of SDLC :-

- Waterfall Model is the oldest and most widely used paradigm for information system development.
- It illustrates the system development process in linear sequential flow hence it is also referred to as linear sequential life cycle model.
- In this model of SDLC, any phase in the development process begins only if the previous phase is completed. In this model whole process of system development is divided into separate phases and outcomes of one phases act as a input for the next phase sequentially.
- This model is suitable for the projects in which user requirements are certain and precise.

- The following diagrammatic representation shows the traditional waterfall SDLC.

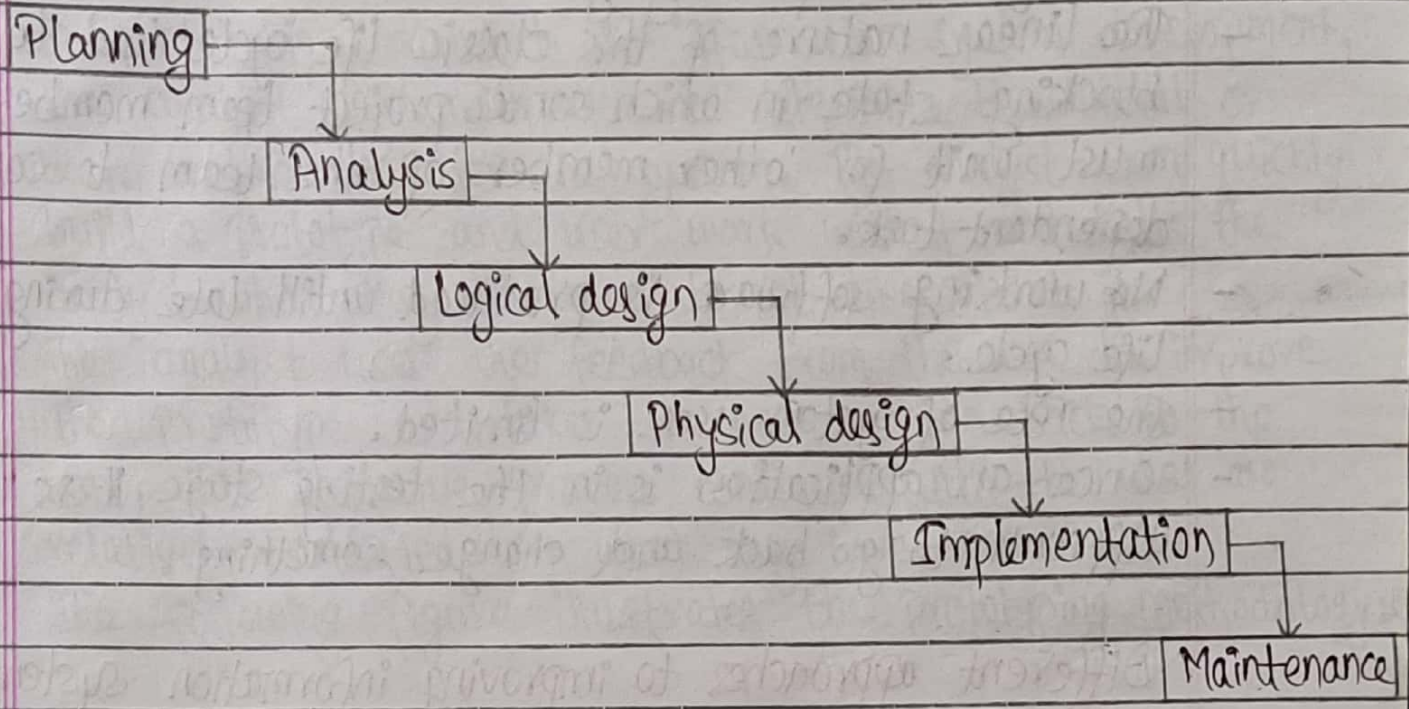


Fig:- Waterfall SDLC

Advantages of waterfall model:-

- Simple and easy to understand and use.
- Phases are processed and completed one at a time.
- Work well for smaller project where requirements are well understood.
- Documentation is produced at every stage of system development. This makes understanding the product designing procedure simpler.

Disadvantages of waterfall model:-

- Not suitable for the project where the requirements are high risk of changing.
- The linear nature of this classic life cycle lead to blocking state in which some project team member must wait for other member of the team to complete dependent task.
- No working software is produced untill late during the life cycle.
- The role of system user is limited.
- Once an application is in the testing stage, it is very difficult to go back and change something.

Different approaches to improving information system development:-

To improve the system analysis and design process, several different approaches have been developed. Among those some approaches are:

1) Prototyping:-

Prototyping is an iterative process of system development in which requirements are converted to a working system that is continually revised through close collaboration between an analyst and users.

- Prototype refers to a working model of information system and it does not contain all the feature of final system but it include the sufficient element to enable

the individuals to use the system, determining what they like and does not like and identify the feature to be added.

- In prototyping approach of information system development, the analyst work with user to determine the initial or basic requirement for the system. The analyst then quickly build a prototype and user work with it and tells the analyst what they like and do not like about it.
- The analyst uses the feedback from the user to improve the prototype and takes the new version back to the user. This iterative process continues until the user are relatively satisfied with what they have seen.
- The following figure illustrates the prototyping methodology:-

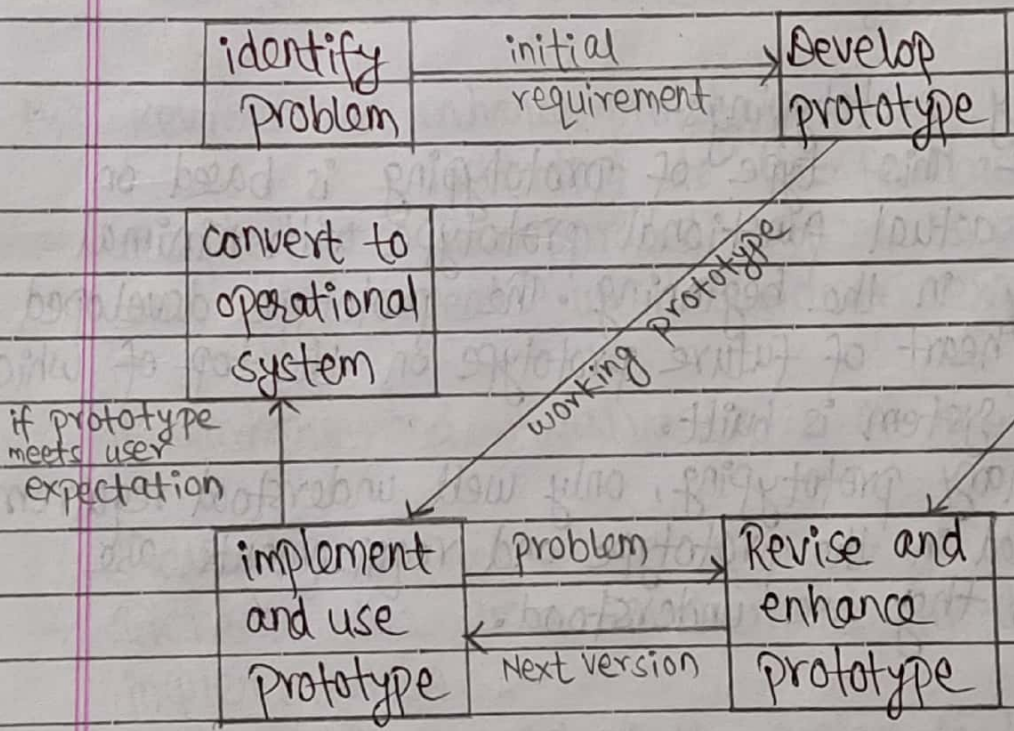


Fig:- The prototyping methodology

Types of prototyping :-

There are mainly two types of prototyping used in the industry:-

1) Throwaway / Rapid prototyping :-

- In this prototyping, the prototype can only serve as a model which is then used as a reference for the construction of actual system.
- With throwaway prototyping there is never any intension to convert the prototype into a working system instead, the prototype is developed quickly to demonstrate some aspect of system design that is unclear or to help users decide among different features.

11) Evolutionary prototyping :-

- This type of prototyping is based on building of actual functional prototype with minimal functionality in the beginning. The prototype developed forms the heart of future prototype on the top of which the entire system is built.
- In evolutionary prototyping, only well understood requirements are included in the prototype and requirements are added when they are understood.

Steps in prototyping process :-

Following steps are carried out during prototyping:

1) Basic requirement identification :-
- This step involves understanding the very basic requirement of the system specially interms of user interface.

11) Developing initial prototype :-
The initial prototype is developed in this stage.

111) Review of prototype :-
The prototype developed is then presented to customer and other important stakeholder in the project and feedback is collected in organized manner.

1V) Revise and enhance prototype :-
According to the feedback, the changes accepted are incorporated into a new prototype developed and cycle repeats untill customer expectation are meet.

Advantages and Disadvantages of prototyping :-

Advantages :-
- Increase the user involvement in the system even before implementation.
- Since working model of the system is displayed, the user gets the better understanding of the system being developed.

- Quicker user feedback is available leading to the better solution.
- Missing functionality can be identified easily.
- Better when user requirement are not clear or well understood.

Disadvantages :-
- Too much dependency on prototype.
- User may confused in prototype and actual system.
- High cost.

CASE (Computer Aided Software Engineering) Tools :-

2) Joint Application Design (JAD) :-
- JAD is the approach for improving the information system development.
- Joint application design (JAD) is the structured process in which users, managers and analysts work together for several days in a series of intensive meeting run by JAD session leader to specify or renew a system requirement.
- The main idea behind JAD is to bring together the key users, managers and system analyst involved in the analysis of current system.
- The primary purpose of using JAD in the analysis phase is to collect system requirements simultaneously from

key people involved with the system.
- JAD sessions are usually conducted at a location other than place where people involved normally work.
- Typical participant in JAD are: JAD session leader, user, manager, sponser, system analyst, information system staff.

Advantage of JAD:-
- This technique allows for the simultaneous gathering and consolidating of large amount of information.
- It decrease time and cost associated with requirement elicitation process.
- It help to bring expert together giving them a chance to share their views, understand views of other and develop the sense of project ownership.
- It promotes the team work with user.
- It allows rapid development of system.

Disadvantage of JAD:-
- Requires significant planning and scheduling effort.
- Requires large block of time to be available for all session participant.
- If the preparation is incomplete, the session maynot go very well.
- Requires significant stakeholder commitment of time and effort.
- Requires trained and experienced personel for faciliation and recording.

CASE (Computer Aided Software Engineering) tools:-

- CASE tools are the set of software application program that provides automated support for some portion of the system development process.
- Computer aided software engineering (CASE) is the use of computer based support in system development process and CASE tool is the computer based product aimed at supporting one or more system development life cycle activities.
- CASE tool can be used to help in project identification and selection, project initiation and planning, analysis and design phase or in implementation and maintainance phase of SDLC.
- CASE tool helps programmer and analyst to do their jobs more efficiently and effectively by automating the task. CASE tool support the drawing and analysis of system model and some CASE tool also provide prototype and code generation capabilities. Some examples are Oracle designer 2000, Rational Rose, etc.

Some general types of CASE tools are:-

1) Diagramming tools:-

These tools enables system process, data and control structures to be represented graphically. i.e. these tools are used to draw system model. For example; flow chart maker tools, etc.

II) Dictionary tool:-
These tools are used to record, delete, edit and output detailed documentation and specification.

III) Design tool:-
These tools are used to construct system component including system input and outputs. These are also called prototyping tools.

IV) Documentation tools:-
These tools produce a technical and user documentation in standard formats.

V) Quality Management tools:-
These tools are used to analyze the system models, description of prototypes for completeness, consistency and conformance to accept the rule of methodology.

VI) Code generation tool:-
These tools enables the automatic generation of program and database definition code directly from the design document, diagram, form and report.

Today's CASE tool provides two distinct ways to develop system model.

i) Forward engineering
ii) Reverse engineering

- Forward engineering requires the system analyst to draw system model either from scratch or from templates. The resulting models are subsequently transferred into program code.
- Reverse engineering on other hand allows a CASE tool to read the existing program code and transform that code into representative system model that can be edited and refined by the system analyst. CASE tool that allow for bi-directional, forward and reverse engineering are said to provide round trip engineering.

Advantage of CASE tool in system development:-

Some of the advantage of CASE tool in system development are:-

1) **Increased speed:-**

CASE tool provide automation and reduce the time to complete many task, especially those involving diagramming and associated specification.

II) Increased accuracy:-

CASE tool can provide ongoing debuging and error checking which is vital for early defect removal which actually play a major role in producing accurate and efficient system.

III) Reduced life time maintenance:-

As a result of better design, analysis, automated code generation, automated testing, overall system quality improves. Thus the net effort and cost involved with maintenance is reduced.

IV) Better documentation:-

By using the CASE tool, vast amounts of documentation are produced.

CASE Tool Used in different Phases of SDLC:-

- CASE helps programmer and analyst do their jobs more efficiently and more effectively by automating their task. However many organizations that use CASE tools do not use them to support all phases of SDLC. Some organizations may extensively use the diagramming features but not the code generators.

- The following table summarizes how CASE is commonly used with in each phase of SDLC.

SDLC phases	key activities	CASE tool usage
Project identification and selection	Display and structure high level organizational information.	Diagramming tools to create and structure information
Project initiation and planning	Develop project scope and feasibility	Documentation tool to develop project plan
Analysis	Determine and structure system requirement	Diagramming tool to create process, logic and data models.
Logical and physical design	Create new system design.	Form and report generator for prototype design analysis and documentation tool to define specification.
Implementation	Translate design into an information system	Code generator and analysis tool, form and report generation tool to develop system.
Maintenance	Evolve information system	All tool are used.

Unit 2: Modeling tool for system analysis

Topic to be covered
- System analyst (Introduction, Role, Skill)
- Context diagram
- Data flow Diagram
- CASE tools
- ER Diagram

System analyst:-

- System analyst is the person who is involved in analyzing, designing and implementing computer based information system to support the decision making and other operation of an organization.
- System analyst is an IT professional who specializes in analyzing, designing and implementing information system.

Responsibility of system analyst in system development:-

- Although many people in organizations are responsible for system analysis and design, the system analyst has the primary responsibility.
- The primary responsibility of system analyst is to study the problem and need of an organization inorder to determine how people, methods and information technology can be best combined to bring the improvement in the organization.

- The main responsibility of system analyst during the system development are:-

I) Defining requirement:-
- The most important and difficult task of system analyst is to understand user requirement.
- It involves interviewing user and finding out what information they use in current system and how they use it, problem they face with current system and what they expect from new system.

II) Prioritizing requirement:-
- In an organization, there are many users and each user has some specific requirement.
- It may not be possible to specify requirement of every one due to limited availability of resources so the system analyst is responsible to set priorities among the requirements of various users.

III) Gathering data and opinion of user:-
- The system analyst must gather necessary data with the help of user by using their long experience and experties while developing a system.
- The system analyst continuously consult the user to get their views.

IV) System analysis:-
- The system analyst analyze the working of current system in the organization and find in what level the system meets user needs.
- System analyst also analyze the fact and find out the best characteristic of new system which will meet the user requirement.
- The key to good analyst is to reject redundant data and focus on important data.

V) Problem solving:-
- The system analyst must study the problem in depth and suggest alternative solution to the management.
- The relative difficulty in implementing each of the alternatives and benefit of those must be determined by system analyst so that manager can fit best solution.

VI) Drawing up specification:-
- The system analyst is responsible to specify the functional specification of the system to be designed in a form which can be understood by the user and manager.
- The specification must be precise and detailed so that it can be used by system implementer.

VII) Designing the system:-
- Once the specification are accepted system analyst design the system.
- The design must be understandable to the system implementor and programmer. The design must be modular to accomodate change easily.

VIII) Implementing and evaluating system:-
- The system analyst implement the new system according to the plan specified in the specification and evaluate the system after it has been in use for reasonable period of time.

The Multifaceted Role of analyst:-

System analyst play different role in an organization. Some important role are:

1) Change agent:-
- An analyst can be viewed as an agent of change. A candidate system is designed to introduce change in how the user organization handles information or make decisions.
- In the role of a change agent, the system analyst may select various styles to introduce the changes to user organization.
- The styles ranges from that of Persuader to imposer and

in between there are catalyst and confronter roles. When the users to have tolerance for change, the catalyst style is appropriate on other hand when drastic changes are required, it may be necessary to adopt confronter or even the imposer style.

ii) Investigator and monitor:-

- The system analyst may work as investigator to know the reason why existing system become fail.
- As an investigator system analyst extract the problem from existing systems and create information structures that uncover previously unknown trends that may have direct impact on the organization.
- Related to the role of investigator is that of monitor. In this role analyst must monitor programs in relation to time, cost and quality.

iii) Architect:-

- The analysts another role is the role of architect. As architect, analyst creates a detailed physical design of candidate system. He/she aids user in formalizing the abstract ideas and provides details to build the candidate system.

IV) Psychologist:-

- In system development, the system are built around people. The analyst play role of psychologist in a way he/she reaches people, interpretes their thoughts, assesses their behaviour and draws conclusion from these intractions.
- It is important for the system analyst to be aware of people's feeling and be prepared to get around things in a graceful way.

V) Motivator:-

- System acceptance is achieved through user participation in its development, effective user training and proper motivation to use the system.
- The analysts role as a motivator becomes obvious during the first few weeks after implementation and when new people being trained to work with the candidate system.

VI) Politician:-

- Related to the role of motivator is that of politician. In implementing a candidate system, the analyst tries to appease all parties involved.
- Diplomacy of analyst in dealing with people can improve the acceptance of the system.
- As much as a politician must have the support of his/her constituency, so as the analyst's goal to have the support of the user, staff.

Skill / attribute of system analyst:-

- System analyst are the key individual in information system development process. In addition to having formal system analysis and design skill, the system analyst must develop or possesses the following skill:

1) Working knowledge of information technology:-
- The analyst must be aware of both existing and emerging information technology. Such knowledge can be acquired in college courses, professional development seminar and training program.
- Analyst must be familiar with capabilities and administration of h/w and s/w product as well as they must have a practical knowledge of one or more programming and database language.

II) Computer programming experience and experties:-
- This is the technical skill that should be need by system analyst.
- Most system analyst need to be proficient in one or more high level programming language so that they can be able to prepare technical specifications for a programmer.

III) General knowledge of business processes and terminology:-
- Most of the systems today are business related and the systems analysts must be able to communicate with business expert to gain understanding of their problems

and needs. So this must be possess by system analyst.
- To develop this skill, system analyst should have knowledge about the course like accounting, finance, business law etc.

IV) Knowledge of organization:-
- It is important for the system analyst to understand the structure and working procedure of the organization for which system is being developed.
- They must be familiar with existing operation of organization and relationship between various component within organization.

V) General problem solving skill:-
- The system analyst must be able to take a large business problem, break down that problem into its part, determine problem cause and effects and than recommend a solution.
- To develop this skill, analyst should have the knowledge about critical thinking and reasoning.

VI) Good interpersonal communication skills:-
- To know the user requirements, an analyst must be able to communicate effectively, both orally and in writing.
- Effective communication is very important for the success of any project. The system analyst is the medium to which communication should follow smoothly.
flow

- System analyst must be able to talk intelligently with manager, employee, non-technical users and programmer.
- System analyst must be able to organize his tounge and present them in a language which can easily understood by all users.
- For an effective communication, analyst must be able to communicate in international as well as local language.
- To develop this skill, the course like business and technical writing, technical speaking, interviewing and listing will be effective.

VII) Good interpersonal relations skills:-
- The system analysts intract with all stakeholders in a system development prject.
- These intraction requires an effective interpersonal skills that enable the analyst to deal with group dynamics, business, politics, conflict and change.
- To improve this skill the analyst should have knowledge about courses like teamwork, leadership, managing change and conflict, etc.

VIII) Flexibility and adaptability:-
- No two projects are like. Accordingly there is no single, magical approach or standard that is equally applicable to all projects.
- Successful system analyst learn to be flexible to adapt to unique challenges and situations.

IX) Character and ethics :-

- The nature of systems analyst's job requires a strong character and a sense of right and wrong. Analyst often gain access to sensitive or confidential facts and information that are not meant for public disclosure.

Process Modeling :-

- Process Modeling involves graphically representing the functions, or processes that capture, manipulate, store and distribute data between a system and its environment and between a component within a system.
- Main focus of process modeling is to model the processes and shows the flow of information through a system.
- A common form of process model is Data flow diagram that concentrate on the movement of data between processes.
- In structured analysis, the primary deliverables from process modeling are a set of coherent, interrelated DFD's.

Data Flow Diagram (DFD) :-

- Data flow diagram is the pictorial representation of the movement of data between external entities and processes and data stores within a system.
- It is a graphical tool that allow an analyst to depict the flow of data in an information system.

- It is also called bubble chart, transformation graph or process model.
- The main advantage of DFD is that it can provide an overview of what data system could process, what transformation of data are done and which data are stored and where.

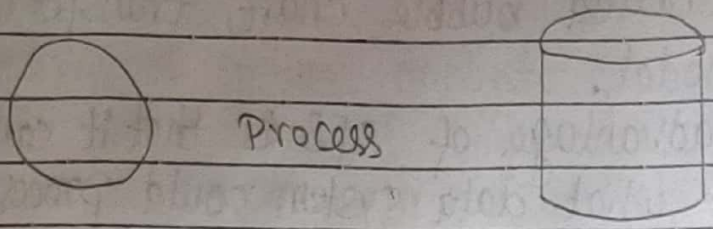
Characteristics of DFD:-

The characteristics of DFD are:-

i) They shows the flow of data through the system.
ii) They focus on processes that transform incoming data flows into outgoing data flows.
iii) They focus on external entities that supply and consume data from the system.

Symbols used in DFD's:-

- Four symbols are used in DFD. There are two different standard set of DFD symbols.
- Each set consist of four symbols that represent the same thing: data stores, data flow, processes and source/sink.
- The following figure shows two different sets of symbols developed by
  i) Demarco and yourdon
  ii) Gane and sarson



data store

source / sink
or
external entity

data flow

Demarco and Yourdon symbol

Gane and sarson Symbol

The description of these symbol is given below:

1) Data flow:-
- A data flow can be understood as data in motion, moving from one place in a system to another.
- The data flow indicates the movement of data either from input to process or from process to output.
- Data flow is labelled to show what data is flowing. For example; customer details, sale reports, customer orders, etc.

II) Processes:-
- A processes is a work or actions performed on data so that they are transferred, stored or distributed.
- Each process has one or more data inputs and produce one or more output data.
- The process are given some meaningful name. For example; prepare Bill, calculate sales, compute pay, compute grade, etc.

III) Data store:-
- A data store is a data at rest. A data store may represent one of many different physical location for data
- For example; customer master file, employee register, etc are data stores.

IV) External entities:-
External entities are the source or destination of data. They may be people, program, organization or other entities that interact with the system. For example; customer employee, etc.

Data flow Diagramming rules:-
There is a set of rules that must follow when drawing DFD's. These rules allow to evaluate DFD for correctness.

The rules for DFD's are listed below:-

Rules for process:
1. No process can have only outputs.
2. No process can only have a input
3. A process has verb phrase label.

Rules for data store:
1. Data cannot move directly from one data store to another data store. Data must be moved by a process.
2. Data cannot move directly from outside source to data store. Data must be moved by process that receives data from the source and place the data into data store.
3. Data cannot move directly to an outside sink from an data store. Data must be moved by process.
4. A data store has noun phrase label.

Rules for source/sink:
1. Data cannot move directly from source to a sink. It must be moved by a process if the data are of any concern to our system.
2. Source/sink has noun phrase label.

Rules for dataflow:

1. A data flow has only one direction of flow between symbols. It may flow in both directions between a process and data store to show a read before an update. The later is usually indicated however by two separate arrows because these happens at different times.
2. A fork in a data flow means that different copies of same data going to different location.
3. A join in a data flow means that exactly the same data come from different location to common location.
4. A dataflow to a data store means update.
5. A dataflow from data store means retrieve or use.
6. A dataflow has noun phrase label.

actually represent what kind of data flow to the and generate output/report

Context diagram:-

- The content diagram is an overview of an organizational system that shows the system boundaries, external entities that intract with the system and major information flow between the entities and the system.
- The context diagram have only one process, source/sink that represent the environmental boundaries of the system. Because the data stores of the system are conceptually inside the process, so the data store do not appear on a context-diagram.
- The context diagram shows the high level view of the system.

- For example the context diagram for food ordering system is given below:

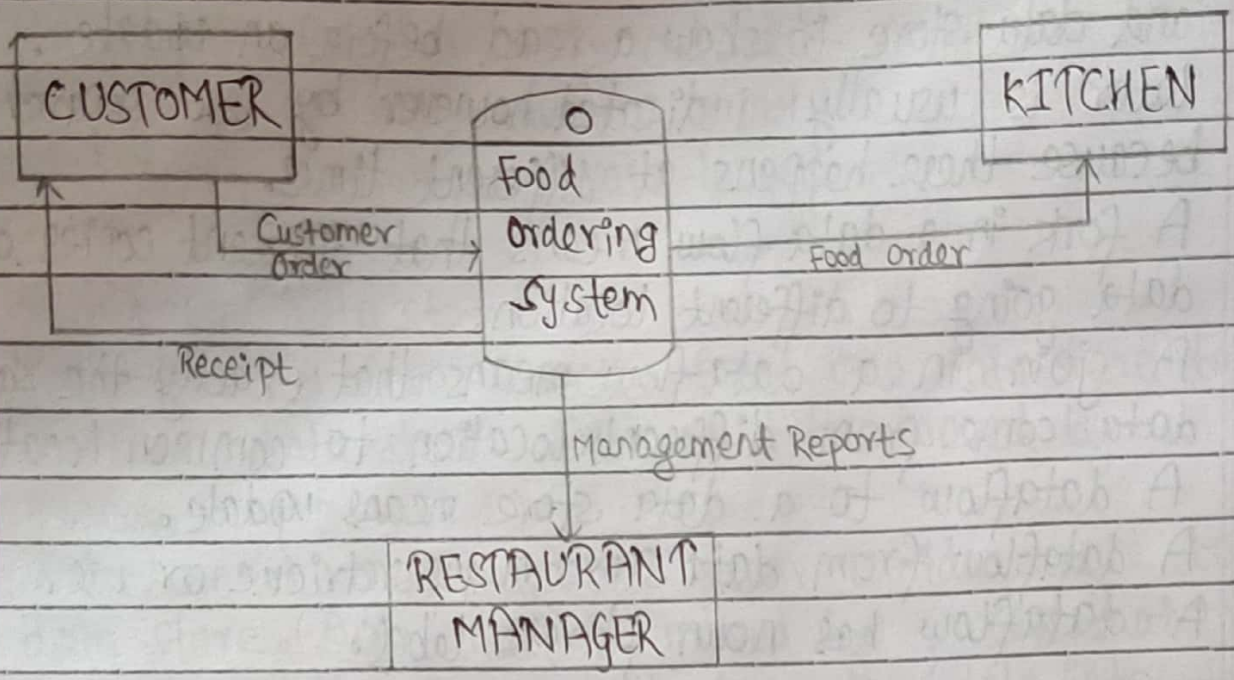


Fig:- Context diagram of Food ordering system

Functional decomposition (Decomposition of DFD):-

- Functional decomposition is an iterative process of breaking a system description down into finer and finer detail.
- This process creates a set of hierarchically related chart in which one process on a given chart is explained in greater detail on another chart.
- In functional decomposition, each larger process is decomposed into subprocesses and each subprocesses are broken down into smaller units.
- Decomposition continues untill we have reached the point at which no subprocess can logically be broken down

any further. The lowest level of DFD is called premitive DFD.

Developing DFD's:-

The following are some steps for constructing the DFD's:

1. Identify external entities and data flow of the system.
2. An entire system can be modelled by a data flow diagram with one process which gives a system overview called context diagram.
3. Draw the DFD with major processes that are represented by single process in the context diagram. These major process represent major function of the system. This diagram also include data stores. These diagram are called level-0 DFD.

   A level 0 DFD is a DFD that represents a system's major processes, data flows and data store at high level of detail. In this diagram, source/sink should be same as in context diagram and each process has a number that end in .0.
4. Decompose level 0 DFD to obtain the level 1 DFD. Level 1 DFD shows the subprocess of one of the processes in the level-0 DFD. Generally level-1 DFD is created for every major process on the level 0 DFD. It shows all the internal processes that comprise process on the level 0 DFD. Source and sink are optional on level-1 diagram. We label each subprocess of 1.0 to 1.1, 1.2 and so on.

5. Explore the processes of level 1 DFD and obtain the 2nd level DFD and so on.

How many levels of diagrams are needed depends upon the nature and complexity of system under consideration.

Example:-

Consider a restaurant uses an information system that takes customer orders, send the order to the kitchen, monitors the goods sold and inventory, and regenerate the reports for management.

The DFD for such a system are presented below:

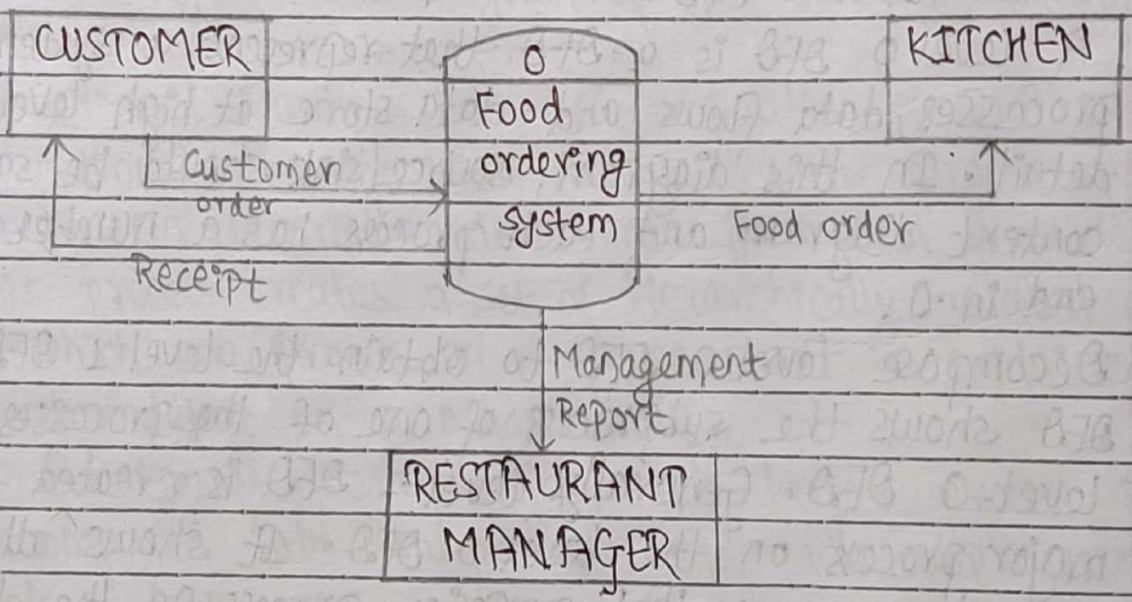


Fig:- Context diagram of food ordering system

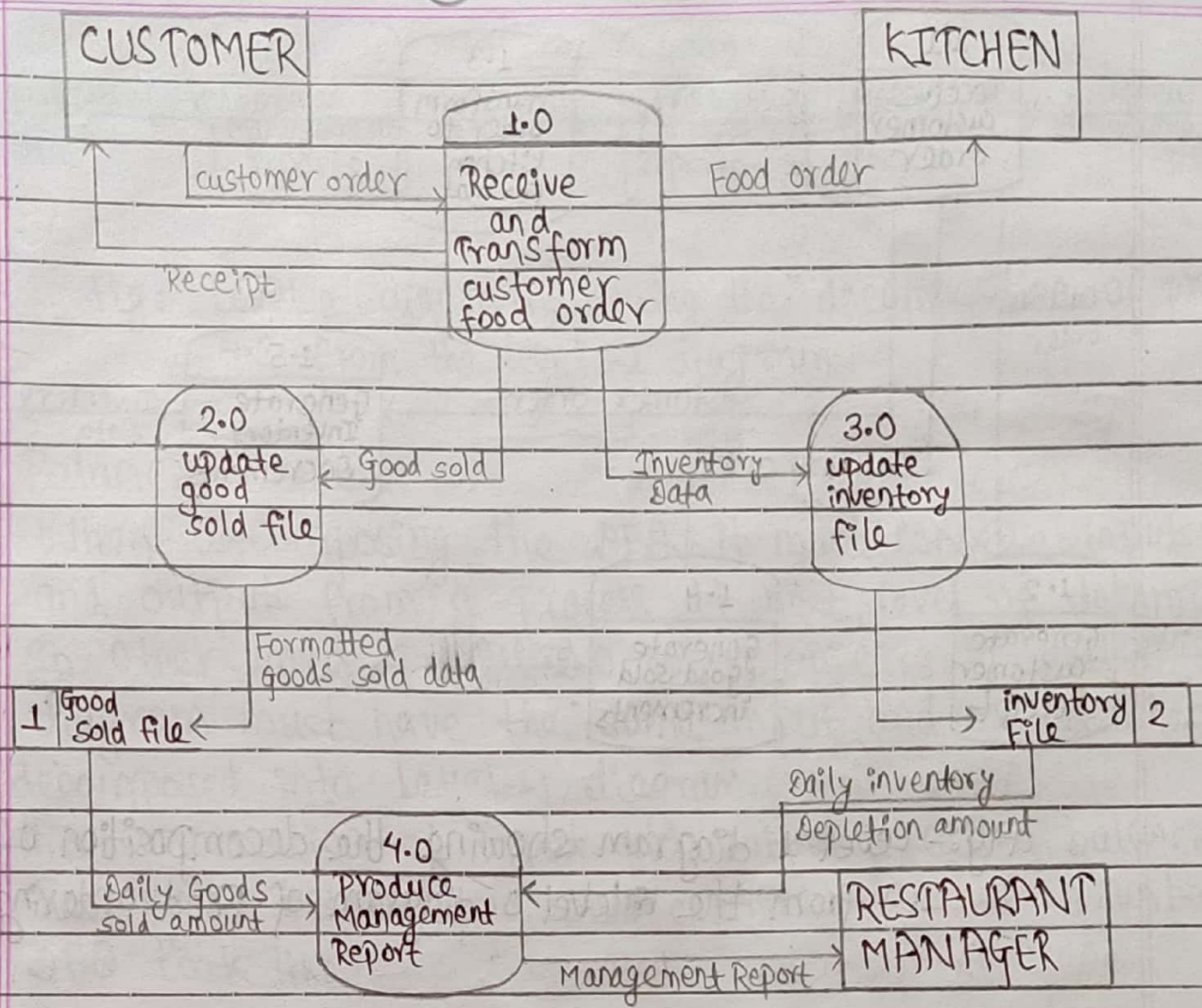


Fig:- Level 0 DFD of food ordering system

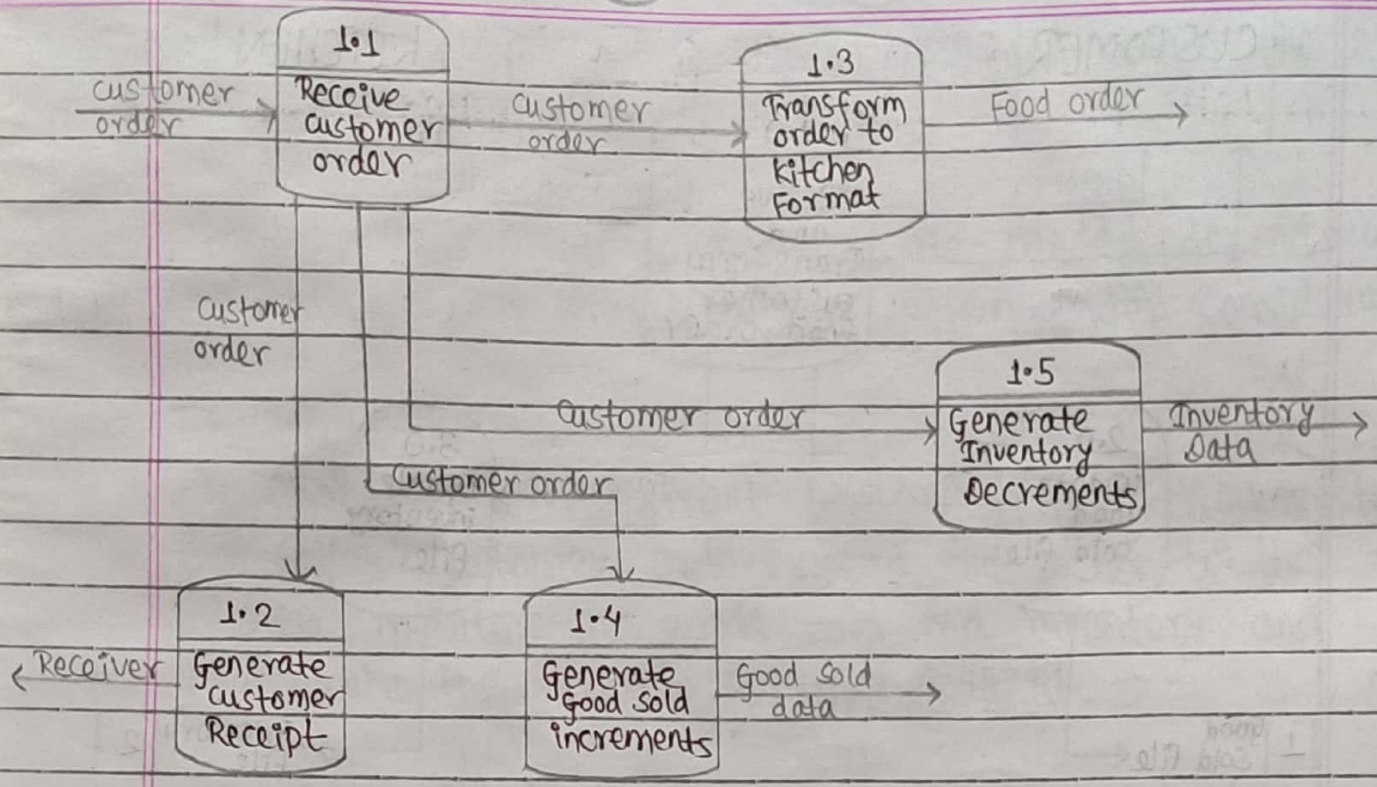


Fig:- Level 1 diagram showing the decomposition of process 1.0 from the level 0 diagram of Food ordering System

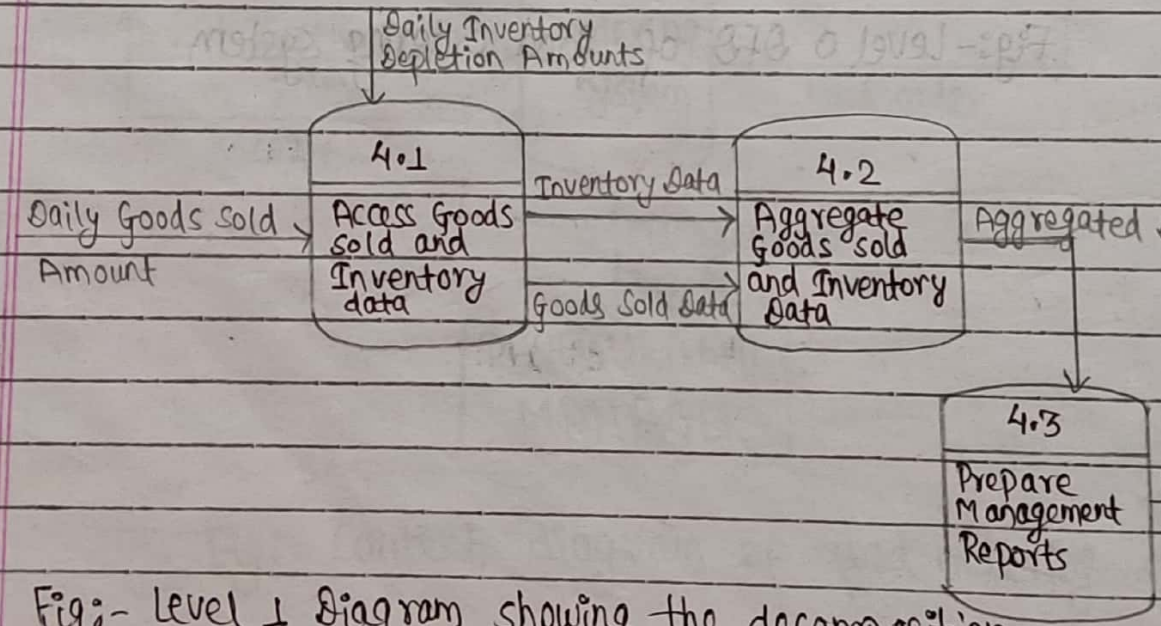


Fig:- Level 1 Diagram showing the decomposition of process 4.0 of level-0 Diagram

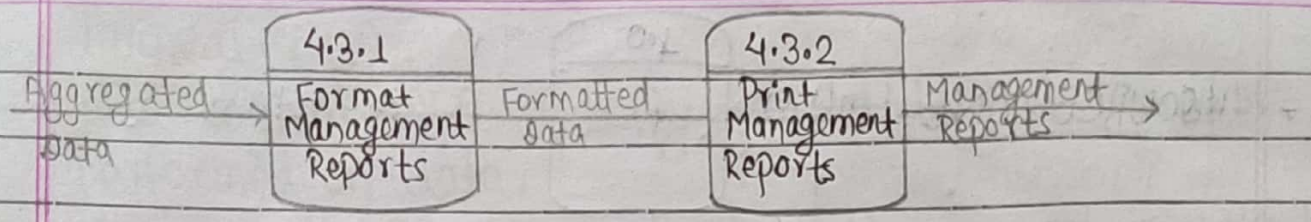
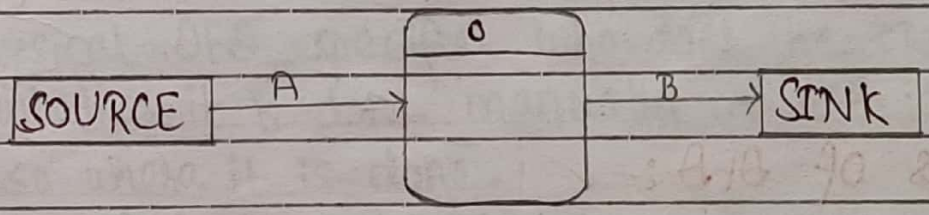


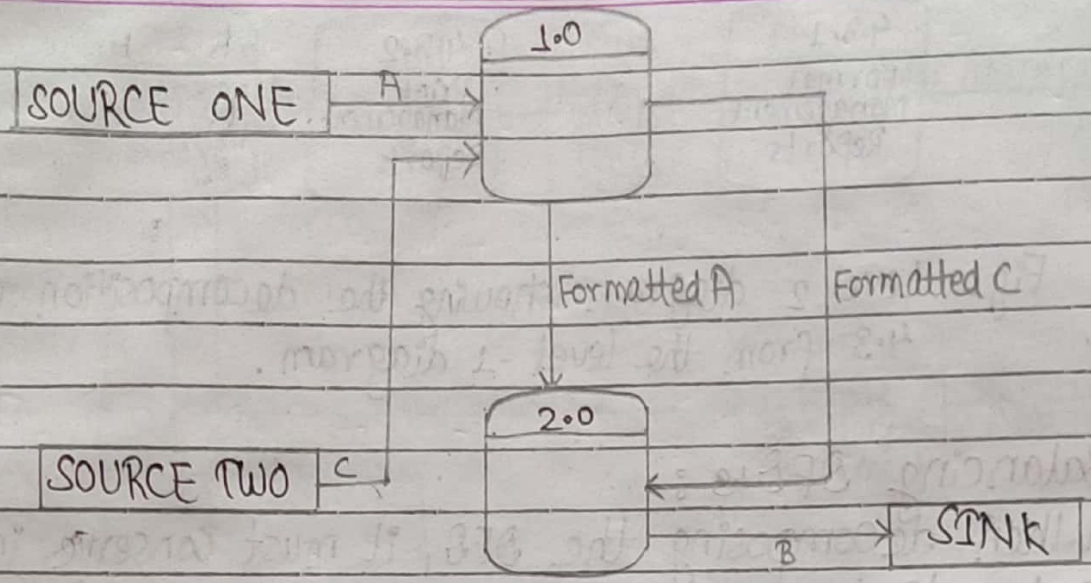
Fig:- Level 2 diagram showing the decomposition of process 4.3 from the level -1 diagram.

Balancing DFD's :-

- When decomposing the DFD, it must conserve inputs to and outputs from a process at next level of decomposition.
- In other word, process 1.0 which appears in level-0 diagram must have the same input and output when decomposed into level -1 diagram.
- This conservation of input and output is called balancing.
- The figure below shows one example of what an unbalanced DFD look like:



(a) Context diagram



b) Level-0 diagram

Fig:- Unbalanced set of DFD's

- In the figure above, the context diagram shows one input 'A' to the system and one output B from the system. But in level-0 diagram there is additional input C, so these two DFD are not balanced.

Types of DFD:-

There are two types of DFD's. They are:

i) Logical DFD
ii) Physical DFD

1) Logical DFD :-

- The logical DFD specify various logical processes performed on data.
- The logical DFD focuses on how the system operates but not concerned with how the system will be constructed.
- A logical DFD does not specify who does the operations, whether it is done manually or with the computer and also where it is done.
- A logical DFD makes it easier to communicate for the employees of an organization lead to the more stable systems, allow for better understanding of the system by analyst.
- A logical DFD captures the dataflows that are necessary for a system to operate and describe processes that are undertaken, data required and produced by each processes and the stores needed to hold the data.

2) Physical DFD :-

- A Physical DFD specifies who does the operation on data, whether it is done manually or with computer and also where it is done.
- In otherword, physical DFD shows how the system will be implemented including hardware, software files and people in the system.
- It is developed such that processes described in the logical data flow are implemented correctly to achieve the goal of business.

- Physical DFD clearify which processes are manual and which are automated and gives the detailed description of processes.
- In a broad sense, the physical DFD shows how the system is actually implemented.

The following are the examples of physical and logical DFD.

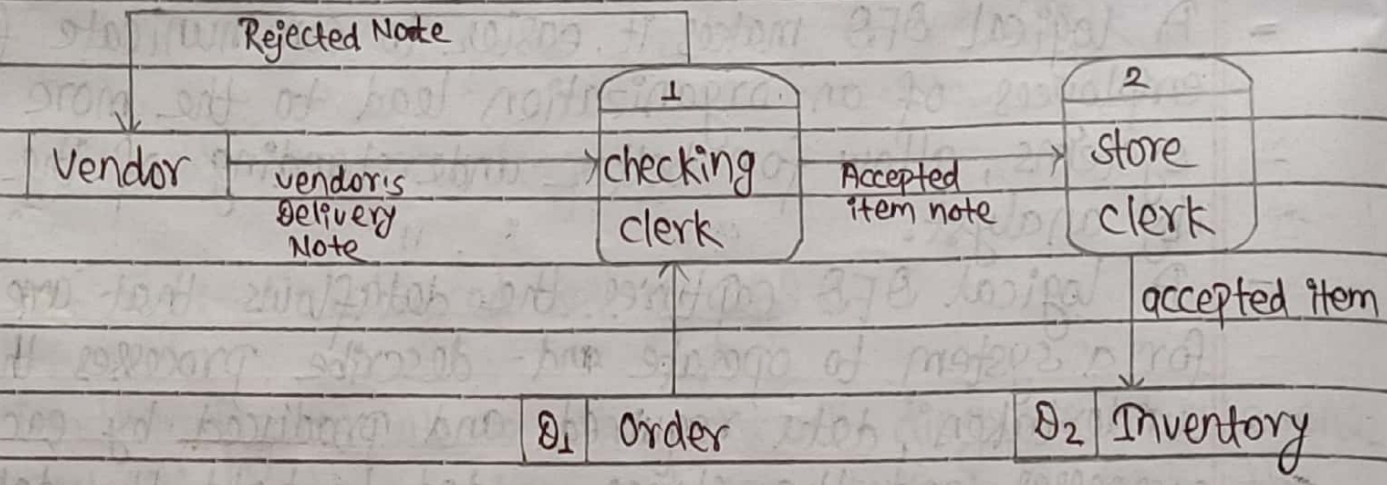


Fig (a): Physical DFD

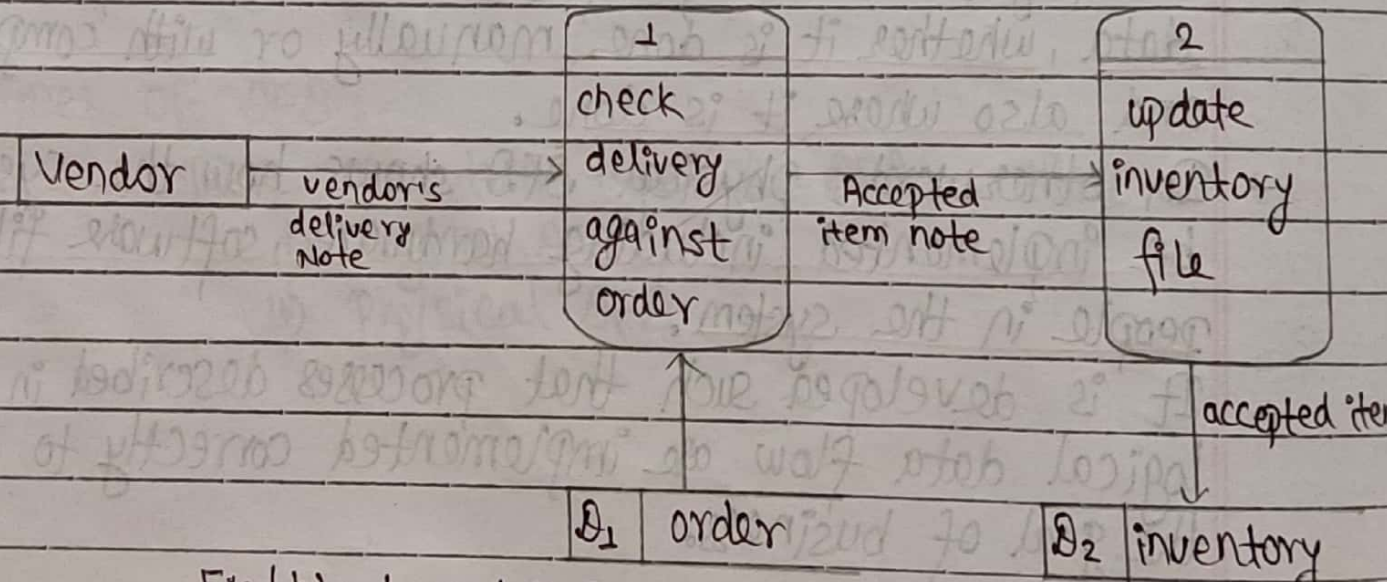


Fig (b): logical DFD

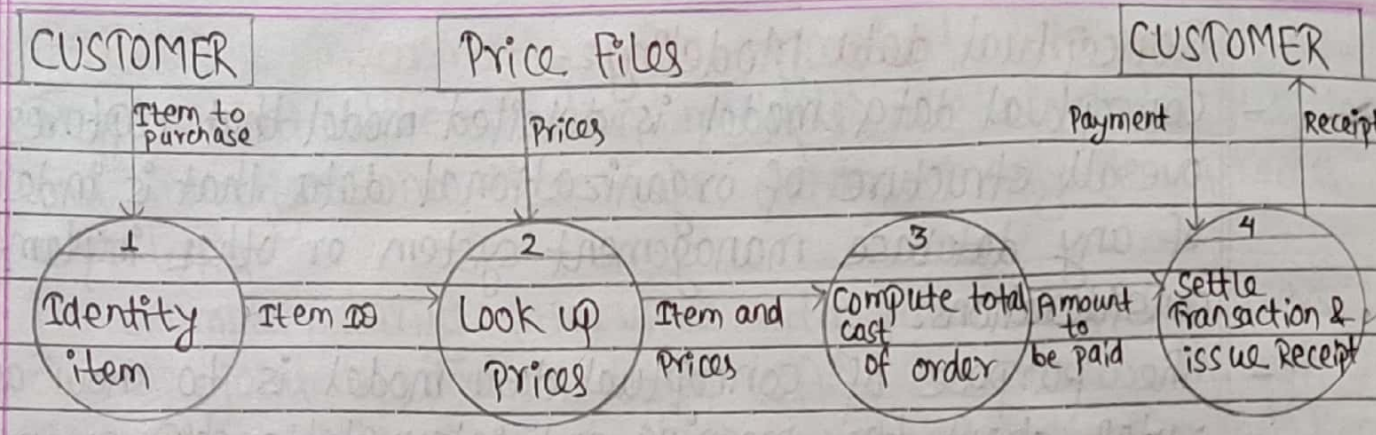


fig :(a) : Logical Data flow diagram

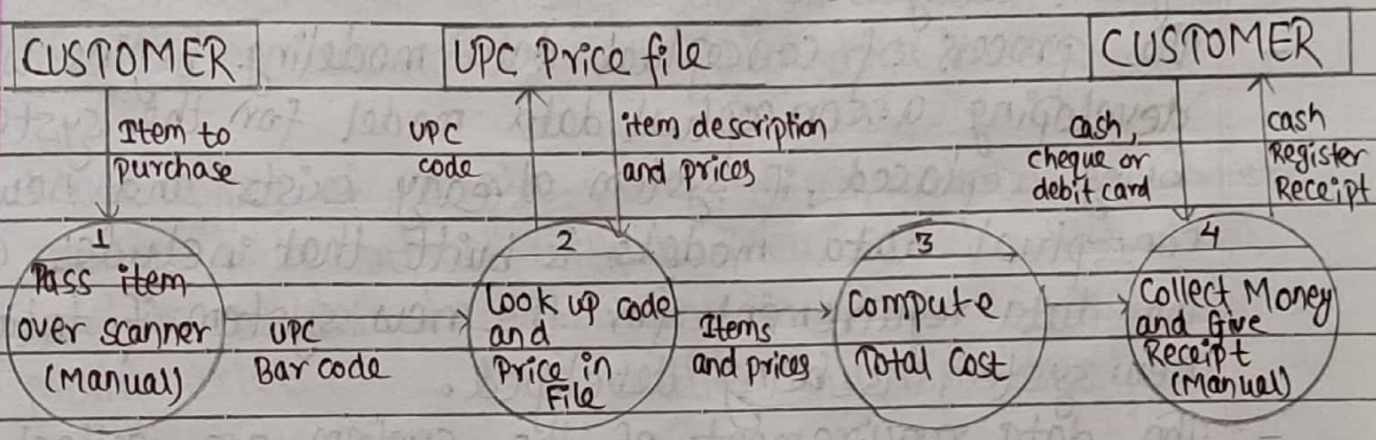


fig (b): Physical Data flow diagram.

Conceptual data Modeling:-

- Conceptual data model is detailed model that captures the overall structure of organizational data that is independent of any database management system or other implementation considerations.
- The purpose of conceptual data model is to show as many rules about the meaning and interrelationship among data as are possible.
- Conceptual data modeling is typically done in parallel with other requirement analysis and structuring steps during system analysis.
- The process of conceptual data modeling begins with developing a conceptual data model for the system being replaced, if system already exists and new conceptual data models is built that includes all the data requirement for the new system if totally new system is being developed.
- The data requirement of the system are collected from the fact finding methods employed during requirement determination.
- Most organization today do conceptual data modeling using E-R modeling, which uses a special notation to represent as much meaning about data as possible.
- The primary deliverables from the conceptual data modeling step within the analysis phase is an E-R diagram.

Gathering information for conceptual data modeling:-

- Requirement determination methods must include questions and investigations that take data, not only the process and logic.
- For example, during interviews with potential system users, during joint application design (JAD) sessions or through requirement interviews analyst must ask specific questions inorder to gain understanding on data that analyst need to develop data model.
- The following are few key questions that should ask to system user and business managers so that analyst can develop an accurate and complex data model.

1. What types of people, places, things, material, events, etc are used or intract with business, about which data must be mantained? How many instances of each object might exists? — Data entities and their description.

2. What unique characteristic distinguishes each objects of same type? — Primary key

3. What characteristic describe each object? On what basis are object referenced, selected and categorized? What must we know about each object inorder to run the business? — attributes and secondary key

4. Who is not permitted to use data? Who is responsible for establishing legitimate values for these data?
   - security controls and understanding who really knows the meaning of data.

5. Are there special kind of each objects that are described or handled differently by the organization? Are some objects summaries or combinations of more detailed objects? - super types, sub-types and aggregation.

6. What event occur that imply associations among various objects? - Relationships, their cardinality and degree.

- Analyst also gather the information he need for data modeling by reviewing business documents, business form, reports handled within the system.

Entity relationship Model (ER Model):-

- The E-R model is the most popular conceptual data model used for designing a database.
- The E-R model views real world as a set of basic objects called entities their characteristics called attributes and association among these objects called relationships.
- The E-R model is detailed logical representation of data for an organization or for a business area. It is expressed in terms of entities, association and attributes or properties of both entities and relationships.

An ER Model is normally expressed as entity relationship diagram which is the graphical representation of E-R Model.

Entity-relationship diagram:-

An entity relationship diagram is a graphical representation E-R model. It has the three basic component entities, attributes and relationships. Once the entity type, relationship type and their corresponding attribute are identified during conceptual data modeling next step is to graphically represent these component using the entity-relationship (E-R) diagram. ERD is different than DFD in the sense that DFD focuses on process and data flow between them while ERD focuses on data and relationship between them. It is an effective tool to communicate with senior management data administrator and database designer. It help to organize the data used by system in disciplined way.

Component of ER diagram:-

Entity:-

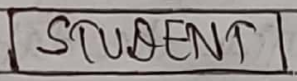
An entity is a person, place, object, event or concept in the user environment about which the organization has to maintain data. For example, each student in the class is entity.

An entity type or entity set is collection of entities that share common properties or characteristics. For example, set of all student in the class is entity set. An entity instance is a single occurance of an entity type.

Some examples of entities are:

- person : EMPLOYEE, STUDENT, PATIENT
- place : STORE, WAREHOUSE, STATE
- object : MACHINE, BUILDING, PRODUCT
- event : SALE, REGISTRATION
- concept : ACCOUNT, COURSE

An entity type in ER diagram is drawn using rectangle. This shape represents all instances of the named entity. For example, the figure below shows STUDENT entity type.



Naming and Defining entity types:-

Each entity type in E-R diagram is given a name. When naming entity types, we should use the following guideline.

- An entity type name is singular noun (like CUSTOMER, STUDENT or AUTOMOBILE)
- An entity type name should be concise like REGISTRATION for event of student registering for a class rather than STUDENT REGISTRATION FOR CLASS.

- An entity type name should be descriptive and specific to the organization.
- Event entity types should be named for the result of the event not the activity or process of the event. For example, the event of a project manager assigning an employee to work on project result in a ASSIGNMENT.

Each entity type in E-R diagram should be defined, when defining attribute we should use following guideline:-

- An entity type definition should include a statement of what the unique characteristic is for each instance of the entity type.
- An entity type definition should make clear what instances are included and not included in entity type.
- An entity type definition often include a description of when an instance of the entity type is created or deleted, etc.

Attributes:-

Each entity type has set of attributes associated with it. An attribute is a property or characteristic of an entity that is of interest to the organization. For example: F

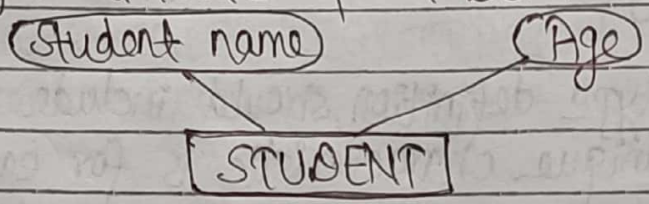
Following are some typical entity types and associated attributes:-

STUDENT: Student_ID, Student_Name, Home_address, Phone_number.

AUTOMOBILE : Vehicle_ID, colour, Weight, Horse Power.
EMPLOYEE : Employee_ID, Employee_Name, Payroll_address, skill.

In E-R diagram, an attribute is represented by ellipse, we place attribute name inside the ellipse with a line connecting it to associated entity type.

For example: The figure below shows Student_Name and age attribute of STUDENT entity type.



Naming and defining attributes :-

Each attribute in E-R diagram is given a name, when naming attributes, we should use following guideline.

- An attribute name is noun such as Customer_ID, age, skill.
- An attribute Name should be unique.
- To make attribute Name unique and for clarity, each attribute name should follow standard format. For example Student_GPA as opposed to GPA_of_Student.
- Similar attributes of different entity type similar but distinguishing names. For example, Student_Residence_City_Name for Student entity type and faculty_Residence_city_Name for FACULTY entity type.

Each attribute in E-R diagram should be defined. When defining the attributes we use following guideline:

→ An attribute definition states what the attribute is and possibly why it is important.
→ An attribute definition should make it clear what is included and what is not included in the attributes value.
→ An alias or alternative name for the attribute can be specified in the definition.
→ An attribute definition may state the source of values for the attribute to make meaning clearer.
→ An attribute definition should indicate if a value for attribute is required or optional.
→ An attribute definition may indicate if a value for attribute may change.

Attribute types:-

Several types of attributes occurs in ER Model:

i) Simple versus composite
ii) Single valued Vs. Multivalued
iii) Stored Vs. derived

i) Simple versus composite:-

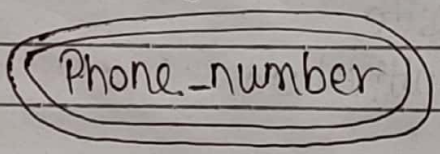
The attributes that cannot be divided into subparts are called simple attributes. For example; roll no. attributes of STUDENT cannot be further divided into subpart thus roll no attribute of student entity acts as a simple attribute.

The attribute that can be divided into subparts are called composite attribute for example: Name attributes of particular student can be further divided into subparts first_name, middle_name and last_name thus name attribute acts as composite.

ii) Single valued and Multivalued attribute :-

The attribute which have only one value are called single valued attributes. For example, age of an employee is single valued attributes because person cannot have two value of age.

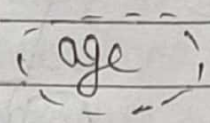
An attribute that can have more than one values are called multivalued attributes. An employee can have more than one contact number therefore contact number are multivalued attribute.
Multivalued attribute are represented by double oval or ellipse in E-R diagram.



iii) Stored verses derived attributes:-

An attribute whose value need not be stored rather it can be computed from other attribute is called derived attributes. For example: The value of age can be computed from current_date and value of Date_of_birth attribute so age attribute is derived attribute

We use dashed ellipse to denote derived attribute.



An attribute whose value are stored in the database are called stored attribute.

Candidate key and identifier:-

- A candidate key is an attribute or combination of attribute that uniquely identifies each instances of an entity type. A candidate key for a STUDENT entity type might be Student_ID.

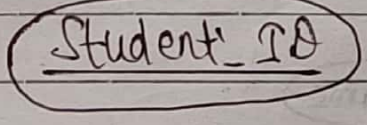
- An identifier or primary key is a candidate key that has been selected to be used as the unique characteristic for an entity type.

We can use the following selection rules to select identifiers or primary key:

→ Choose a candidate key that will not change over the life of each instance of the entity type.

→ Choose a candidate key that will never be null.

The name of identifier is underlined on an E-R diagram. For example, the figure below shows Student_ID as an identifier for student entity type:



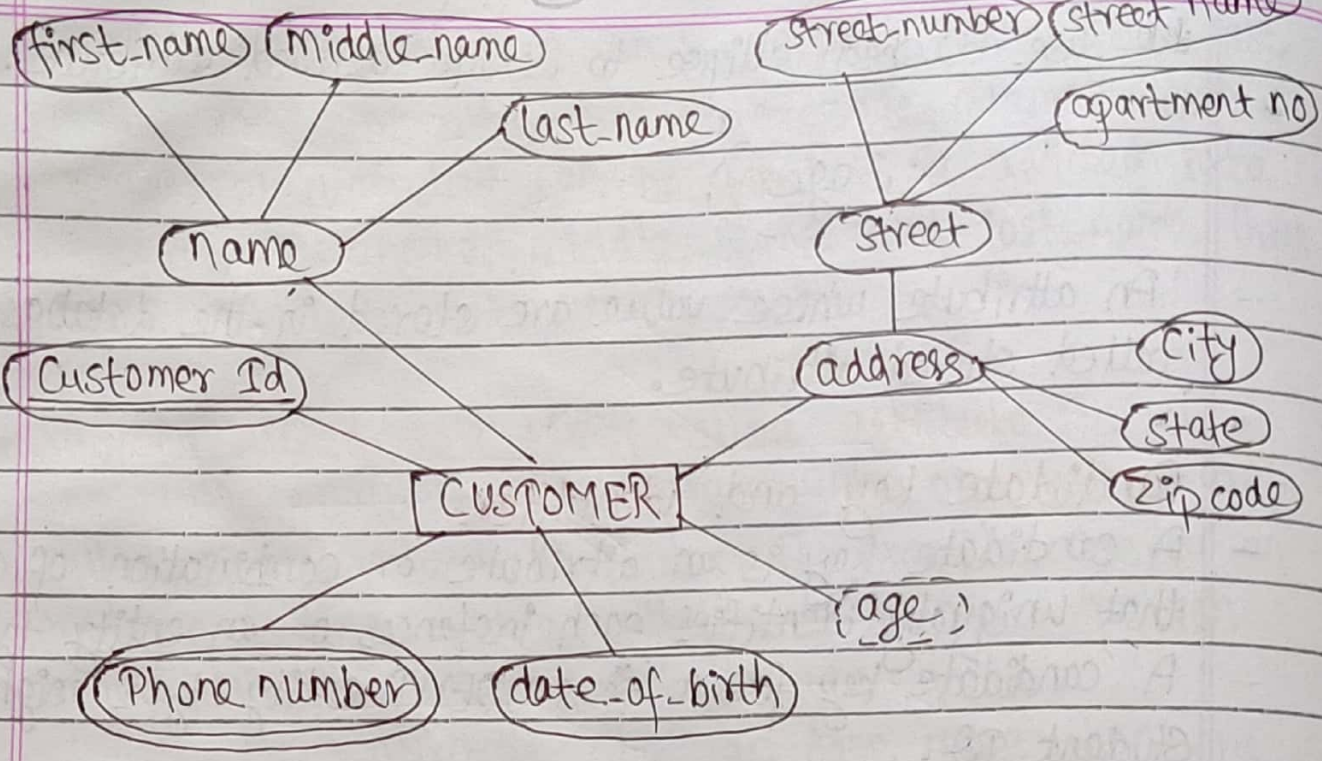
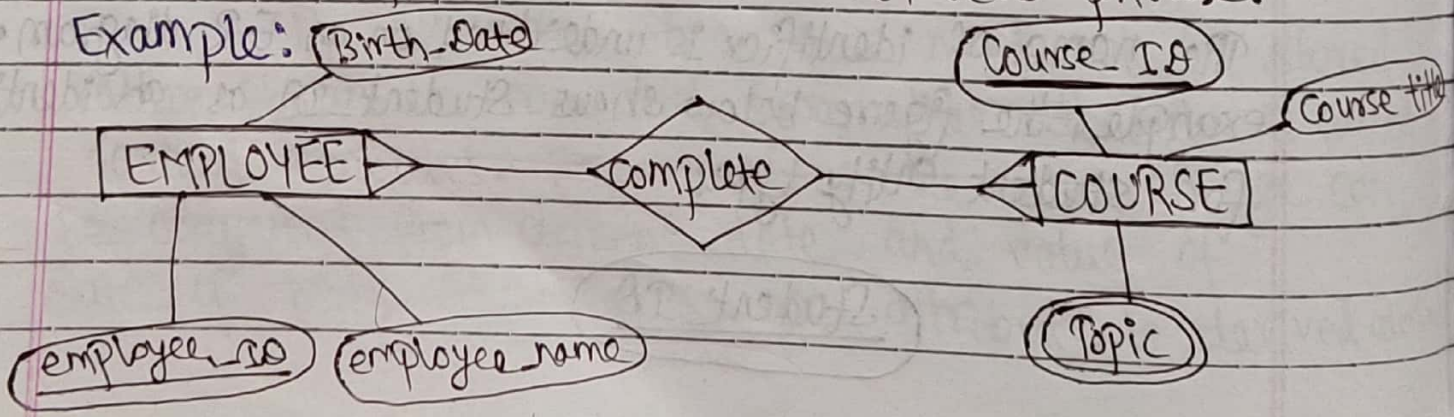


Fig:- Composite attribute, Derived attribute, and Multivalued attribute.

Relationships:-

A relationship is an association between the instances of one or more entity types that is of interest to the organization. In other word, association between two or more entities is called relationship. Relationship are represented by diamond symbol in E-R diagram. Relationships are labelled with verb phrase.

Example:



As indicated by arrow, the cardinality of this relationship is many to many since each employee may complete more than one course and each course is completed by more than one employee.

Degree of relationship:-

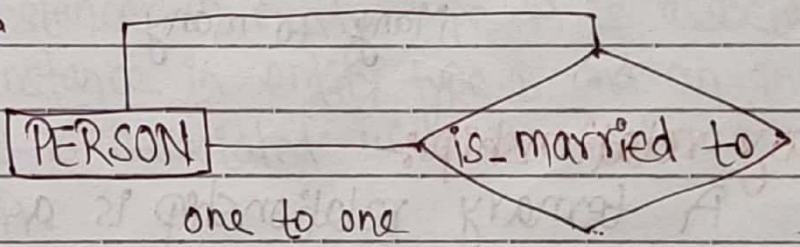
The degree of a relationship is the number of entity types that participate in that relationship. The three most common relationships in ER model are:

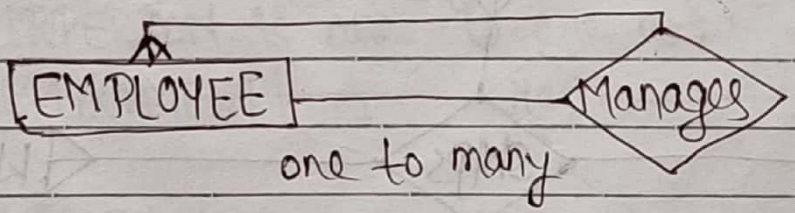
i) Unary relationship
ii) Binary relationship
iii) Ternary relationship

1) Unary relationship:-

Unary relationship is a relationship between the instances of one entity type. It is also called recursive relationship.

For example:

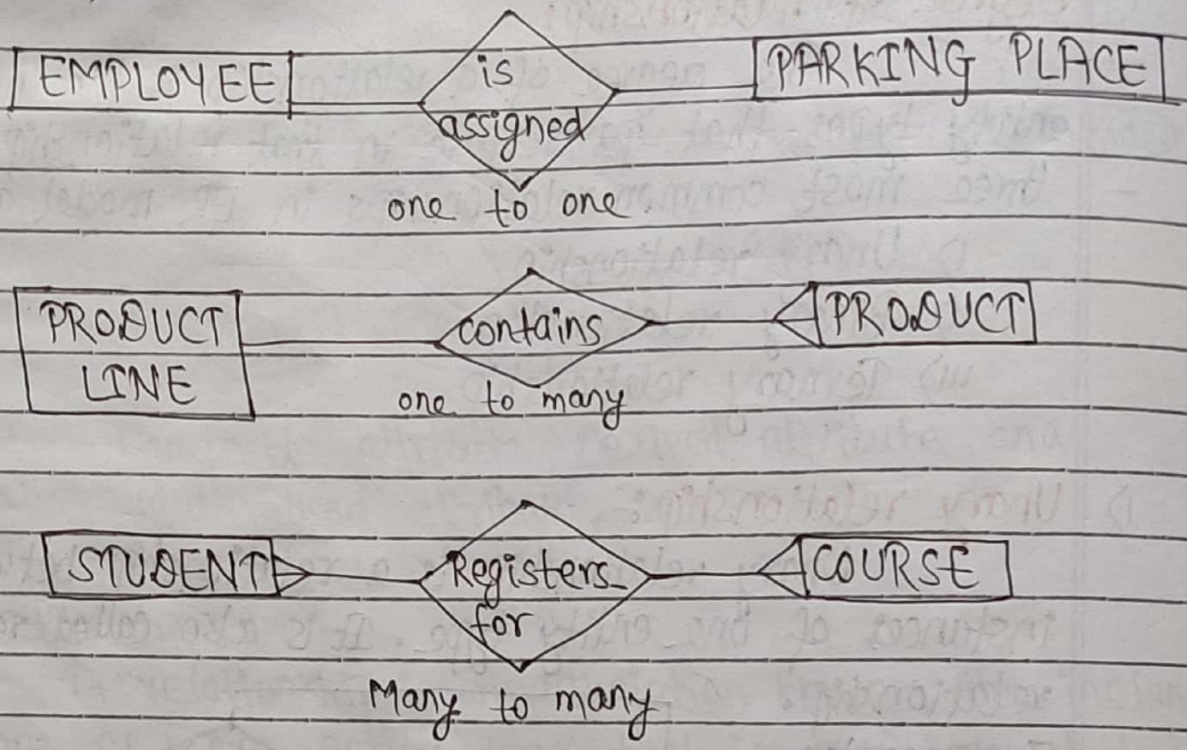




ii) Binary relationship :-

A binary relationship is a relationship between instances of two entity type and is the most common type of relationship encountered in data modeling.

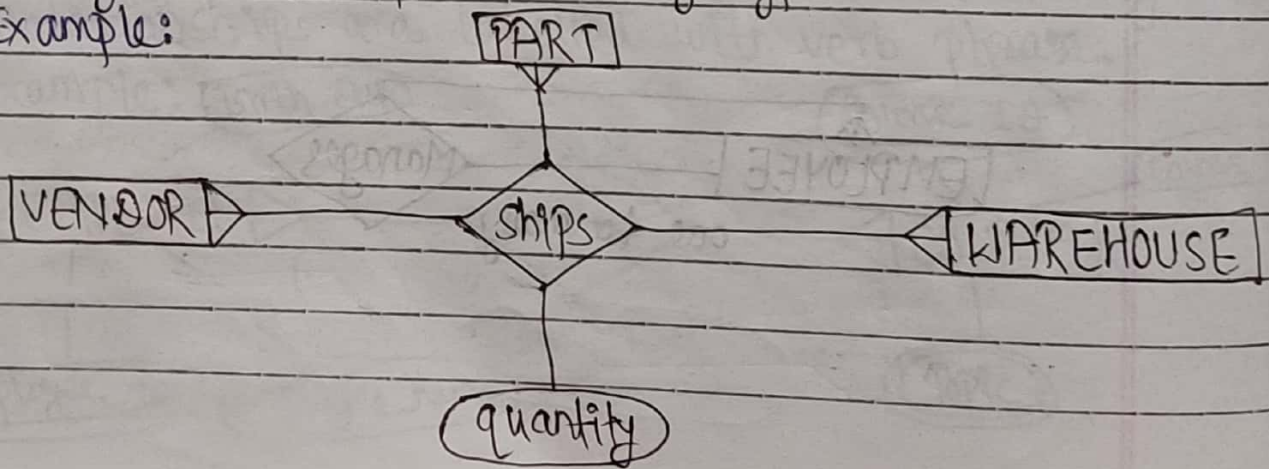
Example:



iii) Ternary relationship :-

A ternary relationship is a simultaneous relationship among instances of three entity type.

Example:



Here, the relationship ships tracks the quantity of given part that is shipped by particular vendor to selected warehouse.

Type of relationship :- (Mapping cardinalities)

The cardinality of a relationship is the number of instances of one entity type that can be associated with each instances of another entity type. On the basis of cardinality of relationship, the relationship are of following types:

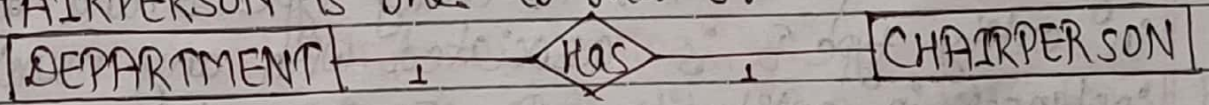
i) One to one
ii) One to Many
iii) Many to one
iv) Many to Many

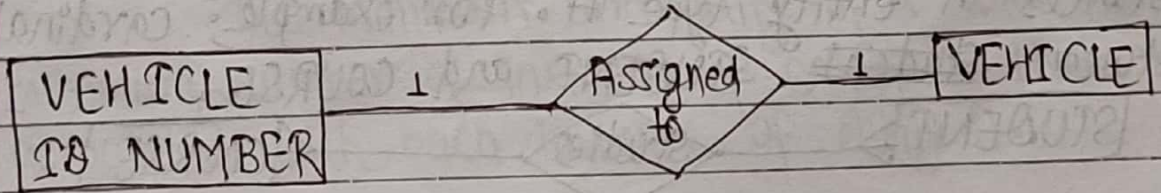
1) One to one :-

An instance in entity type A is associated with at most one instance in entity type B and an instance in entity type B is associated with at most one instance in entity type A.

For example:-

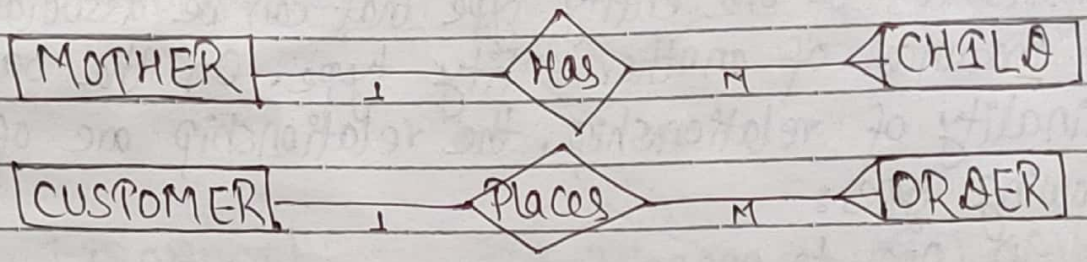
Cardinality between DEPARTMENT and CHAIRPERSON is one to one as:





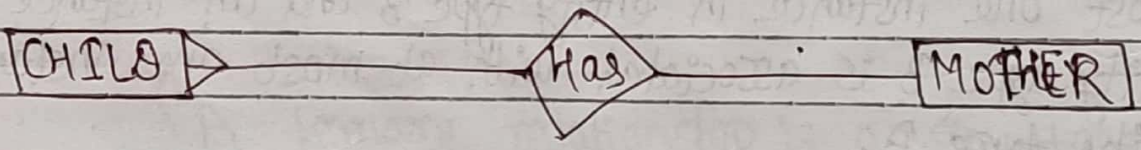
II) One to Many :-

An instance in entity type A is associated with any number of instances in entity type B and an instance in entity type B however can be associated with at most one instance in entity type A, for example, cardinality between MOTHER AND CHILD.



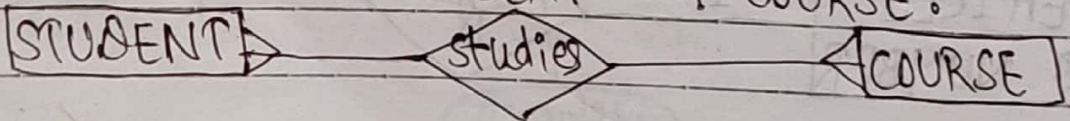
III) Many to One :-

An instance in entity type A is associated with at most one instance in entity type B and an instance in entity type B however can be associated with any number of instances in entity type A. For example; cardinality between CHILD and MOTHER.



IV) Many to Many :-

An instance in entity type A is associated with any number of instances in entity type B. and an instances in entity type B is associated with any number of instances in entity type A. For example; cardinality between ~~student~~ STUDENT and COURSE.



Naming and Defining relationships:-

Each relationship in E-R diagram is given a name. When naming relationship we should use the following guideline.

- A relationship name is verb phrase such as Assigned_to, supplies, Teaches, etc.
- Avoid vague names such as Has or Is_related to as a relationship name but use descriptive verb phrase taken from the action verb.

Specific guideline for defining relationships are as follows:

- A relationship definition explain what action is being taken and possibly why it is important.
- The relationship definition should explain any restrictions on participation in the relationship.
- A relationship definition should explain the reason for any explicit maximum cardinality other than many, etc.

Cardinalities in Relationships:-

The cardinality of relationship is the number of instances of entity B that can be associated with each instance of entity A.

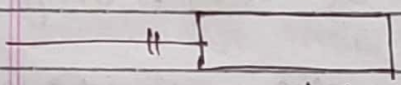
Maximum and Minimum Cardinality:-

The minimum cardinality of a relationship is the minimum number of instances of entity B that may be associated with each instance of entity A.

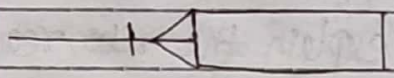
When the minimum cardinality of relationship is one, we say that entity B is a mandatory participant or total participant in the relationship. When the minimum cardinality of relationship is zero, then we say that the entity type is an optional participant or partial participant.

Maximum cardinality is the maximum number of instances of an entity type that may be associated with each instances of another entity type.

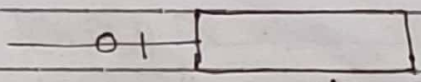
The symbol for relationship cardinality are:-



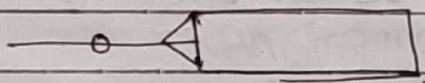
Mandatory one (Exactly one)



Mandatory many (one or more)



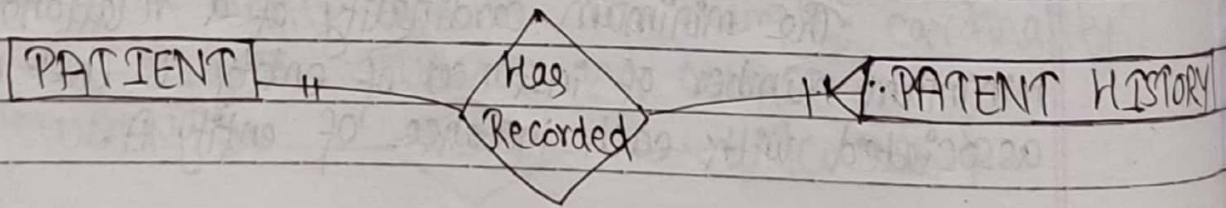
optional one (zero or one)



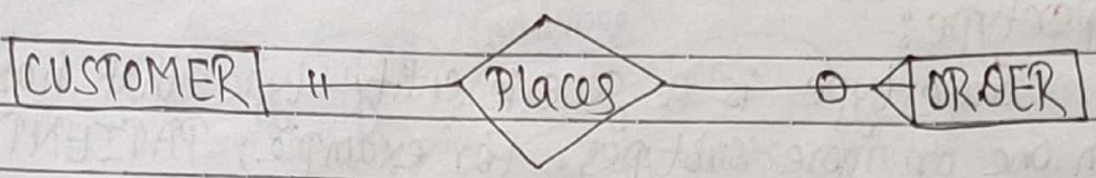
optional many (zero, one or more)

Example:-

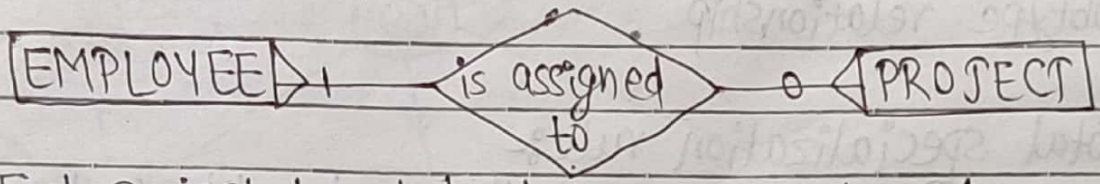
1)



Each patient has recorded one or more patient histories. Each instance of patient history is recorded for exactly one patient.

ii) 

One and only one customer can place anywhere from zero to many of the order.

iii) 

Each project has at least one assigned employee, so each employee may or may not be assigned to any existing project or may be assigned to several project.

Supertypes and subtypes:-

Often two or more entity types share common properties but also have one or more distinct attributes or relationships. To address this situations, the E-R model has been extended to include supertype/subtype relationships.

Subtype:-

Subtype is a sub grouping of the entities in an entity type that is meaningful to the organization and that share the common attributes or relationships distinct from other subgroupings. For example, a STUDENT is an

entity type in a university and two subtypes of STUDENT are GRADUATE STUDENT and UNDERGRADUATE STUDENT.

Supertype:-

Supertype is a generic entity type that has relationship with one or more subtypes. For example; PATIENT with OUTPATIENT and RESIDENT PATIENT.

There are several business rules that govern supertype/subtype relationship.

I) Total specialization rule:-

This rule specifies that each entity instance of the supertype must be member of some subtype in the relationship.

II) Partial specialization rule:-

This rule specifies that an entity instances of supertype does not have to belong to any subtype.

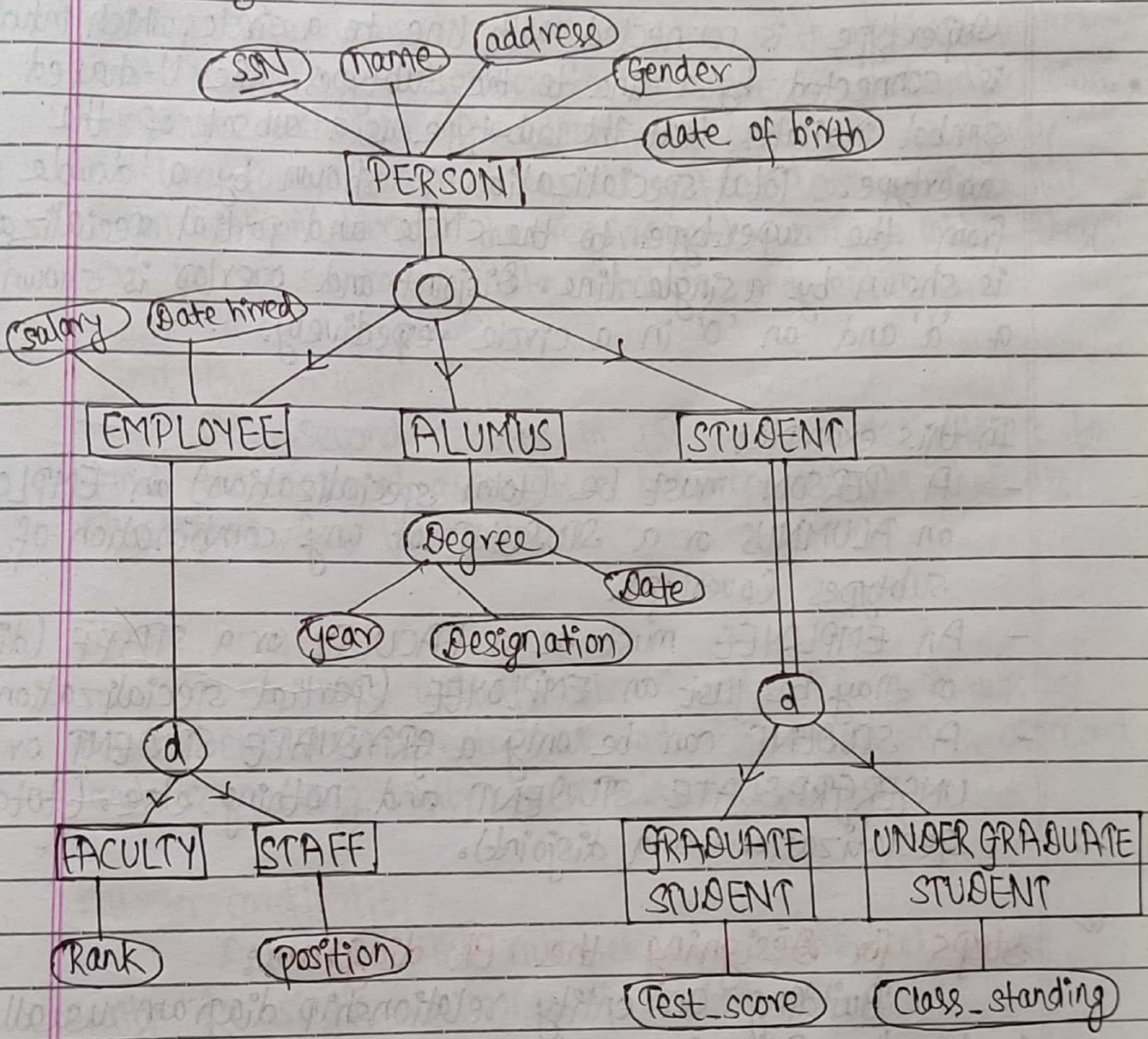
III) Disjoint rule:-

Disjoint rule specifies that if an instance of the supertype is a member of one subtype, it cannot simultaneously be a member of any other subtype.

IV) Overlap rule:-

The overlap rule specifies that an entity instance can simultaneously be a member of two or more subtypes.

The following figure illustrates several combination of these rules for the hierarchy of supertypes and subtypes in university database:



In the figure above, PERSON is supertype and EMPLOYEE, ALUMNUS and STUDENT are subtypes. Similarly EMPLOYEE is supertype for FACULTY and STAFF subtypes and

STUDENT is supertype for GRADUATE and UNDERGRADUATE STUDENT subtypes.

Supertype is connected with line to a circle, which inturn is connected by a line to the subtypes. The U-shaped symbol indicates that the sub-type is a subset of the supertype. Total specialization is shown by a double line from the supertype to the circle and partial specialization is shown by a single line. Disjoint and overlap is shown by a 'd' and an 'o' in a circle respectively.

In this example:
- A PERSON must be (total specialization) an EMPLOYEE, an ALUMNUS or a STUDENT or any combination of these subtypes (overlap).
- An EMPLOYEE must be a FACULTY or a STAFF (disjoint) or may be just an EMPLOYEE (partial specialization)
- A STUDENT can be only a GRADUATE STUDENT or an UNGERGRADUATE STUDENT and nothing else. (total specialization and disjoint).

Steps for Designing the ER diagram:

Building an entity relationship diagram usually involve the following activity:-

1) Identify Entity:-

The first activity in ER diagram designing is

to identify the fundamental entities in the system that might be described by data. There are several technique that might be used to identify a entity for example, During interviews or JAD session with system owner and user, pay attention to key words in their discussion. Another technique for identifying entity is to study existing form, files and reports. If use-case or DFD has been written during the requirement analysis phase they can be a source of data attribute and entities.

2) **Find the relationships:-**

The second activity in ER diagram designing is to find the natural association between entities that are identified for the system.

3) **Draw Rough ERD:-**

In this activity the Rough ERD is drawn by putting entities in rectangles and relationship on a diamond and connecting entity to a relationships.

4) **Fill in cardinality:-**

Determine the number of occurrences of one entity for single occurance of related entity.

5) **Define primary key:-**

Identify a data attribute that uniquely identify the entity instances.

6) Draw a key based ERD :-
Draw a ERD with primary key, foreign key in each entity.

7) Identify attributes :-
Identify the attributes that are essential to the system under development.

8) Map attributes :-
For each attributes, map it with exactly one entity that it describes.

9) Draw full attributed ERD :-
Adjust the ERD from step 6 to account for entities to which attributes are mapped.

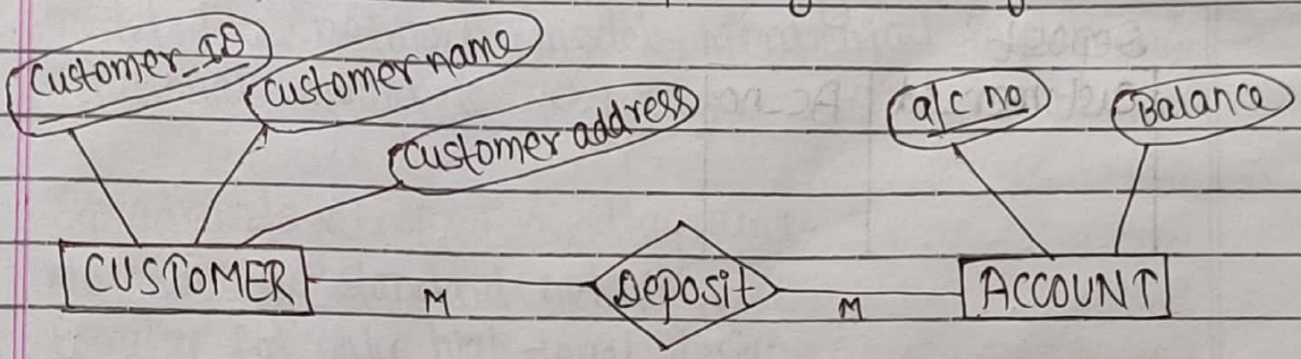
10) Revise and Review ERD :-
Does the final entity relationship diagram accurately depict the system data.

Mapping E-R diagram to relation :-

ER model provides a conceptual model of the real world concept, which is represented in a database. E-R model or diagram is mapped to the relational model by representing E-R database schema by a collection of relation schema. Because the two model employee similar design

principles, we can convert an E-R diagram into relational design. During the conversion of E-R diagram into relation, for each entity set and for each relationship set in the database design, there is unique table to which we assign the name of the corresponding entity set or relationship set.

For example: Consider the following E-R diagram



Here, the entity set is mapped to relation straight forward way. Each simple attribute of the entity set becomes an attribute of the table and primary key of the entity set becomes primary key of the relation.

Hence the tabular representation of E-R diagram becomes.

Customer

Customer_ID	customer_name	customer_address

Account

a/c no	Balance

Here the relationship set Deposit is many to many binary relationship type. For mapping a binary many to many relationship type, separate relation is created for the relationship type. Primary key for each participating

entity set is included as foreign key in the relation and their combination will form the primary key of the relation. Besides this, simple attributes of the many to many relationship type is included as attribute of the relation.

So, relationship set Deposit is now ~~connected~~ converted to the following table:

Deposit

Customer_id	Ac_no

Advantage of E-R diagram:-

1) Visual representation:-

The most curicial benefit of ERD is that it offers a visual representation of the layout. Having an effective design provides assistance to the database designer to determine the flow of the data and working of complete system.

11) Effective communication:-

The clear representation of the data through ER diagram result in the effective flow of information and communication. The reader can easily understand the relationship between various entity.

III) Highly integrated with relational model:-
Having designed an E-R diagram for a database application, the relational representation of the database model becomes relatively straight forward.

IV) Easy conversion to any data model:-
Conversion of ER diagram to any other data model like network model, hierarchical model and relational model is very easy.

Disadvantage of E-R diagram:-

1. No industry standard notation.
2. Popular for only high level design.
3. No representation for data manipulation.
4. Limited constraint representation, etc.

UNIT 3: STRUCTURED METHODOLOGY

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SA & Methodology (SSADM) Techniques

Structured Methodology:-

- Structured Methodologies (or structured system analysis and design) have been used to document, analyze and design the information system since 1970's.
- Structured refers to the fact that techniques are step by step with each step building on the previous one.
- Structured methodologies are top-down, processing from the highest level to lowest level i.e. from general to the specific.
- Structured system analysis and design method (SSADM) divides an application development project into module, stage, steps and task and provides a framework for describing a project in a fashion suited to managing the project.
- The structured system analysis and design method is mainly designed for large scale information system with high volume of events.
- The structured system analysis and design method specifies exactly the flows and task of development project and produce detailed documentation of the project.
- Structured development methods are process oriented, focusing primarily on modeling the processes, or actions that captures, stores, manipulate and distributes data as data flow through a system.

Date
Page

SSADM Techniques :-

(Structured System Analysis and Design Methodology)

The techniques used in structured system analysis and design method are logical data modeling, data flow modeling and entity behaviour modeling.

I) Logical data Modeling :-

- This involves process of identifying, modeling and documenting data as a part of system requirement gathering.
- The data are further classified into entity and relationships.

II) Data flow Modeling :-

- This involves tracking the data flow in an information system. It clearly analyzes the processes, data stores, external entities and data movement.

III) Entity behaviour Modeling :-

This involves identifying and documenting the events influencing each entity and sequence in which each event happens.

Characteristics of structured system analysis and design method (SSADM):-

Some of the important characteristics of structured system analysis and design methodology are:-

i) Dividing the project into small modules with well defined objective.
ii) Diagrammatic representation and other useful modeling techniques.
iii) Performing the activities in sequence.
iv) Simple and easily understood by clients and developers.

Objectives of SSADM:-

- Improve the project management and control.
- Make more effective use of experienced and inexperienced development staff.
- Develop a better quality system with low cost.
- Enable the project to be supported by computer based tools such as CASE tools.
- Establish a framework for good communication between participants in a project.
- Enable the project to deliver the product on time between it allows to plan manage and control a project well.

Steps used in SSADM:-

- SSADM is waterfall view approach where by there are sequence of events that runs in series and each step leads from the last.
- There are five steps used in SSADM. These are:-

1. **Feasibility study:**
   To determine whether it is cost effective to go ahead with system and whether it is actually possible.

2. **Requirement analysis:**
   Identifying the requirements and needs of the system and modeling these needs interms of process carried out.

3. **Requirements specification:**
   The functional and non-functional requirements are identified in details.

4. **Logical system specification:**
   Technical system options are created and logical design of the system created.

5. **Physical design:**
   The logical system specification and technical system specification is used to design a physical

database and set of program specification.

For each of the above step, SSADM defines techniques and procedures for recording the information. This include both textual and diagrammatic representation.

Benefits and advantages of SSADM:-

Some of the important advantage of SSADM are:-

1) Multiple angle of analysis:
The SSADM use three technique to determine information system viability. Logical data modeling determines the entities and relationships between them in the system. Data flow modeling determines the ways in which data changes from one form to another, holding areas of data, etc. Entity event modeling documents how events within the business affect the entities of the information system. So the more accurate and complete system is developed.

11) Better communication:
Since structured system analysis and design method is graphic, it provides easy way to understand presentation of the application.

iii) Timelines:-

Theoretically, SSADM allows one to plan, manage and control a project well. These points are essential to deliver the product on time.

iv) Effective use of skills:

SSADM does not require very special skills and can easily be taught to the staff. Normally, common modeling and diagramming tools are used.

v) Better quality:

SSADM reduces the error rate of Information system by defining a certain quality level in the beginning and constantly checking the system.

vi) Improvement of productivity:

By encouraging on time delivery, meeting business requirement, better quality and using human resource effectively SSADM improves overall productivity of specific project and company.

vii) Modularization:

The process is partitioned so that we have clear picture of the smaller modules which is essential to understand the system thoroughly.

Disadvantages of SSAOM:-

- SSAOM puts special emphasis on the analysis of the system and its documentation. This causes the danger of over-analyzing, which can be very time and cost consuming.
- Due to various types of description methods, checks of consistence cannot be carried out.
- Especially with the large system, the outline diagram can become very unclear because all relevant data flows have to be included.

Need for Structured Methodology:-

- Structured methodology specify the area of study in current system and level of study in detail.
- Structured Methodology help for documenting the system features.
- Make the effective use of experienced and inexperienced development staff.
- To establish a framework for good communication between participants in a project.
- To develop a better quality system with low cost.
- To divide the employee problem, which are easy to manage and solve.
- To improve the productivity of system analyst and programmer.
- To simplify the development activity.
- To respond to the change in the business environment

while project progresses.

Role of CASE in Data Modeling:-

- Computer aided s/w engineering (CASE) is the use of computer based support in system development process and CASE tool is a computer based product aimed at supporting one or more system development activities.
- Data models are stored in repository. CASE provides a repository for storing the data models and its detail description.
- Most CASE tools supports computer asisted data modeling and database design. CASE also support in drawing and maintaining data models and their underlying details.
- Using the CASE product, it is easy to create professional, readable data model without the use of paper, pencil, eraser and template. The data model can easily be modified to reflect corrections and changes suggested by end users
- Most CASE tools are powerful analytical tools that can be used to check data model for mathematical errors, completeness and consistency. So, the CASE tool has also the role in analyzing the data models for consistency, completeness and flexibility.
- Some CASE tool support reverse enginering that has the role in converting existing files and database structure into data models. The resulting data model represents

physical data models that can be revised and translated into their equivalent logical data models.

Data dictionary:-

- Data Dictionary is a structured repository of data about data. It contains description and definition concerning the data element, data structure and other characteristics of system.
- The Data Dictionary contains details of system components, such as data items, data flow, process, data stores, etc.
- If a analyst want to know how many characters in a data items, by what other name it is referenced, where it is used in the system analyst should be able to find answer in a properly developed data dictionary.
- Although we give the descriptive name to the dataflow, process and data store in DFD, it does not give the details. Hence to keep the detail of each element of DFD we need a data dictionary that contains the definition and description of element of DFD.
- The main purpose of data dictionary is to describe document and organize fact about data flow, data store, process and external entities.
- Data dictionary is an important tool for structured analysis. The reasons why analyst use data dictionary are as follows:-

i) It is valuable reference for designing the system.
ii) It is used to build the database and write a program

during design phase.

iii) It help the analyst to record the detail of each element and data structure.

iv) It is used to maintain a standard definition of all term in system.

v) It is used to manage the detail in large system.

- The data dictionary contains description about data element, data structure, data flows, data store and process with in the system.

1) Data element:

Data element is the smallest unit of data that has some meaning. For example: employee number, part code, part name, etc are data element.

11) Data structure:

Data is a group of data elements that describe a unit in the system. For example: part detail is a data structure that contains part code, part name, date of transaction as data element.

111) Data stores and data flow:

Data flow are data structure in motion whereas data stores are data structure at rest.

Describing Data element in data dictionary:

- Each data element should be defined once in a data dictionary.
- The description of data element should include the following:
  i) The name of the data element.
  ii) Aliases, which are synonyms or other name for element.
  iii) The short description of element.
  iv) Whether the data element is base or derived.
  v) The length of data element.
  vi) The type of data.
  vii) Input and output formats.
  viii) Any default value the element may have.
  ix) Any additional comment or remark.

Example:- Fig(1): An example of Data element in Data dictionary

Data Element Description

Name: customer number
Alias: client number
Description: uniquely identifies a customer

Element characteristics

Length : 8 Type of data: Alphanumeric
input format : X(8)
output format : X(8)
Default value : ____
upper limit : < 9999
lower limit : > 0
comment :

Describing data structures in data dictionary:-

- The data structures are described in data dictionary by specifying the name of each data structure and element it represents, provided that they are defined elsewhere in the data dictionary.
- Some element of data structures are mandatory where as others are optionals.

Example:-

Data structure description		
Name: book details		
Data elements:	Mandatory	optional
Author-name:	x	
Title of book:	x	
Edition:	x	
ISBN:		x
publisher_name	x	
Quantity ordered	x	

Fig:- An example of Data structures in Data Dictionary

Describing Dataflows and data stores in Data dictionary:-

- The content of data flow may be described by the name of the data structures that passes along it. The description of dataflow should include following:

1. ID, an optional identification number
2. A unique name

3. General description data flow
4. Source of data flow
5. Destination data flow
6. The volume per unit of time
7. Comment, etc.

Example:-

Data flow description

ID :

Name : Customer order

Description : contains customer order information and is used to update the customer master file and to produce order record.

source : Customer Destination : process 3.

Data structure travelling : order information

Comment:

Fig:- An example of data flow in data dictionary.

- A data store is described by the data structures found in it and data flows that feed it or are extracted from it.
- The information included on Data store description are:
  1. The Data Store ID
  2. The Data store Name
  3. An alias for file
  4. short description

5. file type
6. file format
7. content
8. Data flow in:
9. Data flow out:
10. comment

Example:-

Data store description
ID : D_1
Name : Customer Master file
Alias :
Description : contains a record for each customer.
File type : computerized
File format : Database
Record size : 120 character
Number of record : 15,000
Data structure : customer record
primary key : customer number
secondary key : customer name
content : customer number, customer name, customer type
data flow in :
data flow out :
Comment :

Fig:- Example of data store in Data Dictionary

Describing processes in data dictionary :-

- Process is described in data dictionary by specifying input and output for the process and summarize the logic of the system.

Example:-

Process description

Name : Maintain past register

Input : New past detail

Logic : All past detail Output: updated with unique past code is accepted. Duplicate past code is not accepted.

Fig :- example of process in Data dictionary

Advantage and disadvantage of data dictionary :-

Advantage:

1) It helps in communicating meanings of different elements, terms and procedures.
2) It helps the analyst to record the detail of each element and data structure.
3) It is used as a valuable reference for designing the system and also used to build the database and write the program during design phase.

iv) It provides a good system documentation at granular level.
v) It defines a information unambiguously.
vi) It improves the consistency in data use.
vii) It help to document the feature of the system.

Disadvantage:
- For large computer based systems, data dictionary grows rapidly in size and complexity.
- Difficult to maintain manually.
- It is not acceptable to many non-technical users.

Process Description (Process Description Modeling tools):-
- After defining all the data elements and data structures in the data dictionary, the system analyst begains to describe the processes.
- Process descriptions are tools for describing and documenting the system logic.
- Process descriptions contains the logic used to process the input data for getting the output.
- Different modeling tools are used to specify the detailed logic of elementary processes on DFD. The commonly used process description or logic modeling tools used in structured analysis are:-
  i) Structured english
  ii) Decision table
  iii) Decision tree

1) Structured English:-

- Structured english is a modified form of english language used to specify the logic of information systems processes.
- As the name suggests, the natural language 'English is used in this method, instead of programming language.
- It uses the english language along with the idea of logic and block structuring used in computer language.
- It tries to express verbal statement in more logical framework.
- Structured english uses narrative statements to describe a procedure and reserve word for logic formation during the description of the process.
- Structured english specification of the process requires conditions that occur in a process and action to take.
- Structured english specification is similar to that of block structured computer language but the main difference is the use of english sentence to specify action and the syntax rule are not very strict.
- Structured english makes the description of the process more precise and understandable because it uses english language with identation.

Structured english constructs :-

Structured english uses three basic types of statement to describe a process.

1) Sequence structure :-

Sequence structure include a set of instruction that are carried out one after another and do not depend on any condition.

11) Decision structure :-

- They include one or more set of instructions that are carried out depending on one or more condition.
- There are two types of decision structures used in structured english statement.
- One of them is an if then else structure which is used to make a choice between two alternatives.

Example:

```
IF condition
THEN
    statement
ELSE
    statement
ENDIF
```

- The second type of structure is to choose one out of set of alternatives. For this CASE keyword is used.

Example:-

```
CASE (variable)
    (variable = P) : {statement for alternative P}
    (variable = Q) : {statement for alternative q}.
    (variable = R) : {statement for alternative R}
    None of the above : {statement for default case}.
END CASE.
```

iii) Repetition / Iteration structure :-

- They include set of statement (instruction that are repeated until particular condition occur.
- They generally uses the keyword DO, WHILE, END DO to repeat the set of action.

Example:-

```
WHILE (condition) do
    statement
ENDWHILE
```

Common keyword used in structured English:

The following are the common keyword used in structured english:

IF, THEN, ELSE, REPEAT, START, END, STOP, DO, WHILE, DO WHILE, FOR, UNTIL, CASE, TRUE, FALSE, READ, WRITE, etc.

Example of Structured English:

1) A bank will grant loan under the following conditions:

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

```
APPROVE LOAN
  IF customer has Bank account THEN
      IF customer has no due from previous loan THEN
          Allow loan facility.
      ELSE
          IF Management approval is obtained THEN
              allow loan facility
          ELSE
              Reject
          ENDIF
          ENDIF
  ELSE
      Reject
  ENDIF
  EXIT.
```

2) A university has the following rules for a student to quantify for a degree with physics as a main subject and mathematics as a subsidiary.

- Mark should be 50% or more in physics and 40% or more in Mathematics.
- If Mark in Physics are less than 50% then Mark in Mathematics must be 50% or more, however physics mark must be at least 40%.
- If Mark in Mathematics are less than 40% but those in physics are 60% or more then only examination in Mathematics has to be repeated.
- In all other cases the student fails.

The structured english of above statement is:

```
IF Physics Mark ≥50%. and Math Mark ≥40%.
 THEN
     Pass
 ELSE
    IF Physics Mark ≥40 and Math Mark ≥50%.
      THEN
          Pass
    ELSE
       Fail
    ENDIF
ENDIF
   IF Math Mark <40%. and Physics Mark ≥60%.
   THEN
       Repeat Math exam
```

ELSE
Fail
ENDIF.

3) The structure english specification of "verify cheque" process in Bank Management System is:

VERIFY CHEQUE
Receive cheque from customer
Retrieve customer accounts record using customer number in cheque.
IF amount in cheque ≤ balance in account
THEN
{ Balance = balance - amount in cheque
write token number of cheque
Return token to customer }.
ELSE
{ write "insufficient balance" in cheque.
Return cheque to customer }
ENDIF.

Guidelines for writing structured English:

The following are the guidelines when writing the structure english.

1. Express all logic interms of sequential, repetition and conditional statement.
2. Ensure statement are not ambiguous.
3. Indent statement to show the logical hierarchy.
4. Place each sequence statement on separate lines.
5. Capitalize keywords.
6. Group block of statement together and give them a name that describe their function. Block name are capitalized, block end with EXIT item.
7. Mark the comment line with asterik if any.

Advantage of structured english:

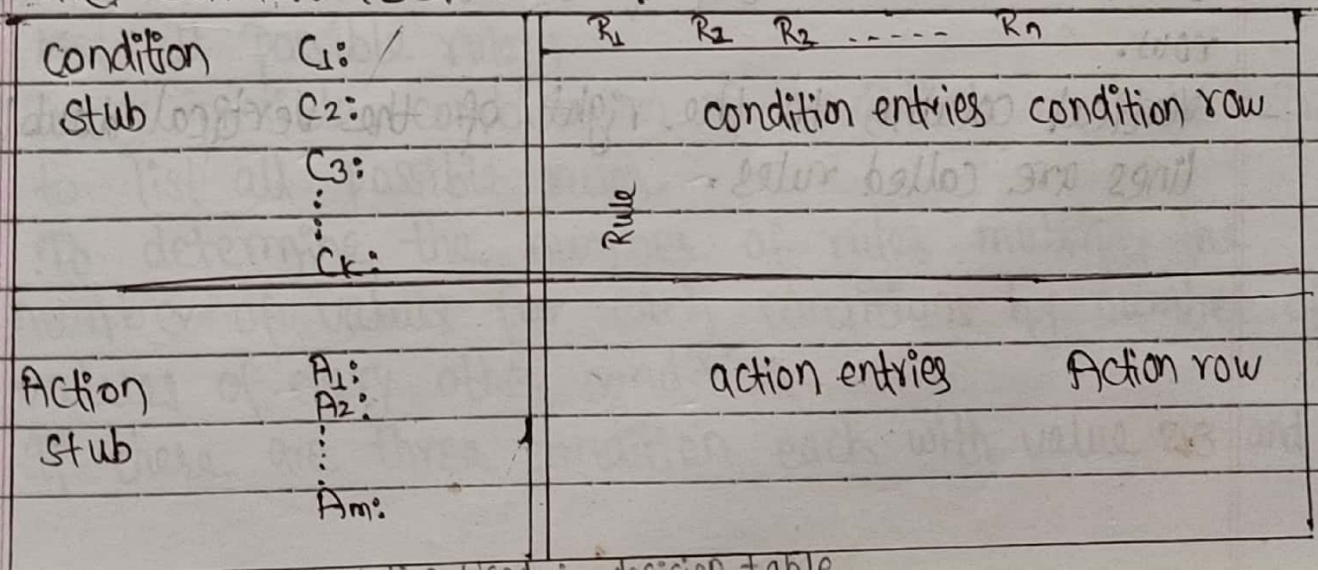
i) Structured english can be used to state the rules clearly and concisely.
ii) It provides a concise way of summerizing a procedure where decision must be made and action taken.
iii) It is used as an effective communication technique for analyst and user.
iv) It can be written quickly and naturally.

Disadvantages of structured english:

i) It takes some time to build structured english skill.
ii) It seems more formal than it is.

11) Decision table:-

- Decision table is a matrix representation of the logic of a decision, which specify the possible condition for the decision and resulting action.
- Decision tables are non-procedural specification of decision rules which specify logical procedure by the means of set of conditions and related actions.
- Decision table are appropriate when large number of condition are to be checked in arriving at set of actions and are used to define clearly and concisely the decision statement of a problem in a tabular form.
- A decision table consist of two part: stub and entry. The stub part is divided into an upper quadrant called condition stub and lower quadrant called action stub.
- The entry part is also divided into upper quadrant called condition entry and lower quadrant called the action entry.
- The four elements of decision table and their definition are summarized below:



I) Condition stub:-
The part of the decision table that lists the conditions relevant to the decision.

II) Action stub:-
A part of the decision that lists the action that result for a given set of condition.

III) Condition entries:-
The part of the decision table that contains the value of each condition. Each row in the top half of the table listing the value of condition is called condition row.

IV) Action entries:-
- The part of the decision table that contains (X) and (-). A cross indicate that action listed in that row has to be performed and dash indicates that action is not performed.
- Each row in this half of the table is called an action row.
- Vertical columns to the right of the vertical double lines are called rules.

Steps in creating decision table:-

In constructing the decision table, we actually follow a set of basic procedure as:

1) Name the conditions and value that each condition can assume:-

The first step in creating a decision table is to determining all the conditions that are relevant to the problem and then determine all the values each condition can take.

- For some condition values will be simply "yes" or "no" called limited entry however some condition may have more values called extended entry.

11) Name all possible action that can occur:-

The purpose of creating decision tables is to determine the proper course of given a particular set of action so second step is to name all possible action in a problem.

111) List all possible rules:-

- Every possible combination of condition must be represented to list all possible rules.
- To determine the number of rules multiply the number of values for each conditions by number of values of every other condition.
- If there are three condition each with value 2,3 and 3

respectively then we need 2x3x3 = 18 rules but some of the rules are redundant and make no sense.

iv) Define the action for each rule :-
After identifying all possible rules we should provide an action for each rule.

v) Simplify the decision table :-
Make the decision table as simple as possible by removing any rules with impossible action.

Examples of Decision table:

1) A bank uses the following rules to classify new accounts.

- if a depositor's age is 21 or above and if the deposit is 1000 or more, classify the account as A.
- if a depositor is under 21 and deposit is 100 or more, classify it as account B.
- if a depositor is 21 or over and the deposit is below 100 classify it as account C.
- if depositor is under 21 and deposit is below 100 do not open an account.

Develop a decision table according to the above specified rules:-

	Rule 1	Rule 2	Rule 3	Rule 4
condition C_1: Depositor's age ≥ 21	Yes	No	Yes	No
condition C_2: Deposit ≥ 100	Yes	Yes	No	No
Action A_1: classify Account as A	X	–	–	–
Action A_2: classify Account as B	–	X	–	–
Action A_3: classify Account as C	–	–	X	–
Action A_4: classify Account as D	–	–	–	X

Example 2:

Applications for admission to an extension course are screened using the following rules:

- For admission, a candidate should be sponsored by his employee and he should possess prescribed minimum academic qualifications.
- If his fee is also paid, then he is sent a letter for admission.
- If fee is not paid, then letter of provisional admission is sent.
- In all other cases a letter of regret is sent.

Develop a decision table for these statement.

Sol^n:

The condition to be tested are:
Condition 1: is the applicant sponsored by an employer?
Condition 2: Does the applicant posses the prescribed minimum academic qualifications?
condition 3: Is the fee paid?
The action to be taken are:
1. Send letter of admission
2. Send letter of provisional admission
3. Send regret letter

Hence the Decision table becomes:

	R_1	R_2	ELSE
C_1: Is the applicant sponsored	Y	Y	
C_2: Does he posses prescribed qualification	Y	Y	
C_3: Is the fee paid	Y	N	
A_1: Send letter of admission	X	–	–
A_2: Send letter of provisional admission	–	X	–
A_3: Send regret letter	–	–	X

Note: Here rule called "ELSE" is used to specify all cases not explicitly covered by Rule 1 and Rule 2.

Example 3:

A company market two products to three types of customer. It has the following discount policy.

- If the order is from a retailer and purchase first product below 500 then organization does not provide any discount.
- If the customer is distributer and purchase first product below 500, then organization provide 5% discount.
- If the customer is retailer and purchase first product above 500, then organization provide 5% discount.
- If the distributer purchase first product above 500 the organization provides 7% discount.
- If the customer is government agency and purchase the first product, the organization provide 6% with any limit of purchase amount.
- If the customer purchase second product the organization provide 5% discount for all types of customer without considering purchase amount.

Develop a decision table according to above specified rule.

Soln:

The decision table for above specified rule is:

	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6
C_1: product type:	1	1	1	1	1	2
C_2: customer type:	R	D	R	D	G	-
C_3: purchase amount:	<500	<500	>500	>500	-	-
Discount =	0%	5%	5%	7%	6%	5%

Reduce the size and complexity of decision table:

- To reduce the size and complexity of decision table, we can use the separate linked decision table.
- If two or more condition result same action, then table can be simplified.

For example:

	Rule 1	Rule 2
Condition 1:	Y	Y
condition 2:	Y	Y
Condition 3:	Y	N
Action	X	X

Here the same action occurs whether condition 3 is true or false. As a result one column can be eliminated from table as follows:

Condition 1	Y
Condition 2	Y
Condition 3	-
Action	X

Advantage of decision table:-

1. When the conditions are numerous and complicated, the decision table help to visualize the outcomes of a situation.
2. Simple and easy to understand by non computer iterates user and manager.
3. Good documentation of rules used in data processing.
4. It provides aids in analysis of structured decisions.
5. Using the decision tables, it becomes very easy to see all the situations arising out of a problem before developing flow-charts or algorithms.
6. The tabular representation allows systematic validation of redundency, incompleteness and inconsistency of rules.

Disadvantage of decision tables:-

- Decision tables do not show the flow of logic.
- It does not present overall picture as presented by flowchart.
- All programmers are not familiar with decision tables and therefore flow chart are more common.

Decision tree :-

- A decision tree is a diagram that ~~represe~~ resembles a tree, with root on the left hand side and branches represent decisions.
- A decision tree presents the conditions and actions sequentially and show the relationship of each condition and its premissible actions.
- It is read from left to right and the action to be taken are recorded to the right hand side of the diagram.
- The root of the tree on the left of the diagram is the starting point of the decision sequence and particular branch to be followed depends on the prevalent conditions and decision to be made.
- Progression from left to right along the particular branch is the result of making a series of decisions.
- Developing a decision tree is beneficial to analyst as the need to describe conditions and actions forces the analyst to formally identify the actual decision that must be taken.

Example:

Let us assume the following discount policy:

- If the customer is book store then get trade discount 25% on order of 6 or more copies per book title otherwise NIL.
- If customer is libraries or individual, 5% discount

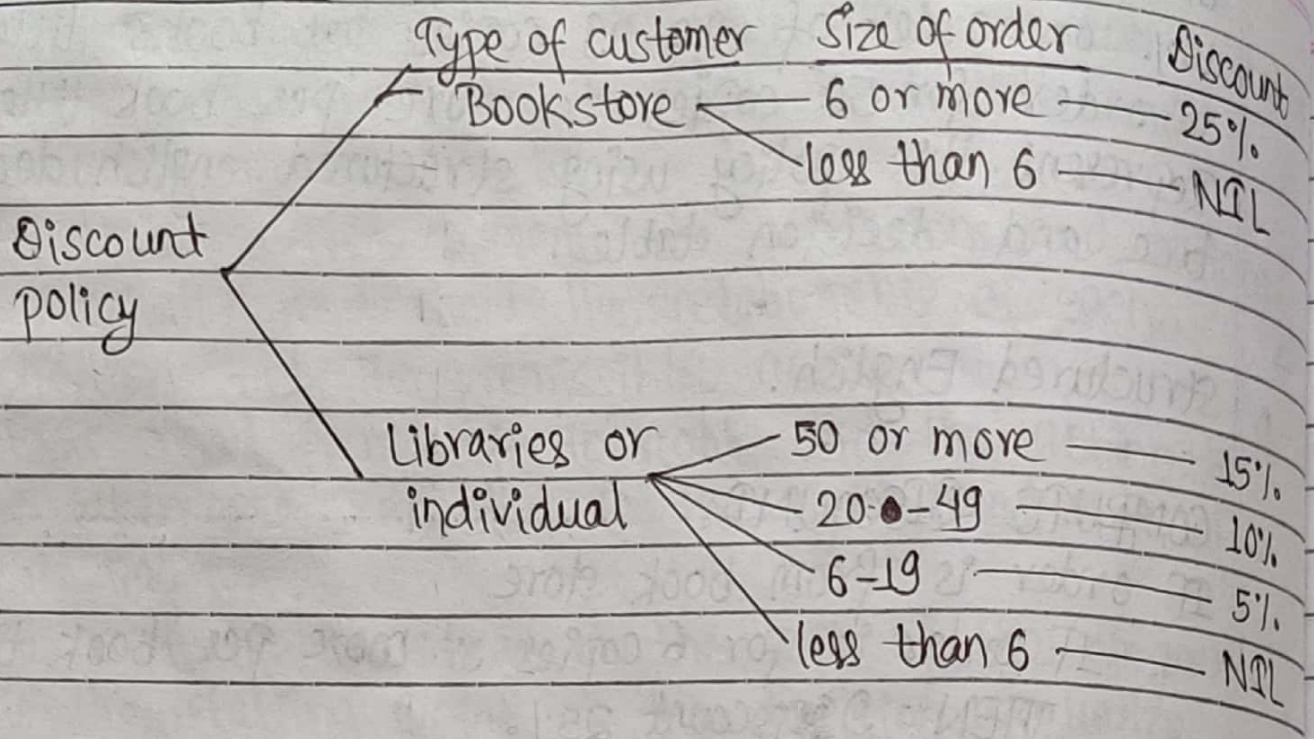
is allowed on order of 6-19 copies per book title, 10% on order of 20-49 copies per books title, 15% on order for 50 copies or more per book title. Represent this policy using structured english, decision tree and decision table.

⇒

1) Structured English.

```
COMPUTE DISCOUNT
IF order is from book store
    IF order is for 6 copies or more per book title
     THEN : Discount 25%.
    ELSE
        No Discount is allowed.
ELSE IF
    IF order is from libraries or individual customer
     IF order is for 50 copies or more per book title
      THEN: Discount is 15%.
     ELSEIF order is for 20 to 49 copies
      THEN: Discount is 10%.
     ELSEIF order is for 6 to 19 copies
      THEN: Discount is 5%.
     ELSE
        No discount is allowed.
    ENDIF
    EXIT
```

ii) Decision tree:



iii) Decision table:

	R_1	R_2	R_3	R_4	R_5	R_6
C_1: customer type	B	B	L	L	L	L
C_2: size of order per book title	≥6	<6	≥50	(20-49)	6-9	<6
A_1: discount percent	25%	0%	15%	10%	5%	0%

Index: B → Book store
L → Libraries

Another way of constructing decision table:

	R_1	R_2	R_3	R_4	R_5	R_6
C_1: customer is bookstore?	Y	Y	N	N	N	N
C_2: ordersize 6 copies or more?	Y	N	N	N	N	N
C_3: customer is librarian or individual?	•	•	Y	Y	Y	Y
C_4: ordersize 50 copies or more	•	•	Y	N	N	N
C_5: ordersize 20-49 copies	•	•	•	Y	N	N
C_6: ordersize 6-19 copies	•	•	•	•	Y	N
A_1: Allow 25% discount	X	-	-	-	-	-
A_2: Allow 15% discount	-	-	X	-	-	-
A_3: Allow 10% discount	-	-	-	X	-	-
A_4: Allow 5% discount	-	-	-	-	X	-
A_5: No discount	-	X	-	-	-	X

Note: Y represents Yes, N represent No and black circle represents condition has not been tested. In action entry, X indication action is performed.

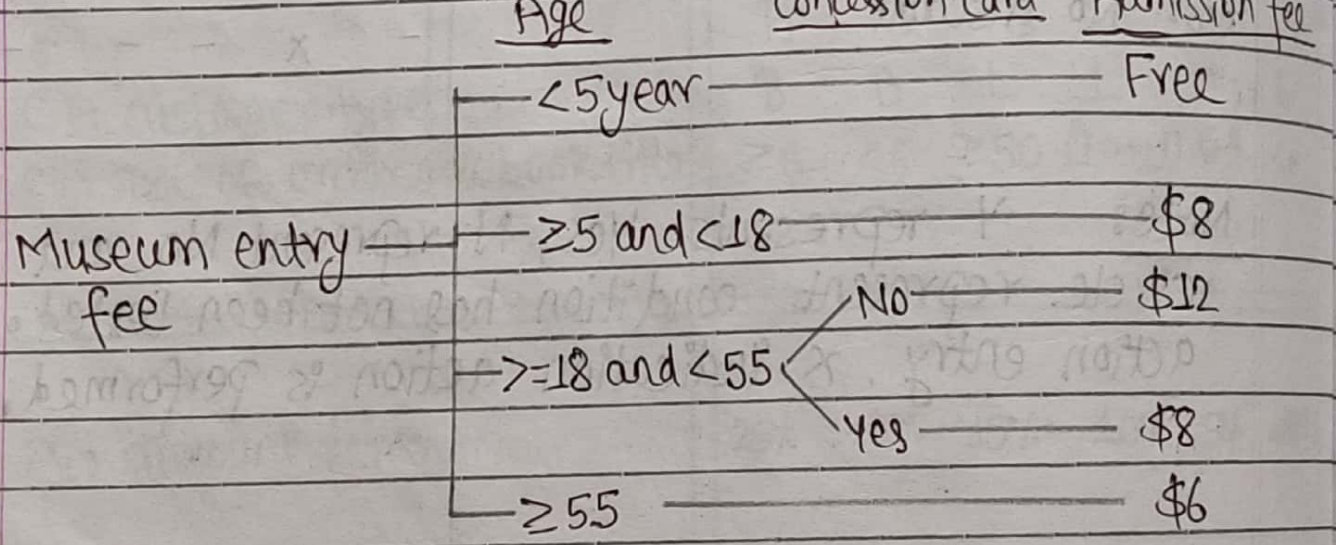
Example 2:

The Museum has the following policy for admission prices:-

- Children under 5 years of age are to be admitted free of charge.
- Children of 5 years and over but under 18 years are charged $8.
- Adults of 18 years and over but under 55 years of age are charged $12 unless they have a concession card, if they have concession card they are charged a child price.
- 55 years and over are charged only $6.00.

Represent above policy in decision tree.

Soln:



Advantage of decision trees:-

a) A decision tree describes conditions and actions and this forces a system analyst to identify the actual decisions that must be made.
b) Useful to express the logic of the process.
c) It is easy to understand and implement.
d) It can map nicely a set of business rules.

Disadvantage of decision trees:-

a) A decision tree for a complex system with many sequences of steps and combination of conditions will be unmanageable.
b) Takes a lots of space.
c) Output must be categorical.

Difference between Decision table and Decision tree:-

- Decision tables are used when process is logically complex involving the large number of conditions and alternate solution.
- A major drawback of decision tree is the back of information in its format to tell us what other combination of conditions to test. This is where the decision table is useful.
- Decision tree are used when condition to be tested must follow a strict time sequence. Decision tree are used to verify logic and problem that involve a few complex

decisions resulting in the limited number of actions. So, decision trees are useful when sequencing of condition is important and if there are not many conditions to be tested.

- Compared to decision table, decision tree are more readily understood by others in the organization. Decision tables are better than decision trees at portraying complex logic. Decision trees are better than decision table at portraying simple problems and at helping people make decision in practice.

Advantage and disadvantage of Modeling:

- A model is a picture that represent the reality. Model can be built for existing system to better understand the system or for proposed system to document the business requirement. We can draw a model in different phases during the information system development.
- Drawing the model offers following advantage:

i) Model represents reality of the system that we are going to develop.
ii) Models are clear to understand and easy to change when requirement change.
iii) Model reduce the risk of missing the business

requirement. We can better analyze the requirement for completeness, accuracy and consistency.

iv) Model allows us to communicate with end user in non-technical or less technical language.

The major disadvantage of model is that, drawing a model is a time consuming process. However we can use CASE tools to draw model easily, quickly and accurately.

UNIT-4 : SYSTEM ANALYSIS -8hr.

Content in this chapter:

4.1 : System planning and initial investigation
4.2 : Information gathering techniques
4.3 : The tools for structured analysis
4.4 : Feasibility study
4.5 : Cost benefit analysis.

System analysis:

- It is the phase of SDLC in which current system is studied and alternative replacement system are proposed.
- During system analysis, the analyst thoroughly studies the organization's current procedures and information system to find out the user requirements.
- Analysis has two subphases: The first is requirement determination and second is requirement structuring.
- In requirement determination subphase, analyst work with user to determine what the user want from proposed system. The requirement determination usually involves careful study of any current system that might be replaced or enhanced as a part of project.
- In requirement structuring subphase analyst study the requirements and structure them

according to their interrelationships and eliminate redundancies.
- The output of the system analysis phase is a description of the alternative solution recommended by the analysis team.
- During the analysis, the implementation details are not care of, only the system model is prepared based on the system study.

4.1) System Planning and initial investigation:

System Planning :-
- Planning is the first phase of SDLC. In this phase some one identifies the need for new or enhanced system.
- During the planning phase, two primary activities are perfomed:
  - i) Project identification and selection
  - ii) Project initiation and planning.

1) Project identification and selection:
- During the project identification and selection, a senior manager, a business group, an IS manager or a steering committe identifies and assesses all possible system development project that the organization unit could undertake.

- Information system development requests come from the variety of sources; one source is request by manager and business unit for replacing or extending existing system. Another source for request is IS Manager who want to make a system more efficient and less costly to operate. A final source of projects is a formal planning group that identifies project for improvement to help the organization to meet its objective.

The Process of identifying and selecting IS development project:-

- Organizations vary in their approach to identifying and selecting project.
- Some organization uses very formal process whereby a proposed project is vigorously compared with all competing project. Alternatively small organization may use informal project selection process that allow highest ranking IS Manager to select a project.
- Regardless of how given organization actually executes the project identification and selection process, a common sequence of activities occurs.
- Project identification and selection consist of three primary activities.

1) Identifying potential development project:
- The first major activity in the project identification and selection process focus on identifying potential development project.
- The potential project are identified by top management, either the CEO of a small or medium sized organization or by a senior executive in larger organization.
- The project are also identified by user departments, senior IS Manager or a steering committee.
- All methods of identification have been found to have strengths and weakness for example project identified by top management have a strategic organizational focus, project identified by individual departments or business units have a narrow focus and project identified by the development group have a characteristics of ease with which existing hardware and systems will integrate with the proposed project.

11) Classifying and ranking IS development projects:
- The second major activity in the project identification and selection process focuses on accessing the relative merit of potential projects.
- As with the project identification process, classifying and ranking
- Projects can be performed by top managers, a steering committe, business units or IS development group.
- In the organization, one or several criteria might be

used during the classifying and ranking process.

iii) Selecting IS development project:
- The final activity in the project identification and selection process is the actual selection of the projects for further development.
- Project selection is the process of considering both short term and long term projects and selecting those most likely to achieve business objectives.
- Numerous factor must be considered when making the project selection decisions. The output of project selection ~~project~~ process is project can be accepted or rejected.
- Acceptance of the project usually means that funding to conduct the next phase of the SDLC has been approved and rejection means that project will no longer be considered for development.

Deliverables and outcome of project identification and selection:-

- The primary deliverables from the project identification and selection phase of planning process is a schedule of specific information system development project to move into the next part of planning phase called project initiation and planning.

- An outcome of this phase is the assurance that careful consideration was given to project selection with clear understanding of how each project can help the organization reach its objectives.

ii) Project initiation and planning:

- During the project initiation, the project manager performs several activities to assess the size, scope and complexity of the project and establish procedures to support subsequent activities.
- The types of activities that will perform when initiating a project are:-

1. Establishing the project initiation team:-
   This activity involves organizing an intial core of project team members to assist in accomplishing the project initiation activities.

2. Establishing a relationship with the customer:-
   This activity involves making the good relationship with the customer.

3. Establishing the project initiation path:-
   This step defines activities required to organize the initiator team while it is working to define the goals and scope of the project.

4. Establishing Management procedure:-
Successful Project require the development of effective management procedures so this step focus on establishing management procedures.

5. Establishing the Project Management and project workbook:-
The focus of this activity is to collect and organize the tools that will use while managing the project and conduct the project workbook.
The personal workbook serves as a repository for all project correspondence, inputs, outputs, deliverables, and standards established by the project team.

6. Developing the project charter:-
The project charter is a short typically one page high level document prepared for the customer that describes what the project will deliver and outlines many of key element of the project.

- Project planning involves defining clear, discrete, activities and the work needed to complete each activity within a single project
- As with the project initiation process various activities must be performed during project planning. The types of activities that can be performed

during project planning are:

i) Describing the project scope alternatives & feasibility.
ii) Dividing the project into manageable task.
iii) Estimating resources and creating a source path.
iv) Developing a preliminary schedule.
v) Developing a communication plan.
vi) Determining project standards and procedures.
vii) Identifying and Assessing Risk.
viii) Creating a preliminary budget
ix) Developing project scope statement.
x) Setting a baseline project plan.

Deliverables and outcome from project initiation and planning:-

- The major outcomes and deliverables from the project initiation and planning phases are baseline project plan and project scope statement.
- The Base Line Project plan (BPP) contains all information collected and analyzed during project initiation and planning.
- The base line project plan mainly consist of project scope, benefit, costs, risk and resource requirement.
- The project scope statement is a short document prepared for the customer that describes whether project will deliver and outlines all high level work, required to complete the project.
- The project scope statement (PSS) ensures both analyst

and customer gain a common understanding of the project.

Initial investigation:-

- The identification of need is, a users request to change, improve or enhance an existing system.
- In an organization the information system request come from variety of sources, so analyst need a standard procedure to deal with them, the initial investigation is one way of dealing with those request.
- The objectives of initial investigation is to evaluate project requests.
- Initial investigation is not a design study nor does it include the collection of details to describe the business system. Rather it is the collection of information that help the committee members to evaluate the merits of the project request and make a judgement about feasibility of requested system project.
- The initial investigation involves the following activities:-

i) Clarify and understand the project request.
ii) Determine the size of the project.
iii) assess costs and benefits of alternative approaches.
iv) Determine the technical and operational feasibility of alternative approaches.

v) Report the finding to management with recommendations outlining the acceptance or rejection of the project.

4.2) Information Gathering technique.

Information gathering :-

- Information gathering is the process of collecting required information for the New system and it is also known as Requirement elicitation / Requirement gathering / Requirement determination.
- The approach and manner in which information is gathered requires a person with sensitivity, common sense and knowledge of what and when to gather and what channels to use in securing information.
- The specific methods used by system analyst for gathering information are called fact finding techniques or information gathering techniques.
- Before determining where to go for information or what tools to use, the system analyst first require to figure out what information to gather.

Where does information originates?

- Information is gathered from two principal sources: personnel or written document within the organization and from the organization's environment.

- The primary external sources of information are:-
  1. vender
  2. government document
  3. Newspaper and professional journals

- The primary internal sources of information are:
  1. financial report
  2. personel staff
  3. professional staff.

System requirements and requirement discovery:-

- To develop a system, the system analyst must be able to correctly identify, analyze and understand what the user requirements are or what the user want the system to do.
- The process and techniques that a system analyst uses to identify, analyze and understand the system requirement are referred to as requirement discovery or requirement determination process.
- System requirements specify what the information system must do or what property or quality the system must have.
- Any system have the two kinds of requirements:
  i) Functional requirements
  ii) Non-functional requirements.

1) Functional requirement:-
System requirements that specify what the information system must do are frequently referred to as functional requirements.

11) Non-functional requirements:-
System requirements that specify a property or quality the system must have are frequently referred to as non-functional requirements.

- The purpose of requirement discovery and management is to correctly identify the knowledge, process and communication requirement for the user of a new system.
- Failure to correctly identify system requirements may results the following:
  1) The system may cost more than the projected.
  11) The system may be delivered later than promised.
  111) The system may not meet the user expectations, etc.

The process of requirements Discovery / Process of requirement determinations:-

- During requirement determination analyst gather the information on what the system should do from as many sources as possible: from user of the current system, from observing the users, from reports forms and procedures.

- The process of requirement determination / discovery consist of the following activities:
  i) Problem discovery and analysis
  ii) Requirement discovery
  iii) Documenting and analyzing requirements
  iv) Requirement Management.

i) Problem discovery and analysis:
- For systems analyst to be successful, they must be skilled in the activity of problem analysis.
- One of the most common mistakes in experienced system analysts make when trying to analyze problems is identifying a symptoms as a problem.
- As a result, they may design and implement a solution that does not solve the problem or that may cause new problems.

ii) Requirement discovery:
After understanding of the problem, the system analyst can start to define requirements.
- System analysts to be successful in defining system requirements, they must be skilled in effective methods for gathering information or fact finding.

iii) Documenting and analyzing requirements:

- When the system analyst is performing fact finding activities, it is important that the analyst assembles or document the gathered information in an organized, understandable and meaningful way.
- These initial document will provide direction for the modeling techniques the systems analyst will use to analyze the requirements and determine the correct requirements for the project.
- System requirements are usually documented in a formal way, this document is called requirement definition document.

iv) Requirement management:

- Over a lifetime of a project it is very common for new requirements to emerge and existing requirements to change after the requirement definition document has been approved.
- To help alleviate many problem associated with changing requirements, it is necessary to perform requirements management.
- Requirement management encompasses the policies, procedures and processes that govern how a change to a requirement is handled.

Information gathering Techniques / Tool :-

- The specific method used by stem o system analyst for gathering information are called information gathering techniques.
- Many tools or techniques are used for information gathering, which are also known as requirement discovery techniques, fact finding techniques or data collection techniques.
- System analyst needs an organized methods for information gathering.

Some information gathering techniques are:-

i) Sampling of existing documentation, forms and files.
ii) Research and site visits.
iii) Observation of the work environment
iv) Questionnaires
v) Interviews
vi) Prototyping
vii) Joint requirement planning

- Analyst usually applies several of these techniques during a single system project.
- To be able to select the suitable technique for use in any given situation, system analyst need to learn the advantages and disadvantage of each of the fact finding techniques.

1) Sampling of existing documentation, forms and files:-

- When studying an existing system, system analyst develop a pretty good feel for the system by studying existing documentation, forms and files.
- A good analyst always knows to get facts first from existing documentation rather than from people.
- The first document the analyst may wish to seek out is the organizational chart. An organizational chart serve to identify key individual owners and users for a project and their reporting relationships.
- Analyst often check for documentation of previous system studies and design performed by former system analyst and consultant. This documentation may include various types of flowchart and diagrams, design documentation such as input, output and database, etc.
- System analyst also check for the document that describe the business function being studied or designed. These document include company's mission statement and strategic plan, standard operating procedures, samples of manual and computerized database, etc.
- Because it would be impractical to study every occurance of every form or record in a file, system analyst normally use sampling techniques to get a large enough cross section to determine what can happen in a system.
- The two commonly used sampling techniques are Randomization and startification.

similar project garisakeko haru bata conclusion nikalne

ii) Research and site visit :-
- A second fact finding technique is thoroughly researching the problem domain.
- Most problem are not completely unique, other people have solved them before us.
- Many times organization contact or perform site visits with companies they know have previously experienced similar problem.
- If these companies are willing to share valuable information then that may save the time and cost in development process.
- Computer trade journals and reference book are good source of information. They can provide information on how other have saved similar problems.

jun org sanga kaam garxau tesko manual work herne.

iii) Observation of the work environment :-
(On-site observation)
- Observation is one of the most effective data collection technique for learning about a system.
- Observation involves the system analyst becoming an observer of people and activities inorder to learn about the system. This method of information gathering is often used when the validity of data collected through other method is in question.
- In this method of fact finding the analyst role is that of information seeker who is expected

to be detached from the system being observed.
- The major objective of on-site observation is to get as close as possible to the real system being studied.
- The following questions can serve as a guide for on-site observations:
  1. What kind of system is it? What does it do?
  2. Who runs the system? Who are the important people in it?
  3. What is the history of the system? How did it get to its present stage of development? etc.

Advantage of on-site observation:
- Data gathered based on observation can be highly reliable. Sometimes observation are conducted to check the validity of data obtained directly from individuals.
- The system analyst is able to see what is being done.
- It is relatively inexpensive compared with other fact finding techniques because other technique usually require more employee.

Disadvantage of on-site observation:
- People usually feel uncomfortable when being watched.
- Some system activities may take place at odd times, causing a scheduling inconvenience for the system

analyst.
- The task being observed are subject to various types of interruptions.
- In complex situation, on-site observation can be very time consuming.

General guidelines for on-site observation:
i) While making observation, analyst should be ready to listen more than talk.
ii) While making observation, the analyst should avoid giving advice.
iii) Take notes during or after the observation.
iv) Don't interrupt the individual at work.
v) Obtain the permission from appropriate authorities, before conducting visits.
vi) Don't make assumption.
vii) Written summary of the observation should be prepared, during immediately and after observation.

iv) Questionnaires:-
- This technique is used to conduct surveys through questionnaires.
- Questionnaires are special purpose document that allow all the analyst to collect information and opinion from respondents.
- Questionnaires allow the system analyst to collect fact from large number of people. When

dealing with large number of audience, no other fact finding technique can tabulate the same fact efficiently.

Types of questionnaires:

There are two formats for questionnaires.

i) Free format
ii) Fixed format

- Free format questionnaire offers the respondent to record the answer in the space provided after the questionnary.
- Fixed format questionnaire contains questions that require selection of predefined responses. In this format, the respondent must choose from the available answer. There are three types of question in fixed format questionnaires:-
  - Multiple choice question
  - Rating question
  - Ranking question.

Procedure for questionnaire construction:-

The procedure for constructing a questionnaire consists of six steps:-

i) Decide what data should be collected, i.e. define the problem to be investigated.
ii) Decide what types of questionnaire should be used.

iii) Outline the topics for questionnaire and then write the questions.
iv) Edit the questionnaire for technical defects or biases that reflect the personal values.
v) Pretest the questionnaire to see how well it works.
vi) Do a final editing to ensure that the questionnaire is ready for administration.

Advantage:
- It is economical and requires less skill to administer than interview.
- It can admistered large number of individual simultaneously.
- The respondent feel greater confidence than in that of interview.
- Time saving as compared to other techniques.
- Answer can be compared with documents.
- With questionnaire, respondents gives opinion without fear.

Disadvantage:
- There is no guarantee that an individual will answer.
- There is no immediate opportunity to clarify vague or incomplete answer to any question.
- Good questionnaires are difficult to prepare.
- Questions may be interpreted differently by different

users.
- It is not possible for the analyst to observe and analyze the respondents body language.

v) Interview:-
- Interview is an fact finding technique whereby the system analyst collects information from individuals through face-to-face interaction.
- There are two roles assumed in interview. The system analyst is the interviewer responsible for organizing and conducting the interview. The system user or system owner is the interviewee, who is asked to respond to a series of questions.
- Interview can be used to achieve any or all of the goals as: fact finding, verify fact, clarify fact, identify requirements and solicit ideas and opinions.
- In the interview, since the analyst and the person interviewed meet face to face, there is the opportunity for flexibity in eliciting information.
- There are two types of interviews structured and unstructured.
- Unstructured interviews are conducted with only a general goal or subject in mind with few specific questions. Structured interview on other hand are conducted with set of specific questions to ask the interviewee.

- In the interview there are two types of questions open ended question and closed ended. Open ended question allow the interviewee to respond in any way that seems appropriate but closed ended question restrict answer to either specific choice or short or direct responses.
- Unstructured interview tend to involve asking open ended question and structured interview tend to involve asking more closed-ended question that are designed to elicit short, direct response from the interviwee.

Advantage:

- Interview give the analyst an opportunity to motivate the interviwee to respond freely and openly to question.
- Interviewees allows the system analyst to probe for more feedback from the interviewee.
- Interviews permits the system analyst to adopt or reward questions for each individuals.
- Interviews gives the analyst an opportunity to observe the interviewee's non verbal communication. A good system analyst may be able to obtain information by observing the interviewees body movement and facial expression.

Disadvantages:

- Interviewing is very time consuming and therefore costly fact finding approach.
- Success of interview is highly dependant on the system analysts human relation skill.
- Interviewing may be impractical due to the location of interviewees.

vi) Discovery prototyping:-

- Discovery prototyping is the act of building a small scale representative or working model of the user's requirement inorder to discover or verify those requirements.
- The process of building a prototype for the purpose of identifying requirements is referred to as discovery prototyping.
- Discovery prototyping is frequently applied to system development project, especially in cases where the development team is having the problems defining the system requirements.
- Usually only the areas where the system requirements are not clearly understood are prototyped, creating discovery prototypes enable the developers as well as the user to better understand and refine the requirement involved with developing system.
- This technique helps in minimizing the risk of

delivering the system that doesnot meet the user's need or that can't fulfill the technical requirements.

Advantage:
- Allows users and developers to experiment with the software and develop an understanding of how the system might work.
- Serve as a training mechanism for users.
- Aids in determining the feasibility and usefulness of system before high development cost are incured.
- May minimize the time spent on fact-finding and help define more stable and reliable requirements.

Disadvantage:
- User and developers may need to be trained in prototyping approach.
- Doing a prototype may extend the development schedule and increase the development cost.

VII) Joint Requirement Planning (JRP):-

- It is the process where by highly structured group meeting is conducted to analyze problem and define requirements.
- JRP is a subset of more comprehensive Joint application development (JAD).
- JRP significantly decrease the time spend on fact finding in one or more phases of the life cycle.
- JRP is becoming increasingly common in system planning and system analysis to obtain group consensus on problems, objective and requirements.
- The JRP participants are: sponser, faciliator, user and manager scribe and IT staff.

Advantage:

- Joint requirement planning offers many benefits as an alternative fact-finding and development approach. Some advantage are:
- It actively involves user and management in development project.
- It reduce the amount of time required to develop a system. This is achieved by replacing traditional, time consuming one to one interviewing of each user and manager with group meetings.
- When JRP incorporates prototyping as a means for conforming requirement and obtaining design approval, the benefit of prototyping are realized.

A fact finding / Information gathering strategy :-

An analyst need an organized method for collecting facts. Inexperienced analysts will frequently jump right into interviews, they believe "go to the people that's where the real fact are". This approach fails to recognize an important fact. To gather the information or fact, analyst should first collect all the facts by using other method than interview. The following is the step by step strategy to gather the information.

1) Learn from existing documents, forms, report and files.
2) If appropriate, observe the system in action.
3) Given all the facts already collected, design and distribute questionnaires to clear up things that aren't fully understood.
4) Conduct interviews or (group work sessions). Because most of the pertinent fact have already been collected by low-user-contact method, interview can be used to verify and clarify the most difficult issues and problems.
5) (Optional) Build discovery prototype for any functional requirements that are not understood or for requirement that need to be validated.
6) Follow up, use appropriate fact finding techniques to verify facts.

Structured analysis :-

Structured analysis is the set of techniques and graphical tools that allow the analyst to develop a new kind of system specification that are easily understandable to the user. The traditional approach focuses on cost / benefit and feasibility analysis, project management, hardware and software selection and personnel consideration. In contrast, structured analysis considers new goals and structured tools for analysis. The new goals specify the following :

i) Use graphics whenever possible to help communicate better with the user.
ii) Differentiate between logical and physical systems.
iii) Build a logical system model to familiarize the user with system characteristics and interrelationships before implementation.

The objective of the structured analysis is to build a new document, called system specification. This document provides the basis for design and implementation.

The structured system specification consist of the DFD that show the major decomposition of system function and their interfaces, the data dictionary documenting all interface flow and datastore on the DFD and documentation of logic of DFD through structured english, decision tree and decision tables.

Tools for structured analysis :-

Structured analysis is a set of techniques and graphical tools that allow the analyst to develop a new kind of system specifications that are easily understandable by the user. There are several tools used in structured analysis, they are :-

i) Dataflow diagrams (DFD)
ii) Entity relationship diagram (ERD)
iii) Data dictionary
iv) Structured english
v) Decision trees
vi) Decision tables

i) Dataflow diagram (DFD) :-

Dataflow diagrams are widely used graphic tools for describing the movement of data within or outside the system. DFD is also called the bubble chart are used for process modeling.

ii) ER diagram :-

An entity-relationship diagram is a detailed, logical and graphical representation of the data for an organization or business area. It is a graphical representation of an ER-model and illustrate the logical structure of database.

iii) Data dictionary :-

Data dictionary is the structured repository of data about data. It is the organized list of terms and their definitions for all the data elements and data structures that are pertinent to the system. It stores the names along with their descriptions of all data used in a system.

iv) Structured english :-

It is a tool for describing the processing logic and procedure. It is based on the principle of the structured programming. It is created by the merging of the english language with the syntax of the structured programming. It tries to express the verbal statement in the more logical form.

v) Decision tree :-

It is a graphical technique that shows a decision situation as a linked series of nodes and branches. Decision tree turns a decision table into diagram. A decision tree is a diagram that resembles a tree, with a root on the left hand side and branches representing each decision. It is read from left to right and action to be undertaken are recorded down the right hand side of the diagram.

vi) Decision table:-

A decision table appears as a matrix of rows and columns that shows condition and corresponding action. Decision rules, included in a decision table, states what procedure is to follow when certain condition exists.

Feasibility study / analysis:-

Feasibility is the measure of how beneficial or practical the development of an information system will be to the organization. Feasibility study is the process by which feasibility is measured. A feasibility study takes into account various constraint within which system should be implemented and operated. The resources needed for implementation such as computing equipment, human resources and cost are estimated based on the specification of the user's requirement. These estimates are compared with the available resources and a comparison of the cost of the system and benefit which will accrue is also made. During the feasibility study, the system analyst evaluate the alternative solution specified in requirement specification to check whether it is feasible to design new system or not and determine which solution is best among these alternative solution.

After the feasibility study, the system analyst generate a report called feasibility report. The main objective of feasibility study are:-

i) to identify the deficiencies in the current system.
ii) to determine the objective of the proposed system.
iii) to acquire a sense of scope of system.
iv) to determine whether it is feasible to develop new system.

Four tests for feasibility / Level of feasibility :-

During the system analysis phase, the system analyst identifies different alternate solutions and analyzes those solution for feasibility. To analyze different alternative solutions, most analysts use four categories of feasibility test:

i) Operational feasibility
ii) Technical fedsibility
iii) Schedule feasibility
iv) Economic feasibility

i) Operational feasibility :-

Operational feasibility is the measures of how well a proposed system solves the problems and takes advantage of the opportunities identified during the scope definition and problem analysis phases and how well it satisfies the system requirements identified in the requirement analysis phase. Operational feasibility should also include

an analysis of how the proposed system will affect organizational structure and procedures.

ii) Technical feasibility :-

Technical feasibility is the measures of the practicality of technical solution and availability of technical resources and experties. This analysis should include an assessment of the development's groups understanding of the possible target hardware, software, operating environment to be used.

Technical feasibility addresses the three major issues :

a) Is the proposed technology or solution practical?
b) Do we currently possess the necessary technology?
c) Do we possess the necessary technical experties?

iii) Schedule feasibility :-

Schedule feasibility measures of how reasonable a project timetable is. The purpose of schedule feasibility is to gain an understanding of likelihood that all potential time frames and completion date schedule can be met and that meeting these dates will be sufficient for dealing with the need of the organization. Some projects are initiated with specific deadlines, it is necessary to determine whether the deadlines are mandatory or desirable. If the deadlines are desirable rather than mandatory, the analyst can

propose alternative schedules.

iv) Economic feasibility :-

Economic feasibility measures the cost effectiveness of project or solution. For any system, if the expected benefits is equal or exceed the expected costs, the system can be judged to be economically feasible. In economic feasibility, cost benefit analysis is done in which expected cost and benefits are evaluated. Economic analysis is used for evaluating the effectiveness of the proposed system.

Some other feasibility that needs to be kept under consideration are :-

Legal feasibility :-

Legal feasibility is a measure of how well a solution can be implemented within the existing legal and contractual obligation. It determines whether the proposed system conflict with the legal requirement.

Social feasibility :-

Social feasibility is a determination of whether proposed project will be acceptable to the people or not. This determination typically examines the probability of the project being accepted by the group directly affected by the proposed system. The effect of the project on the social

status of project participants must be assessed to ensure compatibility.

116 **Steps in feasibility analysis:**

Feasibility analysis involves eight step:

1) From a project team and appoint a project leader:-

The concept behind a project team is that future system user should be involved in its design and implementation. For small project, the analyst and assistent usually sufficies, however more complex studies requires a project team. The team consist of analyst, user staff, outside consultant and an information specialist. The senior analyst is generally appointed as the project leader. He is usually the most experienced analyst in the team, who is responsible for planning and managing the development activities in the system.

11) Prepare system flowchart:-

The next step in the feasibility study is to prepare generalized system flowchart for the system. Information oriented charts and dataflow diagrams prepared in the initial investigation are also reviewed at this time. All other flowchart needed for detailed evaluation are completed at this point.

iii) Enumerate potential candidate system:-
This step identifies the candidates systems that are capable of producing the outputs included in the generalized flowcharts. This requires the transformation from logical to physical system models. The hardware that can handle the total system requirement are estimated.

iv) Describe and identify characteristics of candidate system:-
From the candidate system considered, the team begins a preliminary evaluation in an attempt to reduce them to a manageable number. The feasibility team determine the characteristics of each candidate system within the limitation of organization's resource.

v) Determine and evaluate performance and cost effectiveness of each candidate system:-
Each candidate system's performance is evaluated against the system performance requirement set prior the feasibility study. The cost encompasses both designing and installing system. System performance criteria are evaluated against the cost of each system to determine which system is likely to be the most cost effective and also meet the performance requirement.

vi) Weight system performance and cost data:-
The performance and cost data for each candidate system show which system is the best choice.

So next step is to weight the importance of each system by applying a rating. Then the candidate system with the highest score is selected.

VII) Select the best candidate system:-

The system is weighted under various factor and the system with the highest total score is considered to the best system. This assumes the weighting factor are fair and rating of each evaluation criteria is accurate.

VIII) Prepare a report directive to Management:-

During a feasibility study, the analysts also keep on preparing the feasibility study report. At the end of feasibility analysis, the feasibility analysis report is given to the management along with the oral presentation.

Feasibility Report:-

After the feasibility study, a document is prepared that is known as feasibility study report. Besides this report, the analyst also gives the oral presentation of feasibility study to the management. Feasibility report is a formal document for management use and is prepared by ~~sta~~ systems analysts during or after feasibility study. There is no standard format

for preparing feasibility report. Analyst usually decide on a format that suits the particular user and system. Most reports however begins with a summary of finding and recommendations followed by documented details. The report contains the following section:

I) Cover letter:

Cover letter formally presents the report with brief description of project problem along with recommendation to be considered.

II) Table of contents:

It list the section of the feasibility study report along with their page numbers.

III) Overview:

It presents the overview of the project problem along with the purpose and scope of the project.

IV) Description of existing system:

A brief description of existing system along with its deficiencies are presented in this section.

V) System requirement:

The system requirements, which are either derived from the existing system or from discussion with the user are presented in this section.

VI) Description of proposed system:

It presents the general description of the proposed system highlighting its role in solving problems. A description of output report to be generated by the system is also presented in desired formats.

VII) Development plan:

It presents a detailed plan with starting and completion date for different phases of SDLC. A complementary plan is also needed for hardware and software evaluation, purchase and installation.

VIII) Technical feasibility finding:

It presents the finding of technical feasibility study along with recommendations.

IX) Cost and Benefits:

The detailed findings of cost and benefit analysis are presented in this section. The saving and benefits are highlighted to justify the economic feasibility of the report.

X) Operational feasibility finding:

It presents the findings of operational feasibility along with the human resource requirement to implement the system.

xi) Alternatives considered | rejected:

The different alternatives that an analyst usually considered and reject during feasibility study, should also be included in the feasibility study report. These alternatives are required to be discussed because they show how the suggested system is best alternative to solve the problem.

xii) Recommendation and Conclusions:

The benefits and savings are summarized and it is recommended whether the management should decide to proceed with the project or abort the project.

xiii) Appendixes:

In the last section of the feasibility report, all memos, document and data compiled during the study are enclosed for reference.

Why feasibility analysis is necessary?

At the end of feasibility study, it is necessary to prepare a feasibility report. This report is meant for the management. The primary objective of this report are to inform the management about the following matter so feasibility study is necessary before designing a system.

1. What the proposed system will achieve.
2. Who will be involved in operating it in the organization.

3. The organization changes needed for its successful implementation.
4. The benefits the system will give.
5. The estimate cost of the system.

Cost benefit analysis :-

The cost benefit analysis is necessary to determine economic feasibility. The primary purpose of cost benefit analysis is to find out whether it is economically worthwhile to invest in the project. If the returns on the investment is good, then the project is considered economically worthwhile.

Cost benefit analysis is performed by first listing all the cost associated with the project. Cost consist of both direct cost and indirect cost. Direct costs are those incurred in buying equipment, employing people, rent for accomodation and cost of raw item, etc. Indirect cost are those involving time spend by user in discussing problem with system analysts, gathering data about problem, etc.

Benefits can be broadly classified as tangiable benefits and intangiable benefits. Tangiable benefits are directly measurable such as direct saving due to reduction in human resources, increasing the volume of work with the same human resources, saving due to

reducing wastage, etc. Intangiable benefits are not directly measurable such as better services to customer, superior quality of product, accurate, reliable, etc.

Steps in cost benefit analysis:

Cost benefit analysis is a procedure that gives a picture of various costs, benefits and rules associated with the systems. The determination of costs and benefit entails the following steps:

I) Identify the cost and benefits pertaining to a given project:
The first step in cost benefit analysis is to identify the cost related to the proposed system and benefit afforded by the proposed system.

II) Categorize the various cost and benefits:
In this step, cost estimated in previous steps are categorized into various category. These may include direct cost, indirect cost and benefit offered by the proposed system is also categorized into various category. The classification of cost and benefit simplify the evaluation process.

III) Select a evaluation method:
After categoring the cost and benefits the system analyst use various evaluation method to compare the cost and benefits of the proposed system. The evaluation method

help the system analyst to identify return on investment, time period of return and rate of benefits offered by the system. Evaluation method are used to select best system.

iv) Prepare feasibility report:

In this step, the system analyst specify cost and benefit offered by the proposed system, merit and demerits of system and rate of reaction on investment. This is a written document for management that help the manager to choose appropriate system and take certain decision about the system.

v) Take action:

The management study the feasibility report and select a best alternative and take action for design of proposed system.

Cost and benefit category:

The costs associated with the system are expenses, outlays arising from development and using a system. But benefits are advantages received from installing and using this system. Costs are classified as direct cost and indirect cost. Benefits are broadly classified as tangible benefits and intangible benefits.

Direct and Indirect cost:

Direct cost are those incurred in buying equipment, employing people, cost of consumable item, rent for accomodation, etc. For example, purchase of pendrive for NRs. 2,000/- is a direct cost because we can associate the pendrive with money spent. Direct cost are directly associated with a system.

Indirect cost results from the operations that are not directly associated with the system. They are often referred to as overhead. Indirect cost increases overhead, it incur an additional cost. Indirect costs include those involving time spend by user in discussing problem with system analyst, gathering data about problems. Another example of indirect cost are cost of space to install a system, heat, light, air conditioning are all indirect cost.

Tangible and intangible benefit:

Benefits normally increase profit or decrease the cost. As much as possible benefit should be quantified in dollars and cents. They should be classified as tangible and intangible benefit.

Tangible benefits are those that can be easily quantified. Tangible benefits are usually measured in terms of monthly or annual saving or of profit to the firm. Some examples of tangible benefits are: fewer processing errors, increased throughput, decrease response time,

increased sales, reduced credit losses, direct saving due to reducing delays in collecting outstanding payment, reducing the cost of production, saving due to reduction in human resources or increasing volume of work with the same human resources.

Intangible benefits are those that are believed to be difficult or impossible to quantify. If a benefit cannot be quantified, it is difficult to accept the validity of an associated cost benefit analysis that is based on incomplete data. Examples of intangible benefits are:

- Better service to customer
- Superior quality of product
- Improved customer response
- Better decision making
- Enhanced user experience
- Increased customer satisfaction, etc.

Evaluation Method for cost benefit analysis:

When all financial data have been identified and broken down into cost categories, the analyst must select a method of evaluation. Several evaluation methods are available. The common methods are:-

i) Net benefit analysis
ii) Present value analysis
iii) Payback analysis.

Evaluation

1) Net benefit Analysis :-

Net benefit analysis simply involves subtracting total costs from total benefits. It is easy to calculate, easy to intreprete and easy to present. The main drawback of Net benefit analysis is that it does not account for the time value of money and does not discount the future cash flow. It can be calculated by,

Net benefit = total benefit - total cost

The time value of money is extremely important in evaluation of cost and benefit. The time value of money is usually expressed in the form of interest on the fund invested to realize the future value. The formula is:

$$F = P(1+i)^n$$

where,

F = future value of investment
P = present value of investment
i = interest rate
n = number of year

For example:

$3000 is invested in a certain project for three year at 10% interest would have the value,

$$F = \$3,000\,(1+0.10)^3$$
$$= 3000(1.33)$$
$$= \$3,993$$

11) Present value analysis :-

In developing long term projects, it is often difficult to compare today's costs with the full value of tomorrow's benefits. Present value analysis controls for these problems by calculating the costs and benefits of the system interms of today's value of investment and than comparing benefits provided in future. The present value is the current value of future cashflow. To compute the present value, we use the following formula :-

$$P = F/(1+i)^n$$

Example :

The present value of $1500 invested at 10% interest at the end of fourth year is:

$$P = \frac{1500}{1+(0.10)^4}$$

$$= \frac{1500}{1.61}$$

$$= 1,027.39$$

That is, if we invest $1,027.39 today at 10 percent interest, we can expect to have $1500 in four year.

iii) Payback Analysis:-

Payback analysis is a mathematical methodology to determine the payback period for an investment. Payback analysis can provide important information for decision making. It provides means to manage the risk. Payback analysis is used to determine whether a project will pay for itself in an acceptable period of time. Shorter payback period are usually viewed as less risk. Payback analysis is also used to compare potential projects to see which will recoup its cost quicker.

Payback period:-

The payback period is the length of time required to recover the cost of investment. There are two ways of finding out this:

1) Payback Method
2) Present value Method

When comparing two or more investments, business managers and investors will typically compare the projects to see which one has the shorter payback period. Project with longer payback period are usually associated with higher risk.

a) Simple payback method:

The payback method is used to find out in how many year the money spend is recovered as benefit.

The formula for payback period is:

$$\text{Payback period} = \frac{\text{cost of investment}}{\text{Annual net cashflow}}$$

Example:

The cost of the project is Rs. 1,30,000 and total benefits of the project is Rs. 33,740 per month and recuring cost of the project is 2,000 per month. Find out the pay back period.

→

Here,

Total cost of investment = 1,30,000

total benefit = 33,740 per month

Recurring cost = 2,000 per month.

Net benefit = Rs. 31,740 per month

Now,

$$\text{Payback period} = \frac{1,30,000}{31,740}$$

$$= 4.1 \text{ month.}$$

b) Payback Method with interest:

The payback method is simple method, in this method we have not taken into account the fact if Rs. 1,30,000 is invested in a bank, we will get the interest. Hence, the benefit should be reduced by the amount of interest which would be earned.

For the above example, if the interest rate

of 1.5% per month is used, then

Total interest per month = $1,30,000 * \frac{1.5}{100}$

= 1950

So, Net monthly benefit = 31,740 - 1950

= 29,790.

So,

Payback period = $\frac{1,30,000}{29,790}$

= 4.36 month.

ii) Present Value Method:-

The correct application of the present value method is to ask the question: What is the present value of earnings which may accrue after 'n' years. Thus if r% is the interest rate per annual, the present value of earning x according in the n^{th} year is:

$$\text{Present value} = x / (1 + r/100)^n$$

Example:

Original investment cost = 1,30,000

Net benefit per month = 31,740

Interest rate = 1.5%

P.T.O

Now,

Month	Cost	Net benefit	Present value of benefit	Cumulative present value
0	1,30,000	-	-	-
1		31,740	31,271	31,271
2		31,740	30,809	62,080
3		31,740	30,354	92,434
4		31,740	29,905	1,22,339
5		31,740	29,463	1,51,802

Since the cumulative present value is more than cost so accept the project. The cumulative benefit at the end of 5 month exceed the cost so payback period = 5.

More accurate computation is:

$$\text{Payback period is} = \text{min. year} + \frac{\text{unrecovered amount}}{\text{max. year net benefit}}$$

$$= 4 + \frac{1,30,000 - 1,22,339}{29,463}$$

$$= 4 + 0.26$$

$$= 4.26 \text{ month.}$$

UNIT-5

System Design

System design:-

The most creative and challenging phase of the system development life cycle is system design. System design is the process of defining the architecture, component, module, interfaces and data for a system to satisfy specified requirements. The design describes both a final system and a process by which it is developed. It refers to the technical specification that will be applied in implementing the candidate system.

The design covers the following:

i) Review the current physical system.
ii) Prepare output specification
iii) Prepare input specification
iv) Prepares edit, security and control specification.
v) Specify the implementation plan.
vi) Prepare logical design
vii) Review benefits, costs, target dates and system constraint.
viii) Design the Physical system.
ix) Plan system implementation, etc.

Process and stage of system design:

The design phase focuses on the detailed implementation of the system recommended in feasibility study. In design stage, emphasis is on translating performance

specification into design specification. The design phase is a translation from a user oriented document (system proposal) to document oriented to programmers or database personel. System design goes through two phase of development:

i) Logical design ii) Physical design.

i) Logical design:-

The part of the design process that is independent of any specific hardware or software platform is referred to as logical design. The logical design concentrate on the business aspect of the system and tend to be oriented to a high level of specificity. for a candidate system, logical design describe the input, outputs, database and procedures all in a format that meets the user's requirements. When analyst prepares the logical system design, they specify the user needs at the level of detail that virtually determines the information flow into and out of the system and required data resources.

The logical design covers the following:

- Review of current system, it's dataflows, file organizations, etc.
- Prepare security and control specification. This include specifying the rules for backup procedure, modifying data and control.
- Prepare output specification that determines format and contents of reports.
- Prepare input specification.

- Specify the implementation plan.
- Prepare logical design of information flow, output, input control and implementation plan.
- Review benefit cost, target date, etc.

ii) Physical design :-

The process of turning logical design into physical ones is referred to as physical design. In physical design, analyst design the various part of the system to perform the physical operation necessary to facilitate data capture, processing and information output. During physical design, the analyst must determine many of the physical details necessary to build final system, from the programming language the system will be written in, to the database system that will store the data to the hardware platform on which the system will run.

The physical design produces the working system by defining the design specification that tells programmer exactly what the candidate system must do. In turn, programmer writes the necessary programs or modifies the s/w package that accepts inputs from the user, perform the necessary calculation through the existing file or database and produce the report on hard copy or on screen.

Physical system design consist of the following steps:

1. Design the Physical system
   a) Specify input output media.
   b) Design the database and specify backup procedure.

c) Design physical information flow through the system and physical design walkthrough.

2. Plan the system implementation:
   a) Prepare the conversion schedule and a target date.
   b) Determine training procedure, courses and timetable.
3. Devise test and implementation plan and specify any new hardware /software.
4. Update benefits, costs conversion date and system constraints.

Difference between logical design and physical design:

	Logical design	Physical design
1.	The part of the design process that is independent of any specific hardware or s/w platform is referred to as logical design.	1. The design that relates to actual input and output processes of the system is known as physical design.
2.	The logical design describes the structure and characteristics or features like output, input, database and procedure.	2. The physical design is actual s/w and working system. There will be hardware, software cost, time.
3.	Logical design preceeds the physical design.	3. Physical design suceeds the logical design.

Logical design	Physical design
4. Logical design should accurately provide to reader a visual representation of activities and data relevant to particular business. Example: ERD, DFD, etc.	4. Physical design involves actual design of a database according to the requirements that were established during logical design.
5. The logical design considers which elements must be present for a system to meet its objective.	5. The final physical design considers how the logical design can be implemented with the current technology available.

Design Methodologies:-

There are more clearly defined logical method for developing a system that meets user requirements that lead to new techniques and methodologies that do the following functions:-

i) Improve the productivity of analysis and programmers.
ii) Improve documentation and subsequent maintenance and enhancement.
iii) Cut down drastically on cost overruns and delays.
iv) Improve communication among the user, analyst designer and programmer.
v) Standardize the approach to analysis and design.
vi) Simplify the design by segmentation.

Structured design :-

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

Structured design partition a program into small, independent modules. They are arranged in hierarchy that approximate a model of the business area and is organized in a top-down manner with detail shown at the bottom. Thus, structured design is an attempt to reduce complexity and make a problem manageable by subdividing it into smaller segment which is called modularization or decomposition.

Activities performed in system design :-

System design is the process of defining the architecture, components, modules, interfaces and data for a system to satisfy specified requirement. It goes through logical and physical design with emphasis on the following:

a) Preparing input/output specifications.

b) Preparing security and control specifications.
c) Specifying the implementation plan.
d) Preparing the logical design before implementation.

Input design :-

Input design is the process of converting user originated input to a computer based format. Input design also includes selection of appropriate input media for processing. The input design is the link between the information system and the user. Input design considers the following thing:

- What data should be given as input?
- How the data should be arranged and coded?
- The dialog to guide the operating personnel in providing input.
- Method for preparing input validation and steps to follow when error occur.

The main objectives of input design are as follows:

- Controlling amount of input
- avoiding delay
- avoiding error in data
- keeping the process simple

Output design:-

Computer output is the most important and direct source of information to the user. Efficient, intelligible output design should improve the system's relationships with the user and help in decision making. A major form of output is hard copy from the printer. The output devices to consider during output design depends on factor such as compatibility of the device with the system, response time requirement, print quality, etc during output design. In addition to deciding on the output device, the systems analyst must consider the print format. In the case of online application information or output is displayed on the screen.

The following general principles are important for output design:

1) Computer output should be simple to read and interprete:
   - Every output should have a title.
   - Every output should be dated and time stamped.
   - In tabular-based outputs, column should be clearly labelled.
   - Computer jargon and error message should be omitted from all output.
   - User must be able to easily found the output, more forward and backward.

ii) The timing of computer output is important :-
Output information must reach to recipient while the information is pertinent to. This can affect how the output is designed and implemented.

iii) The computer output must be acceptable to the system users who will receive them.

iv) The distribution of computer outputs must be sufficient to assist all relevent system users.

Designing form and Report :-

Form is a business document that contains some predefined data and may include some areas where additional data are to be filled in. In general, forms are used to present or collect information on single item such as customer, product or event. The form is tool with a message is a physical carrier of data.

Report is a business document that contains only predefined data. It is a passive document used solely for reading or viewing. A report typically contains data from many unrelated record or transactions. Examples of report include weekly sales summaries by salesperson, pi-chart of population by age categories.

Forms can be used for both input and output. Report on otherhand are used to convey information on a

collection of items. Form and report design is key ingredient for successful system. Form and report were identified during requirement structuring. The kind of forms and reports the system will handle were established as a part of design strategy formed at the end of the analysis phase of system development process.

Types of forms :-

Form is generally classified by what it does in the system. There are three primary classification.

1) **Action form :-**
It request the user to do something, get action. Examples of action forms are application form, purchase order, etc.

ii) **Memory form :-**
Memory form is a record of historical data that remains in a file and is used for reference and serve as a control on key details. Examples are journal sheet, stock ledger, etc.

iii) **Report form :-**
A report form guides supervisors and other administrators in their activities. Examples of report form are sales analysis reports, trial balance, etc.

Types of Report:-

The following are the common types of business report.

i) Scheduled reports:-

These are reports produced at predefined intervals such as daily, weekly or monthly to support the informational needs of an organization.

ii) Key indicator report:-

These are the reports that provides a summary of critical information on a recurring basis.

iii) Exception reports:-

Reports that highlight data that are out of the normal operating range.

iv) Drill down reports:-

Reports that provide details behind the summary value on a key indicator or exception report.

v) Ad-hoc report:-

Unplanned information requests in which information is gathered to support a non-routine decision.

Difference between form and report:-

The difference between form and report are subtle. A report is only for reading and often contains data about multiple unrelated records in a computer file. In contrast, form typically contains data from only one record or is based on one record such as data about one customer, one order, or one student. The guidelines for the design of form and report are very similar.

Process of designing the forms and reports:-

Designing forms and reports is a user-focused activity that typically follows prototyping approach.

- The first step in designing the form and report is to gain an understanding of intended user and task objectives by collecting initial requirement during requirements determination. During this process, several question must be answered. These question attempt to answer the who, what, when, where and how related the creation of all form and reports as given below:

1. Who will use the form or report?
2. What is the purpose of form or report?
3. Where is the form or report needed and used?
4. How many people need to use or view the form or report etc.

Understanding of these questions is a first step in the creation of any form or report.

- Second step after collecting the initial requirement is to structure and refine this information into an initial prototype. Structuring and refining the requirements are completely independent of users.

- Final step is to ask users to review and evaluate the prototype. After reviewing the prototype user may accept the design or request that changes be made. If changes are needed repeat the construction.-evaluate-refinement cycle until the design is accepted.

Deliverables of designing forms and reports:-

In order to move from phase to phase, each activity produces some types of deliverables that is used in later phase or activity. In the case of designing forms and reports, design specifications are the major deliverables and are input to the system implementation phase. Design specifications have three sections:

1) Narrative overview:-

This section contains general overview of the characteristics of target users, task, system and environmental factors in which the form or report will be used. The purpose of this section is to explain to those who will actually develop the final form, why this form exists and how it will be used so that they can make the appropriate implementation decision.

ii) Sample design :-

In this section of the design specification, sample design of the form is shown. This design may be hand drawn using a coading sheet, although in most instances, it is developed using standard development tools.

iii) Testing and usability assesment:-

This section provides all testing and usability assessment information.

General guidelines for the design of form and report :-

Form and report design is a key ingredient for successful system. The guidelines or principles for the design of forms and reports are very similar. The general guidelines for the design of form and report are:

1) Meaningful title :-

- Title should be clear and specific describing the content and use of form or report.
- Revision date or code to distinguish a form or report from prior versions.
- Current date, which identifies when the form or report was generated.
- Valid date, which identifies on what date or time the dat

in the form or report were accurate.

ii) Meaningful information:-
Form and report should display only needed information and information should be provided in a manner that is usable without modification.

iii) Balance of layout:-
- Information should be balanced on the screen or page
- Adequate spacing and margin should be used.
- All data entry fields should be clearly labelled.

iv) Design an easy navigation system:-
- Clearly show how to move forward and backward.
- Clearly show where you are (eg: page 1 of 3)
- Notify user when last page of multipaged system.

Designing database:-

A database is an organized collection of logically related data that contains informations relevant to an enterprise. The database is also called the repository or container for a collection of data files. For example; university database maintains information about student, courses and grades in university.

A database management system is the set of programs that is used to store, retrieve and manipulate the data in convenient and effective way.

The term database design can be used to describe many different part of the design of overall database system. Principly it can be thought of as the logical design of the base data structures used to store the data. The process of doing database design generally consist of number of steps which will be carried out by the database designer.

Process of database design:-

The database design process can be divided into following steps:

1) Requirement analysis:-

The very first step in designing a database application is to understand what data is to be stored in the database, what application must be built in top of it and what operation are most frequent and subject

to performance requirements. In other word at this step we must find out what the user want from the database.

II) Conceptual database design:-

Once all the requirements have been collected and analyzed, the next step is to create conceptual schema for the database, using high level conceptual data model. The result of this phase is ER-diagram, it is high level data model of specific application area and describe how different entities are related to each other.

III) Logical database design:-

At this step, the conceptual database design is converted into schema in the data model of the choosen DBMS. Normally, we will consider relational DBMS and therefore, the task in the logical design step is to convert an ER schema into relational database schema.

IV) Schema refinement:-

This step is to analyze the collection of relations in our relational database schema to identify a potential problem and refine it.

V) Physical database design:-

This is the last step of database design whose goal is to implement the database. At this step, one must know which database management system (DBMS) is used. The indexes

the integrity constraints and user access rights are defined. finally the data to test the database is added in.

Objective of database:-

A database is a collection of interrelated data stored with minimum redundancy to serve the many user quickly and efficiently. The effectiveness objective of database include following:

i) Ensuring that data can be shared among users for a variety of applications.
ii) Maintaining data that are both accurate and consistent.
iii) Ensuring that data required for current and future application will be readily available.
iv) Allowing a database to evolve as the need of user grow.
v) Allowing the user to construct their personal view of data without concern for the way to data physically stored.

Normalization:-

Normalization is the process of organizing data in a database. The process of decomposing unsatisfactory relations by breaking up their attributes into smaller relations is called normalization. Normalization includes creating a table by establishing relationships between those table according to rules designed both to protect the data and to make data more flexible by eliminating

two factors: Redundency and inconsistent dependency. It is the process of decomposing relations with anomalies to produce well structured relation. Normalization is formal process of deciding which attribute should be grouped together in a relation. The normalization theory is based on concept of normal forms. A relation table is said to be in a particular form if it satisfied a certain set of constraint.

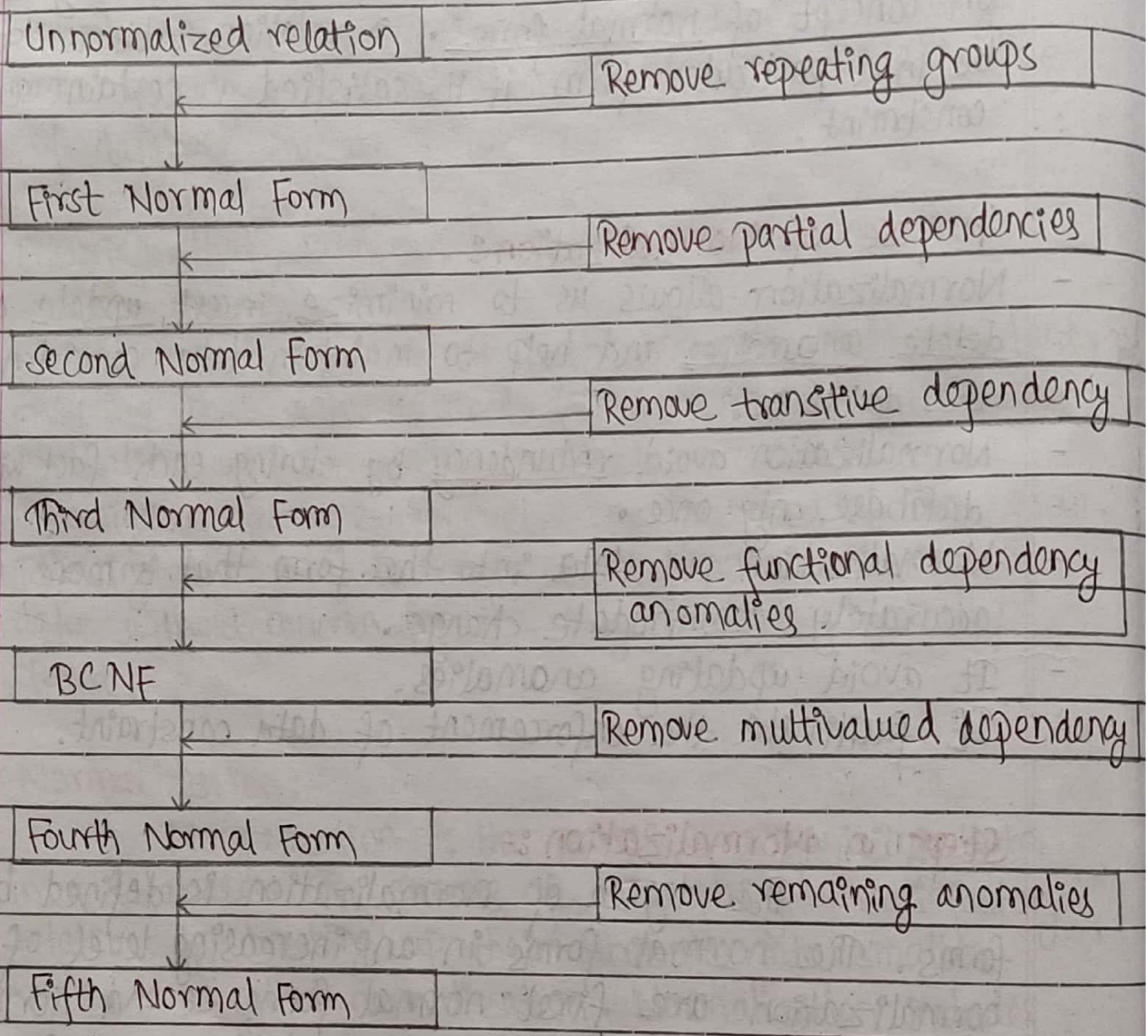
Purpose of Normalization :-

- Normalization allows us to minimize insert, update and delete anomalies and help to maintain data consistency in the database.
- Normalization avoid redundency by storing each fact within database only once.
- Normalization put data into the form that is more able to accurately accommodate change.
- It avoid updating anomalies.
- It facilitate the enforcement of data constraint.

Steps in Normalization :-

The degree of normalization is defined by normal forms. The normal forms in an increasing level of normalization are first normal form, second normal form, third normal form, Boycee codd Normal form, 4NF and 5NF. Each normal form is set of conditions on schema that guarantees certain properties relating to redundency

and update anomalies. In general, 3NF is considered good enough. Each normal form is improvement over the earlier form. The following figure shows steps in normalization.



[Fig:- Steps in normalization]

Forms of normalization :-

The breaking down of table during normalization may undergo series of stages called the normal form or just NF in short. There are by six normal forms. They are numbered from one, the lowest form of normalization. In practice, first, second and third normal forms are widely used. A higher level of normalization cannot be achieved unless previous levels have been satisfied. For example, to be in second normal form it must be already in first normal form.

First Normal Form :-

- A relation is said to be in 1NF if and only if all domain of the relation contains only atomic values.
- More simply, a relation is in 1NF if it does not have multivalued attributes, composite attributes and their combinations.
- 1st NF states that domain of an attribute must include only atomic values.
- A relation is said to be in first normal form if it has no repeating groups. if group of items repeats it should be split into new table.

Example :-

Let us take a relation that is not in 1NF (containing multivalued attribute).

Student

Sid	S_name	address	Phone_no
1	Nitesh	Kalanki	9849145464, 9813335467
2	Laxman	Balkhu	9841882345, 9841025010
3	Geeta	Kirtipur	9848334898
4	Anisha	Pokhara	9849283827
5	Monika	Ratopool	9840084732, 9808267499

Now converting this relation into 1NF by decomposing this relation into two relation as:

Student

Sid	S_name	address
1	Nitesh	Kalanki
2	Laxman	Balkhu
3	Geeta	Kirtipur
4	Anisha	Pokhara
5	Monika	Ratopool

Phone

sid	Phone_no
1	9849145464
1	9813335467
2	9841882345
2	9841025010
3	9848334898
4	9849283827
5	9840084732
5	9808267499

Fig:- Relation in 1NF

Second Normal Form:-

- A relation is said to be in 2NF if it is in 1NF and non-key attributes are fully functionally dependent on the key attributes.
- Speaking inversely, if table has some attributes which is partially dependent on the primary key then it is not in 2NF.
- Let X and Y be two attributes of a relation, given the value of X, if there is only one value of Y corresponding to it then Y is functionally dependent on X. This is indicated by $X \rightarrow Y$.
- Thus to become in a second normal form, no non-key attribute is functionally dependent on part but not all of primary key. (i.e. partially dependent).
- Second normal form is satisfied if any of the following condition apply
  1) Primary key consists of only one attribute
  2) No non-primary key attribute exist in the relation
  3) Every non primary key attribute is functionally dependent on full set of primary key attribute.

Example:- Let us take the relation in 1st NF but not in 2NF as:

Employee_Department

emp_id	emp_name	emp_salary	Dept_no	Dept_name
1	Bhupi	40000	D_1	BBA
1	Bhupi	40000	D_2	CSIT
2	Bindu	30000	D_3	BBS
3	Arjun	60000	D_1	CSIT

This relation is in 1NF because there is no composite attribute and every attribute is atomic.

- In this relation, {emp_id, Dept_no} is primary key.
- Here, the non key attribute emp_name is functionally dependent on emp_id which is the part of relation key. i.e. emp_id ← emp_name. Similarly, emp_id → emp_salary and dept_no → dept_name, thus there occur partial dependency due to which the relation is not in 2NF.

Now converting this relation into 2NF by decomposing this relation into three relation as:

employee

emp_id	emp_name	emp_salary
1	Bhupi	40000
2	Bindu	30000
3	Arjun	60000

Department

Dept_no	Dept_name
D_1	BBA
D_2	CSIT
D_3	BBS

Emp_Dept

Emp_id	Dept_no
1	D_1
1	D_2
2	D_3
3	D_1

[Fig:- Relation in 2NF]

Third Normal Form:-

- A relation is said to be in 3NF if and only if it is already in 2NF and every non-prime attribute is non-transitively dependent on the primary key.
- Speaking inversely, if a table contains transitive dependency then it is not in 3NF and table must be split to bring into 3NF.
- In another word, a relation is in third normal form if it is in second normal form and there is no functional dependencies between two or more non-primary key attributes (a functional dependency between non-primary key attributes is also called a transitive dependency).

Example:-

Consider the relation which is in 2NF but not in 3NF.

S_id	S_name	age	sex	Hostel_name
1	Laxmi	21	Female	White house
2	Binita	22	Female	White house
3	Rajesh	32	Male	Red house
4	Aaryan	21	Male	Red house

- Here S_id is the primary key and all other non-key attributes are fully functionally dependent on it. Thus it is in 2NF.
- Here hostel_name is also functionally dependent on sex where both Hostel-name and sex are non-key attribute

so transitive dependency occurs so it is not in third normal form.

- To transform it into 3NF, we should introduce another relation which includes the functionally related non-key attribute.

Student

S_id	S_name	age	sex
1	Laxmi	21	Female
2	Binita	22	Female
3	Rajesh	32	Male
4	Aaryan	21	Male

Hostel

sex	hostel_name
Female	White house
Male	Red house

File organization

File structure :-

To learn about files, we need to understand basic terms used to describe the file hierarchy. Some of the term related to file organization are:

I) Byte :-

A byte is an arbitrary set of eight bits that represent a character. It is a smallest addressable unit in today's computer.

II) Data item or element :-

One or more bytes are combined into a data item to describe an attribute of an object. A data item is sometimes referred to as a field. A field is actually a physical space on tape or disk whereeas data item is the data stored in the field.

III) Records :-

A data items related to an object are combined into a record. A hospital patient (object) has record with his/her name, address, health, insurance policy, etc. Each record has a unique key or ID number.

IV) File :-

A collection of related records is called the file. The size of

file is limited by the size of memory or storage medium.

v) Database:-

The set of related file for real time processing is called database. It contains the necessary data for problem solving and can be used by several users accessing the data concurrently.

Types of files:-

There are mainly six types of files used in information system.

i) Master files
ii) Transaction files
iii) Work file
iv) Audit files
v) History files
vi) Backup/ Security file

i) Master files:-

Master files store core information that is important to the business and more specifically to the application such as order information or customer mailing information. They are usually kept for long period of time and new records are appended to the end of files as new order or new customer are captured by the system. If changes to be made to existing records, program must be written to update the master file with the new information.

Date
Page

ii) Transaction files:-

Transaction files are files in which the data relating to business events is recorded, prior to further stage of processing and are created from source documents used for recording event or transaction. Examples of transaction files are customer's orders for product (to update an order file). Details of price changes for product (to update the product file) etc.

iii) Work file:-

Any file which is required to enable the processing of business data to be carried out is called a work file. These files are sometimes referred to as transfer files. The temporary files which hold information for printing also falls into this category.

iv) Audit files:-

An audit file records "before" and "after" image of data as it is altered so that an audit can be performed if the integrity of data can be questioned. For control purpose, a company might need to store information about how data changes over time. For example; as a human resource clerks changes employee salary in a human resource system, the system should record the person who made the changes to the salary amount, the date, and the actual change that was made.

v) Backup or security file:-

These files are taken in order to provide back copies, in case of loss or damage to current version and are copies of currently used master files kept in the computer library as a measure of security.

vi) History files:-

History files are often stored on magnetic tape and are kept in case past information is even required. For example; an employee who was dismissed three years back may wish to apply for unemployment insurance. The past employee's record must be retrieved by personnel to complete the necessary work.

File organization:-

File organization refers to the relationship of the key record to the physical location of that record in the computer file. A file is organized to ensure that records are available for processing. File organization is a technique for physically arranging records of files. The objective for computer based file organization are:-

i) Fast data retrieval
ii) High throughput for processing transactions
iii) Efficient use of storage space.
iv) Protection from failures or data loss.
v) Security from unauthorized use, etc.

Literally hundreds of different file organizations and variations have been created but most basic families of file organization used in most file management environment are:

i) Sequential file organization
ii) Indexed file organization
iii) Inverted list organization
iv) Direct access organization
v) Hashed file organization

1) Sequential file organization:-

It is the simplest way to store and retrieves records in the files. In sequential organization, records are stored one after another in a sequence according to primary key value. To access the record, a program must normally scan the file from the beginning until the desired record is located. In a sequential organization, records can be added only at the end of the file. It is not possible to insert a record in the middle of the file without rewriting the file.

Advantage:

1. Simple to understand
2. Easy to maintain and understand
3. Best use of storage space.

Disadvantage:

1. Entire file must be processed to get specific information.
2. Transactions must be stored and placed in sequence prior to processing.
3. Record cannot be added at the middle of the file.

II) Indexed file organization:-

In an indexed file organization, the records are stored either sequentially or non-sequentially and index is created that allow the application software to locate individual records. An index is a table used to determine the location of records in a file that satisfy some condition index can point to unique record or potentially more than one record. Indexed organization reduces the magnitude of sequential search and provide the quick access for sequential and direct processing. The main disadvantage to indexed file organizations are extra space required to store the extra time necessary to access and maintain indexes.

III) Inverted list organization:-

Like the indexed organization, the inverted list organization maintains an index. The two method differs however in the index level and record storage. The indexed method has multiple index for a given key where as inverted list method has single index for each key type, records are not necessarily stored in

particular sequence. They are placed in the data storage area but index are updated for record key and location.

iv) Direct access organization:-

In direct access file organization records are placed randomly throughout the file. Records need not be in sequence because they are updated directly and rewritten back in the same location. New record are added at the end of file or inserted in specific locations based on software command.

Records are accessed by addresses that specify their disk location. An address is required for locating a record, for linking records or for establishing relationships.

Advantage:
- Records can be immediately accessed for updating.
- Very easy to handle random enquires.
- Record can be inserted or updated in middle of file.
- Most attractive for intractive online application.

Disadvantage:
- Data may be accidentally erased or overwritten unless special precaution are taken.
- Less efficient use of storage.
- Expensive hardware and software are required.

v) Hashed file organization :-

In a hashed file organization, the location of each record is determined using an algorithm that converts a primary key value into record address. Although there are several variations of hashed files, in most cases the records are located non-sequentially as dicted by hashing algorithm. In hashed file organization, retrieval of random record is very fast.