

Unit-1 System Analysis and Design

❖ Introduction:

System means is organized relationship between any set of components or degree to achieve some common cause or objective.

System Analysis it is a process of collecting and interpreting the facts, identifying the problems and decomposition of a system into its components. System analysis is conducted for the purpose of studying the system in order to identify its objective. It is problem solving mechanism that improves the system and ensures that all the components of the system work efficiently to accomplish their purpose.

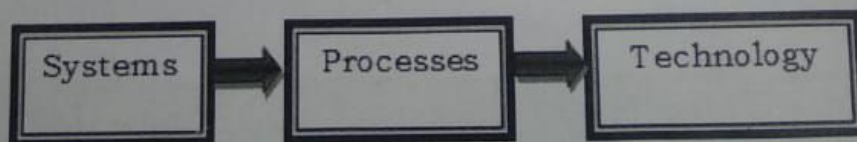
The **design of the system** is a layout or plan for a solution for the system. The design process of a system is has two levels. At the first level the focus is on deciding which modules are needed for the system, the specifications of these modules, and how the modules should be inter - connected. This type of design is called as **High level design**.

In second level, the things like internal design of the modules or how the specifications of the module can be satisfied is decided. This type of design is called as **Detailed design or Logic design**.

Detailed design essentially expands the system design to contain a more detailed description of the processing logic and data structures so that the design sufficiently complete for further coding portion.

The **Design of the system** is correct if a system built exactly according to the design which satisfies the requirements of that system. The goal of design process is not simply to produce a design for the system. Instead goal is find to the **best** possible design within the limitations imposed by the requirements and the physical and social environment in which the system will operate.

System analysis and design (SAD) is mainly focus on:



1.1 Software Development Models:

Basically, a model is a representation of a real or planned system. A model is used to visualize relationship.

1.1.1 Waterfall Model:

The waterfall model was the first process model to be introduced. It is also referred as a **Linear Life Cycle** model. It is very simple to understand and use.

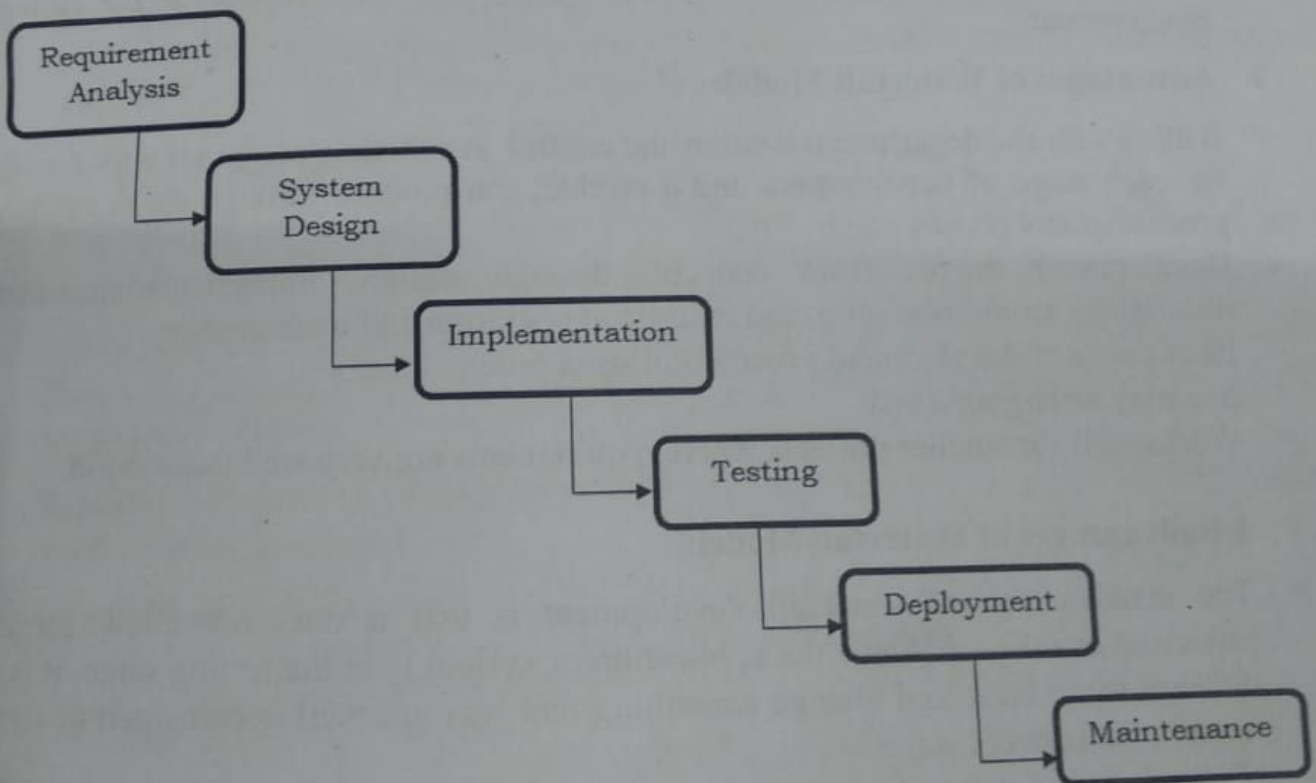
In waterfall model, each phase must be completed before next phase can begin and there is no overlapping in the phases.

Waterfall model is earliest SDLC approach that was used for the software development.

➤ Waterfall model design:

In waterfall approach, the whole process of software development is divided into separate phase. The outcome of the one phase acts as the input for the next phase sequentially.

Following is the diagrammatic representation of different phases of waterfall model:



The Sequential phases in waterfall model are:

Requirement Gathering and Analysis:

All possible requirements of the system to be developed are captured in this phase and documented in a requirement specification document.

System Design:

The requirement specifications from first phase are studied in this phase and system design is prepared. System design helps in specifying hardware and system requirements and also helps in defining overall system architecture.

Implementation:

With inputs from system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality which is called as Unit Testing.

Integration and Testing:

All the units developed in the implementation phase are integrated into a system after testing of each unit.

Deployment of System:

Once the functional and non functional testing is done, the product is deployed in the customer environment or released into the market.

Maintenance:

There are some issue which come up in the client side environment. To fix the issues patches are released. Maintenance is done to deliver these changes in the customer environment.

➤ **Advantages of Waterfall Model:**

- ✓ It allows for the departmentalization and control. A schedule can be set with deadline for each stage of development and a product can proceed through the development process model phases one by one.
- ✓ Development moves from concept, through design, implementation, testing, installation, troubleshooting, and ends up at operation and maintenance.
- ✓ Each phase of development proceeds in strict order.
- ✓ It is easy arranging a task.
- ✓ Works well for smaller projects where requirements are very well understood.

➤ **Disadvantages of Waterfall Model:**

- × The disadvantage of waterfall development is that it does not allow for much reflection or revision. Once the application or system is in the testing stage, it is very difficult to go back and change something that was not well documented or thought upon in the concept stage.
- × High amount of risk and uncertainty.
- × Not a good model for complex and object oriented projects.
- × It is difficult to measure progress within stages.

1.1.2 Incremental Model:

The Incremental model is a method of software development where the model is designed, implemented and tested incrementally until the product is finished.

It involves both **development** and **maintenance**. The product is defined as finished when it satisfies all the requirements of the client.

This model is combines the elements of waterfall model.

➤ **When to use Incremental Model:**

This model is used where requirements are clear and can implement by phase wise. Mostly this model is used in web applications and product based companies.

➤ **Advantages of Incremental Model:**

- ✓ This model is more flexible, less costly to change scope and requirements.
- ✓ Easier to test and debug during the smaller iteration.
- ✓ Easier to manage risk because risky pieces are identified and handled during its iteration.

➤ **Disadvantages of Incremental Model:**

- × Each phase of an iteration is rigid and do not overlap to each other.
- × Problems may arise pertaining to system architecture because not all requirements are gathered up front for the entire software life cycle.

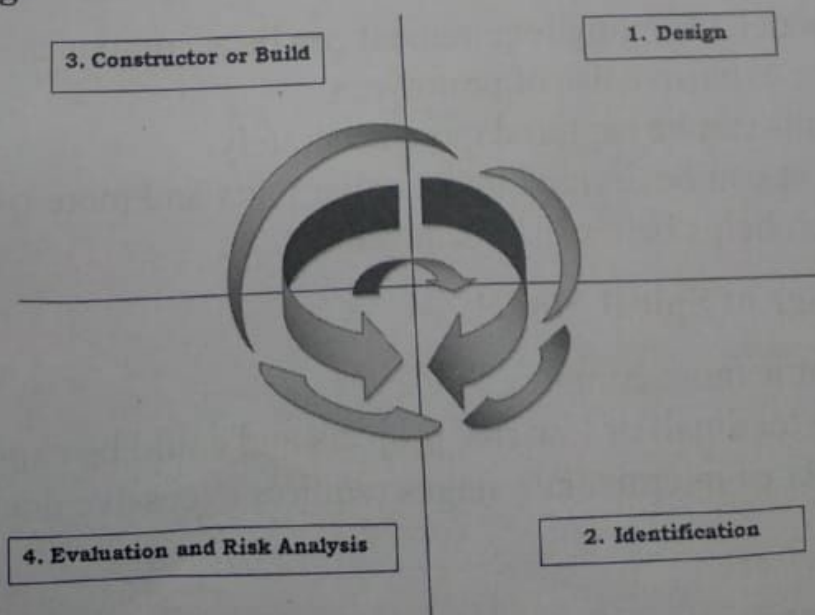
1.1.3 Spiral Model:

The spiral model combines the idea of iterative development with the systematic, controlled aspects of the waterfall model.

Spiral model is a combination of iterative development process model and sequential linear development model i.e. waterfall model with very high emphasis on risk analysis.

It allows for incremental releases of the product, or incremental refinement through each iteration around the spiral

➤ **Spiral Model Design:**



The spiral model has four phases. A software project repeatedly passes through these phases in iterations called **Spirals**.

Identification:

This phase starts with gathering the business requirements in the baseline spiral. In the subsequent spirals as the product matures, identification of system requirements, subsystem requirements and unit requirements are all done in this phase.

This also includes understanding the system requirements by continuous communication between the customer and the system analyst. At the end of the spiral the product is deployed in the identified market.

Design:

Design phase starts with the conceptual design in the baseline spiral and involves architectural design, logical design of modules, physical product design and final design in the subsequent spirals.

Construct or Build:

Construct phase refers to production of the actual software product at every spiral. In the baseline spiral when the product is just thought of and the design is being developed a POC *Proof of Concept* is developed in this phase to get customer feedback.

Then in the subsequent spirals with higher clarity on requirements and design details a working model of the software called build is produced with a version number. These builds are sent to customer for feedback.

Evaluation and Risk Analysis:

Risk Analysis includes identifying, estimating, and monitoring technical feasibility and management risks, such as schedule slippage and cost overrun. After testing the build, at the end of first iteration, the customer evaluates the software and provides feedback.

➤ **Advantages of Spiral Model:**

- ✓ In spiral model, changing requirement can be accommodated.
- ✓ It allows for extensive use of prototypes.
- ✓ Requirements can be captured more accurately.
- ✓ Development can be divided into smaller parts and more risky parts can be developed earlier which helps better risk management.

➤ **Disadvantage of Spiral Model:**

- × Management is more complex.
- × Not suitable for small or low risk projects and could be expensive for small projects
- × Large number of intermediate stages requires excessive documentation.

1.2 Requirement Modelling / Fact – Finding technique:

There are various fact-finding techniques used for gathering information about the system under study, some of these are:

- Interviews
- Document review
- Observation
- Questionnaires and Surveys
- Sampling and research

Let's understand about all fact finding technique one by one.

1.2.1 Interview:

An interview can be defined as a gentleman conversation between two people or more where questions are asked to a person to get the required responses or answers.

The interviews are an important fact-finding technique. It is a planned meeting during which you obtain information from people. The analyst must have skills needed to plan, conduct, and document interviews successfully.

➤ Objective of an Interview:

It helps to verify the information provided by the candidate. It helps to ascertain the accuracy of the provided facts and information about the candidate.

Its helps in establishing the mutual relation between the employee and the company. It is also used to candidate so that he comes to know about his profession, the type of work that is expected from him and he gets to know about the company or organisation.

➤ Interview Process:

Interviewing process consists of the following steps:

1. Prepare for the interview.
2. Establish objectives for the interview.
3. Determine the people to interview.
4. Write down all the questions that must ask.
5. Conduct the interview.
6. Document the interview.
7. Evaluate the interview.

To conduct an Interview following things need to consider:

- Use simple and clear words.
- Don't mix between facts and opinions.
- Listen to the answer.

- Don't interrupt.
- Don't suggest.
- Don't make the interview personally.
- Let him think. - Be flexible.

Advantages of Interview:

- ✓ Give analyst opportunity to motivate interviewee to respond freely and openly.
- ✓ Allow analyst to probe for more feedback Permit analyst to adapt or reword questions for each individual.
- ✓ It can observe nonverbal communication.

Disadvantage of Interview:

- × It is Time – Consuming Process.
- × Success highly dependent on analyst's human relations skills.
- × May be impractical due to location of interviewees.

1.2.2 Document Review:

Document review can help you to understand how the current system is supposed to work. You should review all the system documentation, which include technical documentation and operations manual such as user guide, also include the software package documentation if any.

1.2.3 Observation:

Observation is broad approaches available for the collection of the data in primary data collection method.

In **Observation method**, only present/current behaviour can be studied. Therefore many researchers feel that this is great disadvantage.

A casual observation can familiarize the researcher to identify the problem. Such a length of the queue in front of a food chain, price and advertising activity of the competitor etc.

Observation is the least expensive of the data collection.

➤ Types of Observation Methods:

There are several methods of observation of which, any one or combination of some them, can be used by the observer. They are:

- Structured or unstructured observation methods
- Disguised or undisguised observation methods
- Direct – Indirect observation methods
- Human – mechanical observation methods

➤ **Structured or unstructured Observation Methods:**

Observation should be structured or unstructured depends on the data needed to be observed.

Example 1: A manager of a hotel wants to know "How many of his customer visits the hotel with family and how many visits as single customer".

Here observation is structured because since it is cleared "What is to be observed?" He may tell waiters to record this. This information is required to decide the tables and chairs requirements and also the layouts.

Suppose, the manager wants to be know how single customer and customer with family behave and what is their mood. This study is unclear or vague, it needs non-structured observation.

It is easier to record structured observation than non structured observation.

➤ **Disguised - Undisguised Observation Methods:**

In Disguised observation, the respondents do not know that they are being observed.

In Undisguised observation, the respondents are well aware that they are being observed.

The main strength of disguised observation is that, it allows for maintaining the true reactions of the individuals.

In undisguised method, observation may be contained due to induced error by the objects of observation. The ethical aspect of disguised observation is still questionable.

➤ **Direct - Indirect Observation Methods:**

In direct observation method, the actual behaviour or phenomenon of interest is observed.

In Indirect observation, results of the consequences of the phenomenon are observed. Suppose, researcher is wants to know about the soft drink consumption of a student in hostel room. He may like to observe empty soft drink bottles dropped in to the dustbin. Similarly, the observer may seek the permission of the hotel owner to visit the kitchen or store. He may carry out the kitchen/store audit, to find out the consumption of various brands of spice items being used by the hotel.

It may be noted that the success of an Indirect observation largely depends on "How best the observer able to identify the physical evidence of the problem under study".

➤ **Human - Mechanical Observation Methods:**

This type of observation is mostly done by the human observation, wherein trained observers are required to observe and record their observations.

In some cases mechanical devices like eye cameras are used for observation.

One of the major advantages of electrical or mechanical devices is that, the recordings are free from subjective bias.

➤ **Advantages of Observation Methods:**

- ✓ The original or actual data can be collected at the time of occurrence of the event.
- ✓ Observation is done in natural surroundings. Therefore, facts are known.
- ✓ Observation can be done on those who cannot voluble.
- ✓ Bias of the researcher is greatly reduced in observation method.

➤ **Limitations of Observation Methods:**

- × This is an expensive method.
- × For observation, extensive training of observer is required.
- × External observation gives only surface indications. So only concrete behaviour can be observed.
- × Two observers may observe the same event but may draw inference differently.
- × It is very difficult to gather information on opinions and intentions etc.
- × Observation is required over a long period of time and hence delay may occur.

1.2.4 Questionnaire and Surveys:

Questionnaire is a tool used to collect the data. Questionnaires are used to obtain information about workloads, reports received, volumes of transactions handled, typed of job duties, difficulties, and opinions, of how the job could be performed better or more efficiently.

A typical questionnaire starts with a heading, which includes a title, a brief statements, of purpose, the name and telephone number of the contact persons, the deadline date for completion, and how and where to return the form.

The heading usually is followed by general instruction that provide clear guidance on how to answer the questions. Also the questionnaires contain conclusion that thank the participants and reminds them how to return the form.

➤ **Characteristics of Questionnaire:**

- It must be simple. Respondent should be able to understand the questions.
- It must be generate replies, which can be easily recorded by the unreview.
- It should be specific, so as to allow the interviewer to keep the interview to the point.
- It should be well arranged, to facilitate analysis and interpretation.
- It must keep the respondent interested throughout.

➤ **Different Types of Questionnaire:**

- (i) Structured and Non Structured Questionnaire
- (ii) Structured disguised Questionnaire

- (iii) Non Structured disguised Questionnaire
- (iv) Non Structured and Non disguised Questionnaire

Now, let understand about different types of Questionnaire in detail.

(i) Structured and Non Structured Questionnaire:

In this type of questionnaire, all the questions are structured so as to get the facts. The interviewer will ask the questions strictly as per the pre arranged order. E.g. "What is the strength of soap A in comparison with soap B?"

- Cost is less
- Lasts longer
- Better fragrance
- Produces more lather
- Comes in more convenient sizes

Structure, none disguised is widely used in market research. Questions are presented with exactly the same wording and same order to the entire respondent. The reason for standardizing questions is, to ensure that all respondents reply the same questions. The purpose of question is clear. The researcher wants the respondent to choose one of the five options given above. In non disguised type, the purpose of the questionnaire is known to the respondent.

(ii) Structured disguised Questionnaire:

- This type of questionnaire is used to find people's attitude, when a direct undisguised questions produces a bias.
- In this type of questionnaire what comes out is "What does the respondent know rather than what he feels". In a disguised type, the respondent is not revealed the purpose of the questionnaire.

(iii) Non structured and disguised Questionnaire:

- The main objective is to conceal the topic of enquiry by using a disguised stimulus. Though the stimulus is standardized by researcher, respondent is allowed to answer in an unstructured manner.
- The assumption made here is that individual's reaction is an indication of respondent's basic perception.
- The techniques involve the vogue stimulus, that an individual is asked to expand or describe or build a story, three common types under this category are (1) Word association (2) Sentence Completion (3) Story telling.

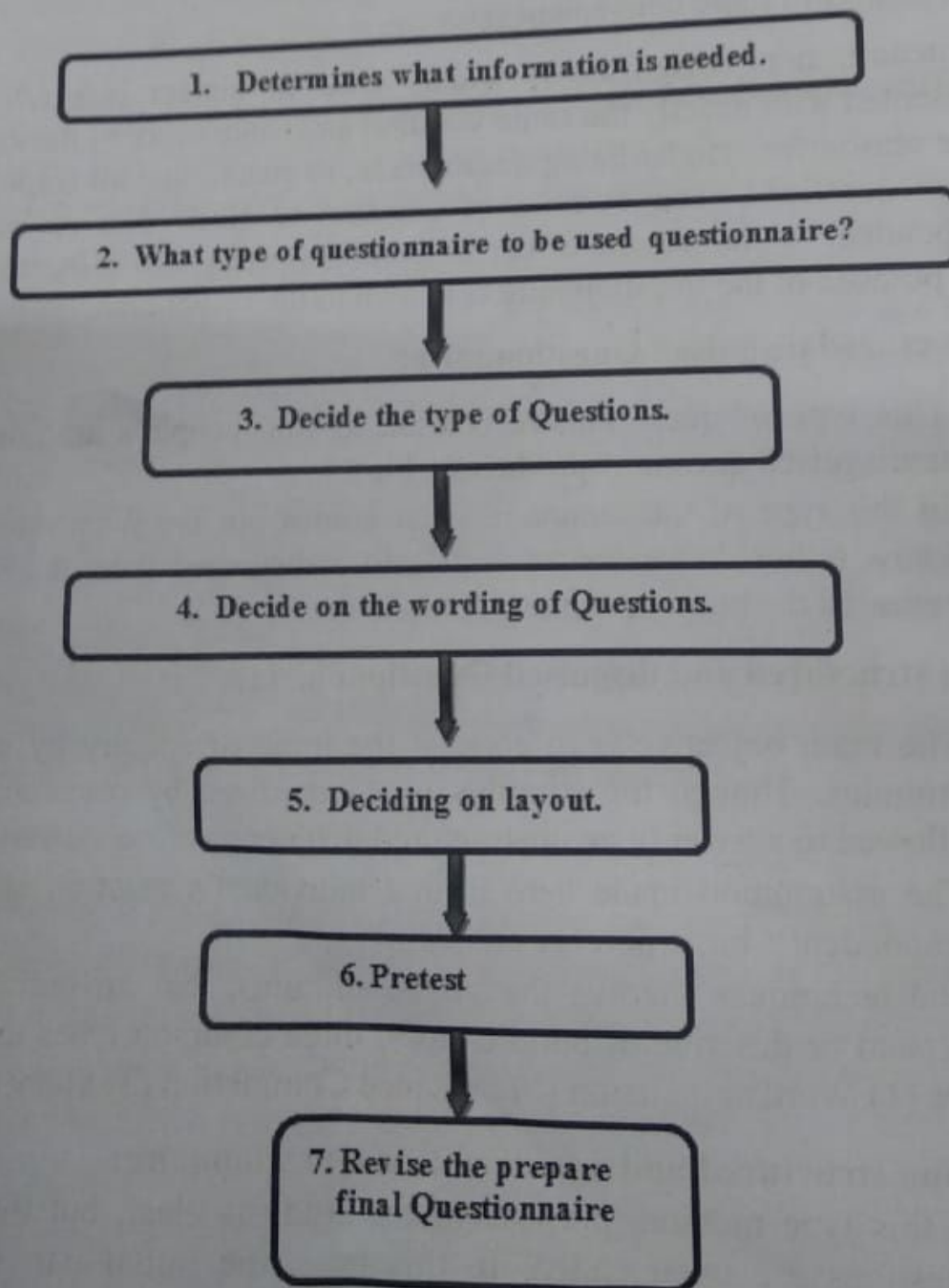
• Non structured and non disguised Questionnaire:

- In this type method, purpose of the study is clear, but the responses to the questions are open ended. In this type, the initial part of the question is constant.

- After presenting the initial questions, the interviewer becomes much unstructured as the interviewer probes more deeply. Respondent subsequent answer determines the direction the interviewer takes next.
- The question asked by the interviewer varies from person to person. This method is called "**Depth interview**". The main advantage of this method is freedom permitted to the interviewer.
- The main disadvantage of this method of interviewing is that, it takes time and respondents may not co - operate. Another disadvantage is that coding of open ended questions may pose a challenge.

Questionnaire Designing:

Basically, Questionnaire is designed in 7 steps. Let's understand that 7 steps via figure.



1.2.5 Overview Feasibility Study:

Feasibility is a process that identifies, describes and evaluates proposed systems and selects the best system for the Job.

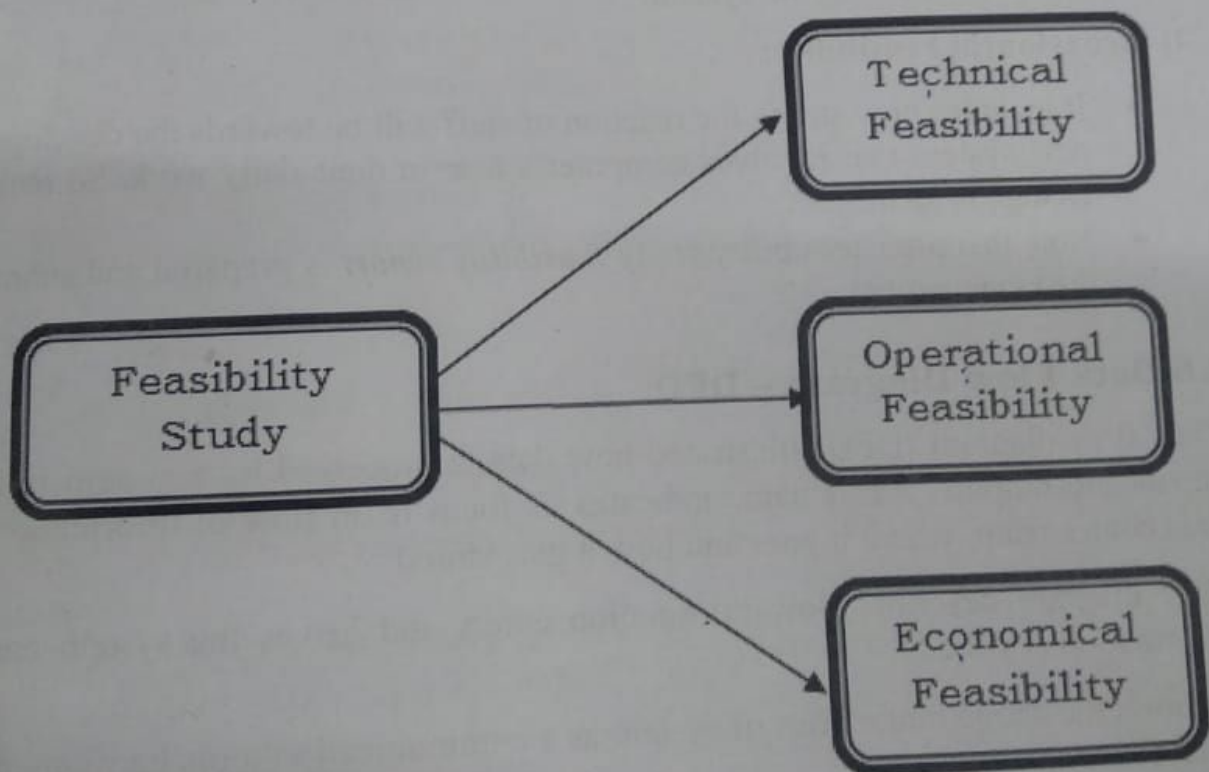
The objective of feasibility study is to establish the reasons for developing the software that is acceptable to end users, adaptable to change and conformable to established standards.

During the study, the problem definition is solved and all aspects of problems to be included in the system are determined.

To analyze whether the software will meet organizational requirements. To determine whether the software can be implemented using the current technology and within a specified budget and schedule.

➤ Types of Feasibility:

Various types of feasibility that are commonly considered include technical feasibility, Operational feasibility and Economic feasibility.



1) Technical Feasibility:

- It determines whether the technology needed for the proposed system is available and how it can be integrated within the organisation.
- Technical evaluation must also assess whether the staff have technical expertise to understand and use the new technology.

2) Operational Feasibility:

It is concerned with human, organisational and political aspects to study. It includes two ways:

(i) **Technical Performance:** It includes issues such as whether the system can provide the right information for organisation's personnel at right time and right place.

(ii) **Acceptance within the organisation:**

It determines the general attitudes and job skills of existing personnel and whether any changes in job work will be acceptable by the current users.

3) Economical Feasibility:

- The purpose of assessing economical feasibility is to identify the financial benefits and cost associated with the development of the system.
- Economic feasibility is often known as the cost benefit analysis. To carry out an economical feasibility study actual money value against activities needed for implementing the system.

4) Behavioural Feasibility:

- It includes how strong the reaction of staff will be towards the development of new system that involves computer's user in their daily work. So resistant to change is identified.
- Note that after feasibility study *feasibility report* is prepared and submitted to the management.

1.2.6 Data Flow Diagram – DFD:

Data flow diagram (DFD) illustrated how data is processed by a system in terms of inputs and outputs. As its name indicates its focus is on flow of information, where data comes from, where it goes and how it gets stored.

DFD diagram describes how information enters and leaves the system and where information is stored.

It shows the scope boundaries of system as a communication tools between a system's analysis.

Creating Data Flow Diagrams Steps:

1. Create a list of activities
2. Construct Context Level DFD (Identifies external entities and processes)
3. Construct level 0 DFD (Identifies manageable sub process)
4. Construct level 1 – n DFD (Identifies actual data flows and data stores)
5. Check against rules of DFD

DFD Naming Guidelines:

External Entity -> Noun

Data Flow -> Names of data

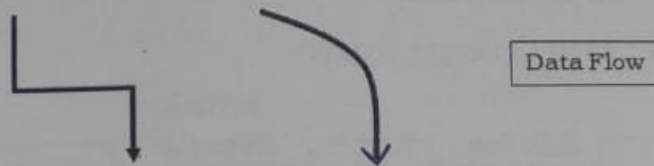
Process -> Verb Phrase

- a system name
- a sub - system name

Data Store -> Noun

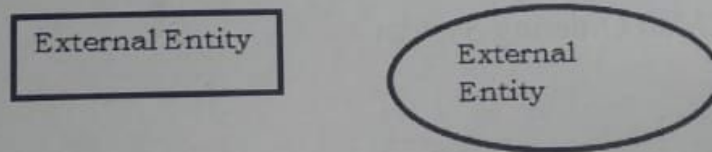
Data Flow Notations:

Data flows are pipelines through which packets of information flow. Label the arrows with the name of the data that moves through it.



External Entity Notations:

External entities are objects outside the system, with which the system communicates. External entities are destinations of the system's inputs and outputs.



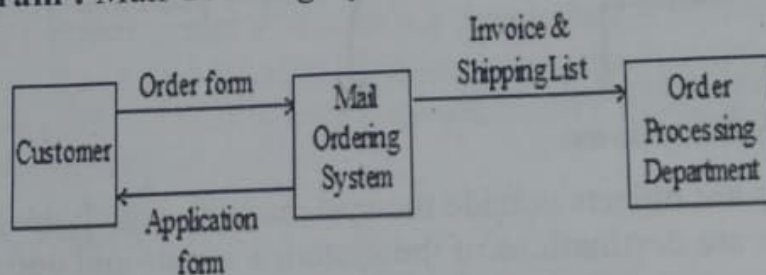
❖ DFD Examples :

Example 1 : Mail Ordering System :

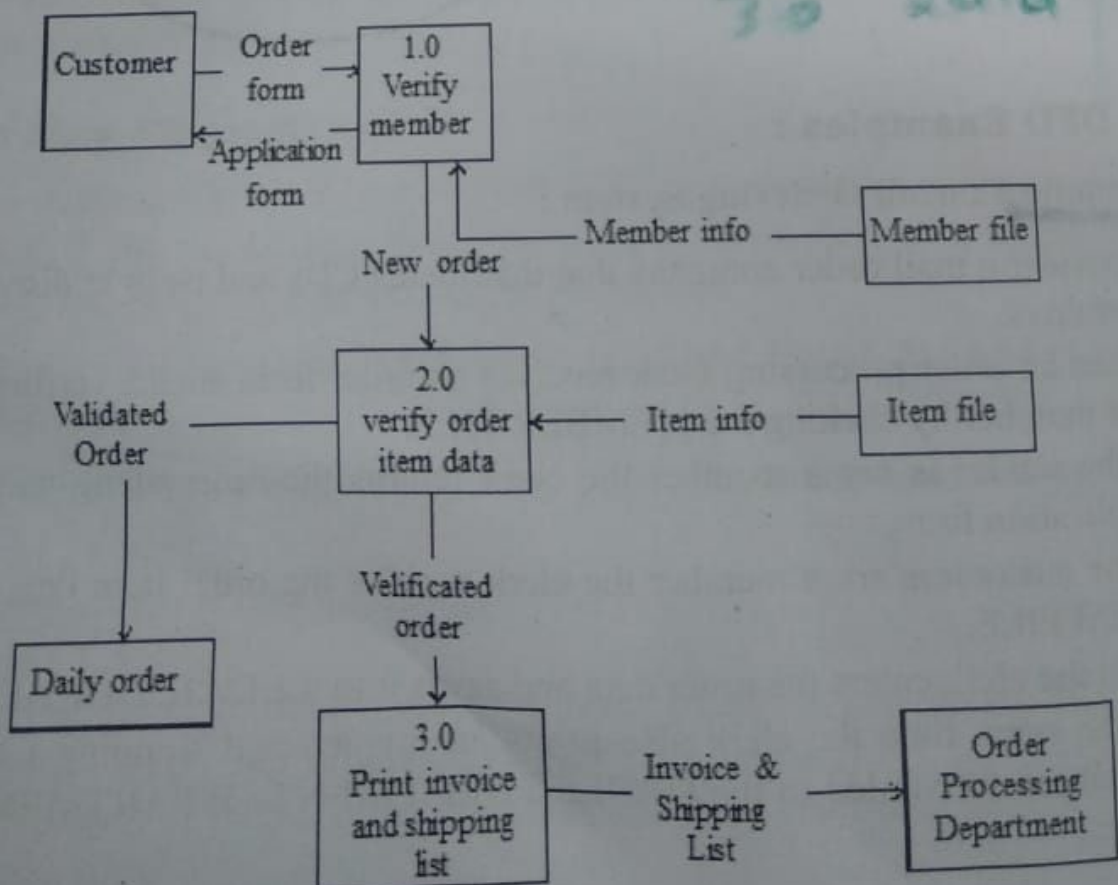
- Consider a mail order company that distributes CDs and tapes at discount prices to its members.
- When an order processing clerk receives an order form she/he verifies that the sender is a member by checking the MEMBER FILE.
- If the sender is not a member the clerk returns the order along with a membership application form.
- If the customers are a member the clerk verifies the order item data by checking the ITEM FILE.
- Then the clerk enters the order data and saves it to the DAILY ORDERS FILE.
- At the same time the clerk also prints an invoice and shipping list for each order, which are forwarded to the ORDER FULFILMENT DEPARTMENT for processing there.

- A mail order company that distributes CDs and tapes at discount prices to record club members (tells the purpose of the system).
- When an order processing clerk receives an order form (data flow) she verifies (process # 1) that the sender is a club member by checking the MEMBER FILE (data store). If the sender is not a member the clerk returns the order along with membership application form (data flow). If the customer is a member the clerk verifies the order item data (process #2) by checking the ITEM FILE (data store).
- Then the clerk enters the order data (data flow) and saves it to the DAILY ORDER FILE (data store).
- At the same time the clerk also prints an invoice and shipping list (data flow) for each order (process #3) which are forwarded to the ORDER FULFILLMENT DEPARTMENT (external entity) for processing there.

➤ **Context Diagram : Mail Ordering System**

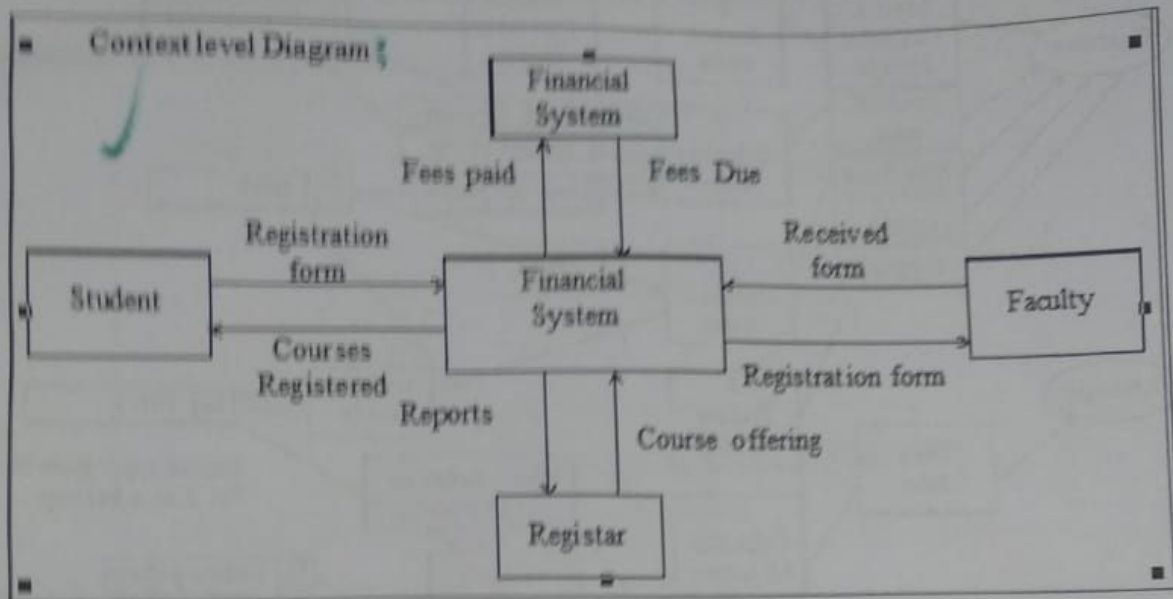


Level 0 diagram: Mail Ordering System

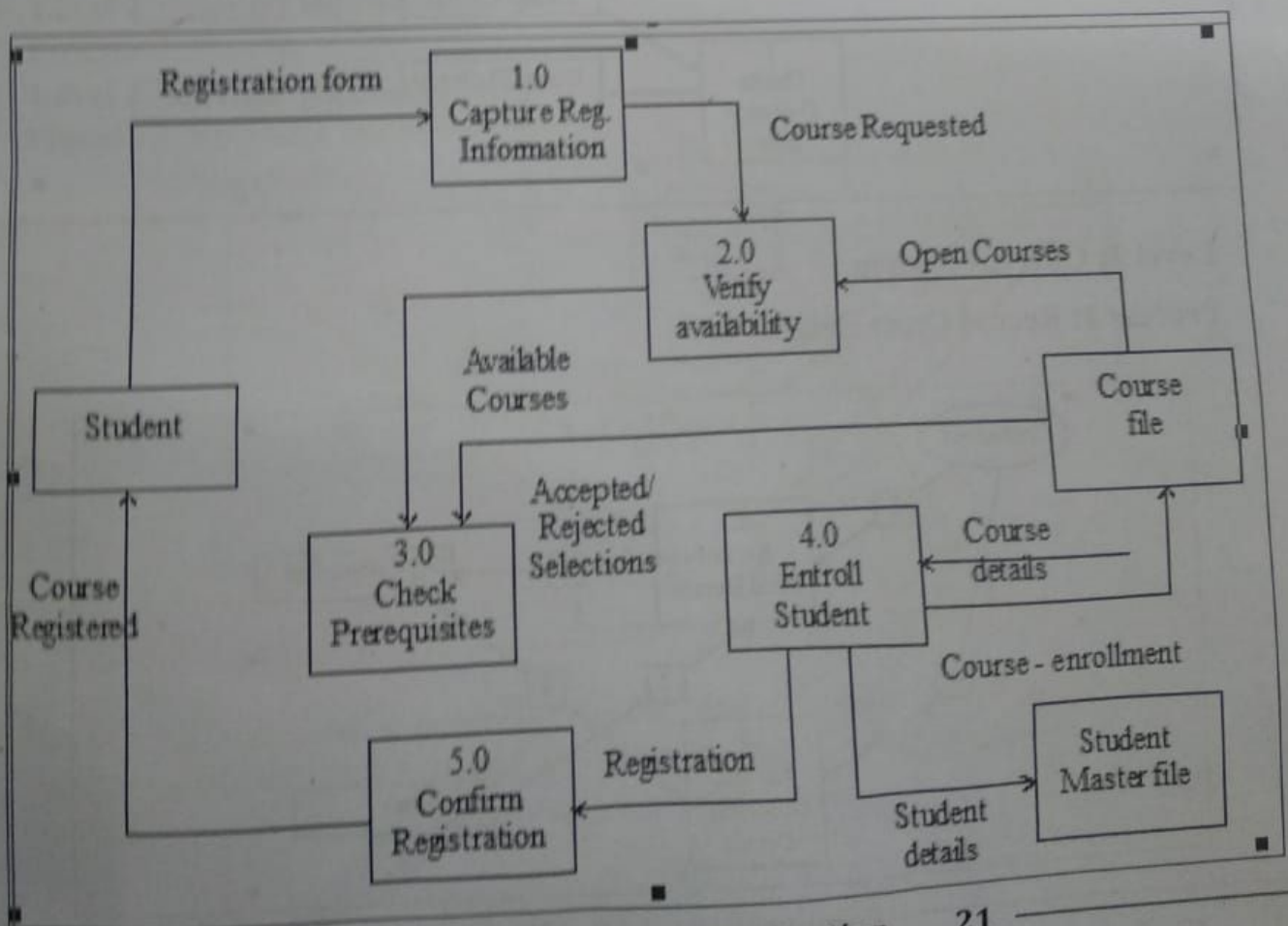


Example 2: Registration System

Context level Diagram:



Level 0 Diagram: Registration System



Exercises

1. Explain waterfall model.
2. When to use incremental model?
3. List out all fact finding techniques.
4. What is interview technologies and write down the advantage and disadvantages of it?
5. Describe different types of questionnaire.
6. Write down the advantages of spiral model over the waterfall model.
7. Write a short note on feasibility study.

Select proper options:

- (i) Which fact finding techniques can help to understand that how the current system is supposed to work?
- | | |
|---------------------|----------------|
| (a) Questionnaire | (b) interview |
| (c) Document review | (d) A & B both |
- (ii) Is a process that identifies describes and evaluates processed systems and select the best system for the job.
- | | |
|-----------------|-----------------------------|
| (a) Feasibility | (b) Questionnaire Designing |
| (c) Interview | (d) none of above |
- (iii) Which software model is referred as "Linear like cycle" model?
- | | |
|-----------------------|-------------------|
| (a) Waterfall model | (b) spiral model |
| (c) Incremental model | (d) none of above |

Ans:**1 - c,****2 - c,****3 - a**