UNIT:- I

Introduction to Software Engineering

* Software :-

Software is

(i) instruction (computer program) that when executed provid desired fun^c and perfomance.

(ii) Data structure that enables the program to manipulate information.

(iii) Documents that describe operation and view the program logically.

A/C to IEEE, software is a collection of computer programs, procedures, rules and associated documentation and data.

Types of S/W :-

Computer software is divided into 2 main categories which are:-

* System software : O.S, compiler, assembler etc
* Application software : word processor, etc.

classes of S/W :-

(i) Generic S/W

(ii) Customised S/W

(iii) Embedded S/W

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Characteristics of Software :-

The following are some of the characteristics of software :-

(i) Software is developed :- The software is ~~deve~~ developed but not manufactured because it depends on individual skills and creativity.

(ii) S/w does not wear out :- It does not suffer from any environment issues and does not deteriote with time.

(iii) Software construction is humen-intensive.

(iv) Software problems are usually complex.

(v) Software directly depends on Hardware.

(vi) Software has discontinuos operational nature.

Software Crisis :-

The crisis is defined as a turning point in the course of anything, on crucial time and event. The problem associated with software development are reffred to as software crisis.

In other words, software crisis is the set of difficulties encountred while developing software.

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Reason for software crisis :-

1) Increase in size and length of the software.
2) Increase in complexity of problem area.
3) Data analysis and collection is not done timely.
4) Duplication of efforts due to lack of automation.
5) change in user requirement increases the problem.
6) High software cost as compared to the hardware cost.

Possible solutions of software crisis :-

The software crisis can be prevented by adopting the following :-

1) The cost should not exceed the budget
2) The delivery of the software must be on time.
3) The requirement of customers must be met.
4) The software quality should should follow the ISO & CMM models.

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Difference between Program and a software :-

Program	software
• has limited functionality	More functionality
• Small in size	Large in size.
• Lacks proper documentation	Good documentation.
• Programs are developed by individuals for personal use	Usually for group of people by developers.

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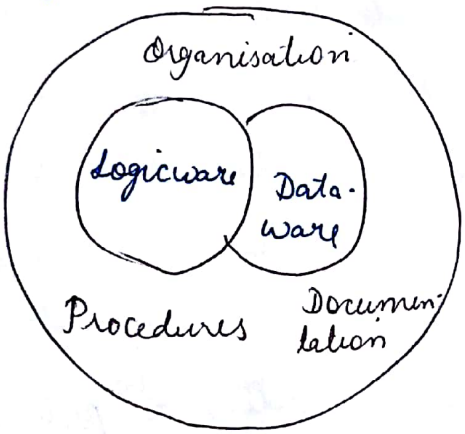
Software Components

1) Components of S/W

* Logicware :- It consist logical sequence of active instructions, controlling the execution sequence done by Hardware.

* Dataware :- the physical form in which all information, including logicware, appears to the H/W, which is further processed.



Software Contains :.

1) Set of programs
2) Documents — System design
   - Operating procedures.

Software Engineering :.

S/W Engineering is an engineering discipline that is concerned with all aspects of S/W production from early stages of System specification to maintaining the System after it has being used.

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S/w Engineering deals with engineering problems, opportunities and needs associated with the development & utilization of Software.

"A discipline whose aim is the production of quality software, software that is delivered on time, within budget, and that satisfies its requirements."

According to IEEE definition:

Software Engineering is the application of systematic, discipline, quantifiable approach for the development, operation and maintenance of software i.e the application of engineering to the software.

Software Process :-

The software process utilise a process to organise the execution of tasks to achieve the goals on the cost, schedule and quality.

A process model specifies a general purpose process, usually set of stages in project in which it is divided & the order in which the stages are executed.

It deals with the technical and management issues of software development is called 'Software Process'

The following are some of the characteristic of software process:-

1. Predictability :- It determines how accurately the outcome of process can be predicted.

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▲ Testability and Maintenance :-

Both testing and maintenance depend heavily on the quality of design and code so the important objective of S/W development should be to reduce maintenance effort.

▲ Early defect removal :-

Error detection and correction should be a continuous process and must be done in early phases.

▲ Process Improvement and feedback :-

To satisfy the quality of software, the processes must be improved with the help of proper feedback from different phases that are executing.

The following activities are common to all the processes:.

- S/W specification
- S/W development
- S/W Validation
- S/W Evolution.

Phases in Software Process :-

The software development is achieved in multiple iterations and covers the following phases

* Inception
* Elaboration
* Construction
* Transition.

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(i) Inception phase :- The idea of the development is perceived with understanding the requirements & describing the scope of project.

(ii) Elaboration phase :- It leads to elaboration of the risk involved in the process and product of the development.

(iii) Construction phase :- In this the technical methods are applied to implement the development and the software is implemented with programming language.

(iv) Transition phase :- It collects the feedback on the development from different sources & drafts the basis of next iteration.

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Software Quality

Software Quality is the degree of conformance to explicit or implicit requirements and expectations

It is also defined as degree to which a system, component meets specified requirements.

Customer:
solves problems at an acceptable cost & resources used

User:
easy to learn;
efficient to use;
helps get work done;

Developer:
- Easy to design
- Easy to maintain
- Easy to reuse.

Development manager:
Sells more & please customers while costing less

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Software Quality Attributes

The following are the most important attributes of software Quality.

Usability The higher the usability of software, the easier it is for users to work with it.

Efficiency The more efficient software is, the less it uses of CPU-time, memory, disk space, network bandwidth and other resources.

Reliability Software is more reliable if it has fewer failures. Designers can improve reliability by ensuring the software is easy to implement and change, by testing it thoroughly, and also by ensuring that if failures occur, the system can handle them or can recover easily.

Maintainability This is the ease with which you can change the software. Software that is more maintainable can result in reduced costs for both developers and customers.

Reusability A software component is reusable if it can be used in several different systems with little or no modification. High reusability can reduce the long term costs faced by the development team.

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* Software development life cycle :

The Software development life cycle (SDLC) is used to facilitate the development of large Software product in a systematic, well defined and cost effective way.

* SDLC is used to provide

(i) Enable planning of resources in advance.
(ii) Enforce a structured approach to the development.
(iii) Enable subsequent control of resources.
(iv) It helps to understand the whole process.

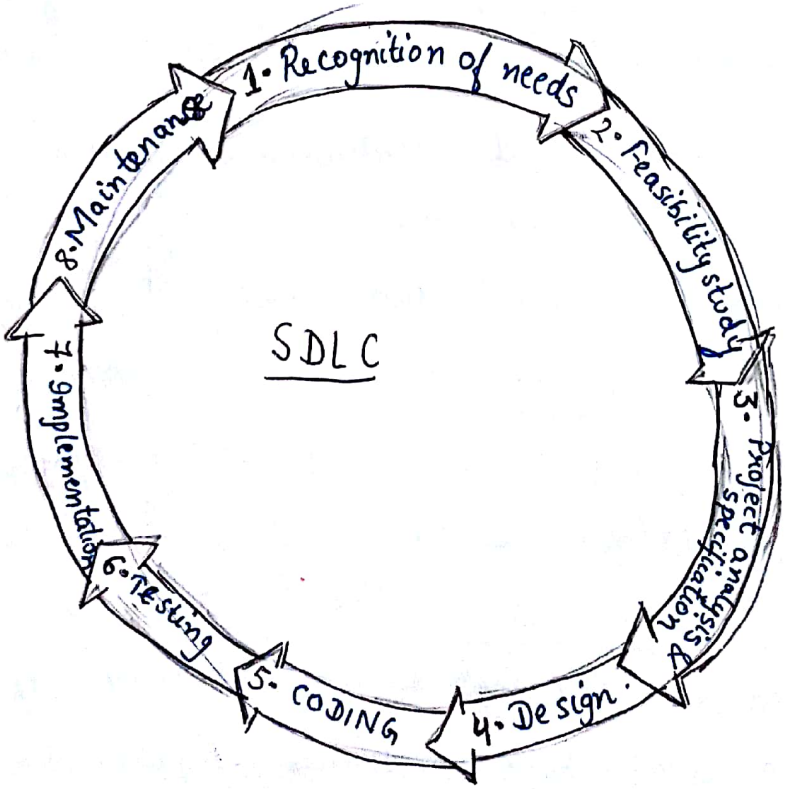

Figure : Software development life cycle.

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The software development life cycle can be divided into the following 8 phases as shown in the figure :-

① Project Initiation / Recognition of Needs :-

Recognition of need is nothing but simply problem statement. It is decision about problem in existing system. The first stage of any project or SDLC is called preliminary investigation.

It is also a brief investigation of system under investigation.

② Feasibility study :-

The main aim of feasibility study is to determine whether developing the project is financially & technically feasible. The feasibility study involves analysis of a problem and collection of data which would be input to the system.

The system is evaluated into 4 ways :-

(i) Organisational feasibility :-

It describes how well a proposed system supports the objectives of organisation.

(ii) Economical feasibility :-

It is concerned with whether expected cost saving, increased revenue, increased profit & other benefits will exceed the cost of developing & operating a proposed system.

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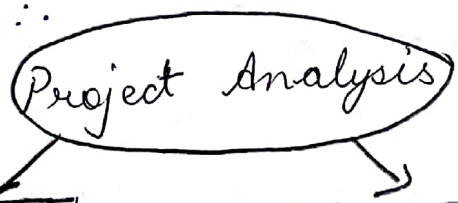
(iii) Technical feasibility :-
It can be demonstrated if the reliable H/w & S/w are capable of meeting the needs of proposed system.

(iv) Operational feasibility :-
It is the willingness and ability of the management, employees, customers and others to operate, use and support a proposed system.

③ Project analysis (Rqmt & Specification)

The aim of requirement analysis and specification phase is to understand the exact requirement of the customer and to document them properly. This phase consists of two distinct activities :-



Requirement Analysis

- It starts with coll^{n} of all relevant data regarding the product from user through interviews & discussions

Requirement specification

- During this the requirement are properly organised & documented in SRS document.

④ System Design :-

This phase is most creative and challenging phase of system development procedure.

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The term design describes final system and process by which it is developed. The main goal is to transform analysed data and SRS into implementation form.

(5) Coding Phase :-

The purpose of this phase of S/W design is to translate the design of system into code with a programming language. Well written code can reduce testing and maintenance effort.

(6) Testing phase :-

The goal of testing is to uncover requirement, design and coding error in a program

Testing is extremely critical & time consuming activity. It requires proper planning of overal testing process. Each test report contains the set of test cases and the result for executing the code with these test cases.

(7) Implementation :-

Once the system is designed, it is ready for implementation. It includes the final testing of Computer system to user satisfaction & supervision of initial operation of system.

(8) Maintenance Phase :-

If any error is found, then changes and corrections must be done and it is done in this phase.

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Software development process Models :-

A software life cycle model is either a descriptive or prescriptive characterization of how a software is or should be developed.

Each process model follows a particular life cycle in order to ensure success in process of software development.

The various models are :-

- Waterfall model
- Prototype model
- Spiral Model
- Evolutionary Development model
- Iterative Enhancement model.

* WATERFALL MODEL :-

The waterfall life cycle model was originally proposed by 'Winston Royce' in 1970.

In waterfall model, software development is split up into a number of independent steps. And these steps are carried out in sequence. Each step produces product which is input to next stage. For example, all the coding is completed before testing.

When to use ?

- Requirements are very well known.
- Technology is stable.
- New version of existing product.
- Porting an existing product to new platform.

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Different phases of Waterfal Model :-

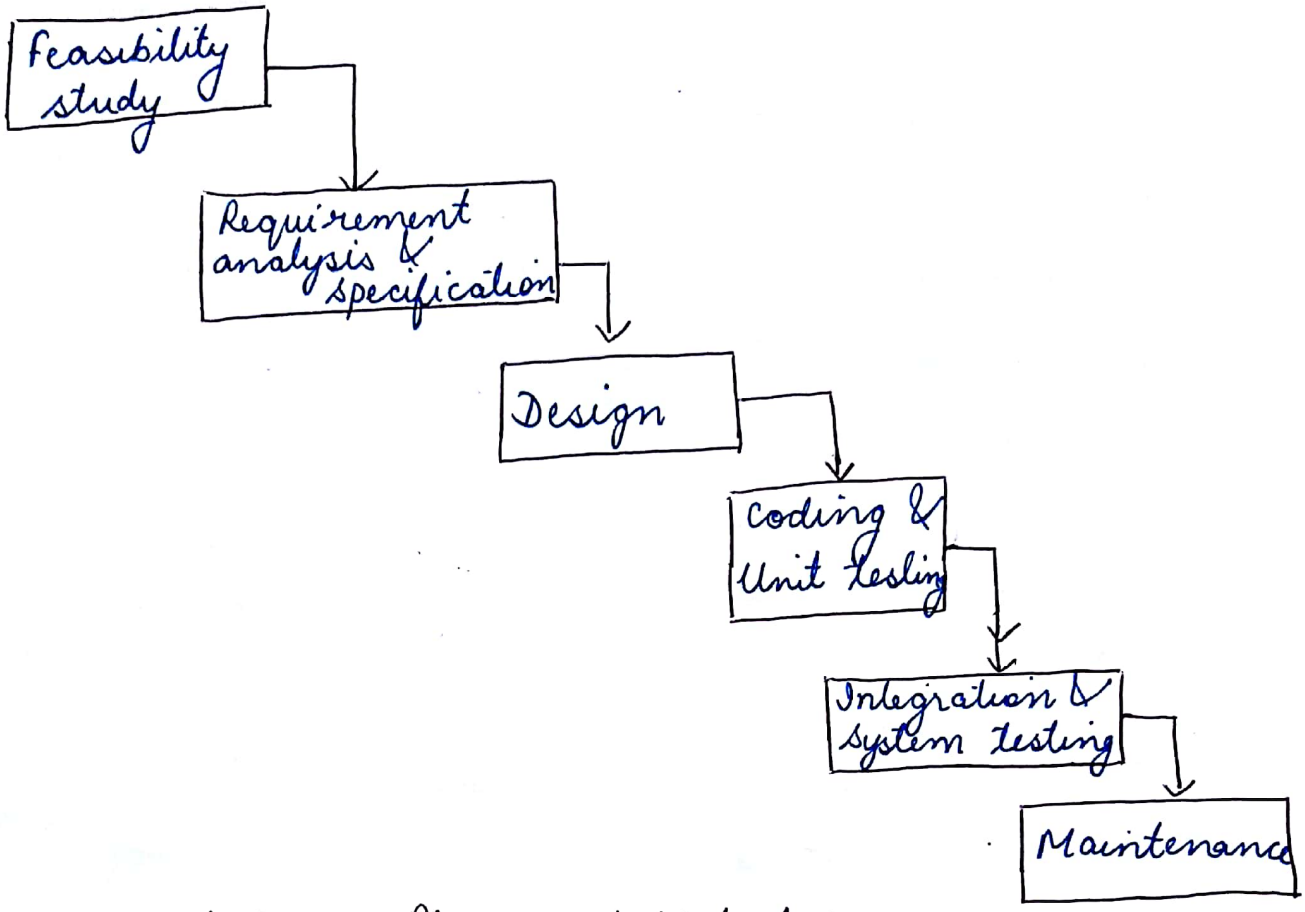

Figure :- Phases of Waterfall model.

The following are the phases of Waterfall model :.

(i) Feasibility study :- The main aim of feasibility study is to determine whether it would be financially & technically feasible to develop the product.

(ii) Requirement analysis & specification :.

In this phase the requirement are gathered from the end-user, these requirement are then analysed for their validity. and then the user requirements are systematically organised into a Software Requirement Specification (SRS) document.

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(iii) Design :-

The design phase is used to transform the requirement specified in the SRS into a structure that can be implemented in some programming language. The two approaches available are :-

- Traditional design approach :-
  In this structured analysis of rqmt specification is carried out. and this is followed by structured design.
- Object-Oriented design approach :-
  This approach is based on identifying the various objects in problem & solution domain, and also the relationship among them which is helpful to obtain the detailed design.

(iv) Coding and Unit testing :-

In unit testing each module is tested in isolation to determine the correct working of all individual modules. The system's design documents are divided into Units and then actual coding is started.

(v) Integration and system testing :-

During the integration & system testing phase modules are integrated in a planned manner. The ck-testing of integrated modules is done to check if all the modules coordinate between each other and the developed system conforms to its requirement specified in SRS document.

α testing :- Performed by development team

β testing :- performed by customers.

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(vi) Maintenance :-

Errors may occur when the system is developed and diployed. These problems arise time to time and needs to be solved and this process is referred as 'Maintenance'.

Types of Maintenance :-

- Corrective Maintenance :- Correcting errors that were not discovered during the product development phase.
- Adaptive Maintenance :- It means changing the program function. This is done to adapt to current trend of technology.
- Perfective Maintenance :- means enhancing the performance, modifying the programs to respond to users changing needs.
- Preventive Maintenance :- is the process by which we prevent our system from being in failure state due to errors & changes.

Advantages of Waterfall Model :-

1) Easy to understand
2) clear project objective
3) It is a linear model
4) It is systematic and has proper documentation
5) Helps to plan & schedule the project.

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Disadvantages of Waterfall Model :-

(i) Difficult to refine all requirements explicitly

(ii) This model is not suitable for accomodating any change.

(iii) It involves heavy documentations if project is large.

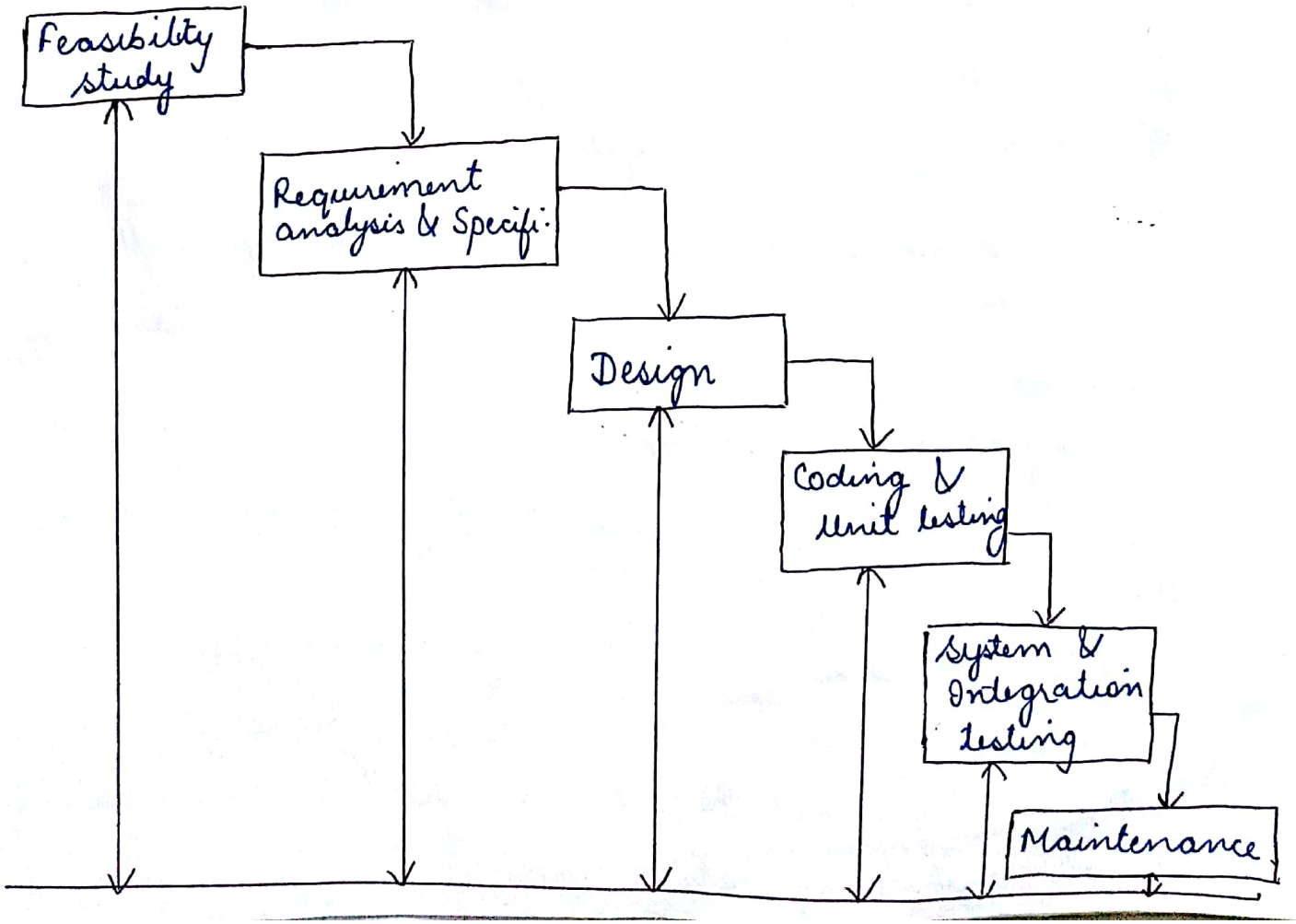
(iv) Customer gets opportunity very late to review so less user involvement.

(v) Iteration not possible as it is one-way.

(vi) There is no risk analysis.

Modified Waterfall Model :-

The modified Model is shown below:.



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The following are the major extensions in this model over classical model.

(i) In any S/W development work it is not possible to strictly follow classical model.

Feedback paths are needed from every phase to preceding phase.

(ii) Provision for verification & validation of phase output in software life cycle are added.

(iii) It helps to handle the risk associated with a phase and helps to achieve better efficiency and higher productivity.

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Prototype Model :-

- The design goal of this model is to first develop working prototype of S/W instead of developing the actual S/W.
- Developers use this prototype to refine the requirements and prepare the final specification document.
- when the prototype is created it is received by customer, this review gives feedback to developer that helps to remove uncertainties.
- The prototyping model suggest that before development of actual S/W, a working prototype should be developed to illustrate the Input data, formats reports, initial gathering of data.

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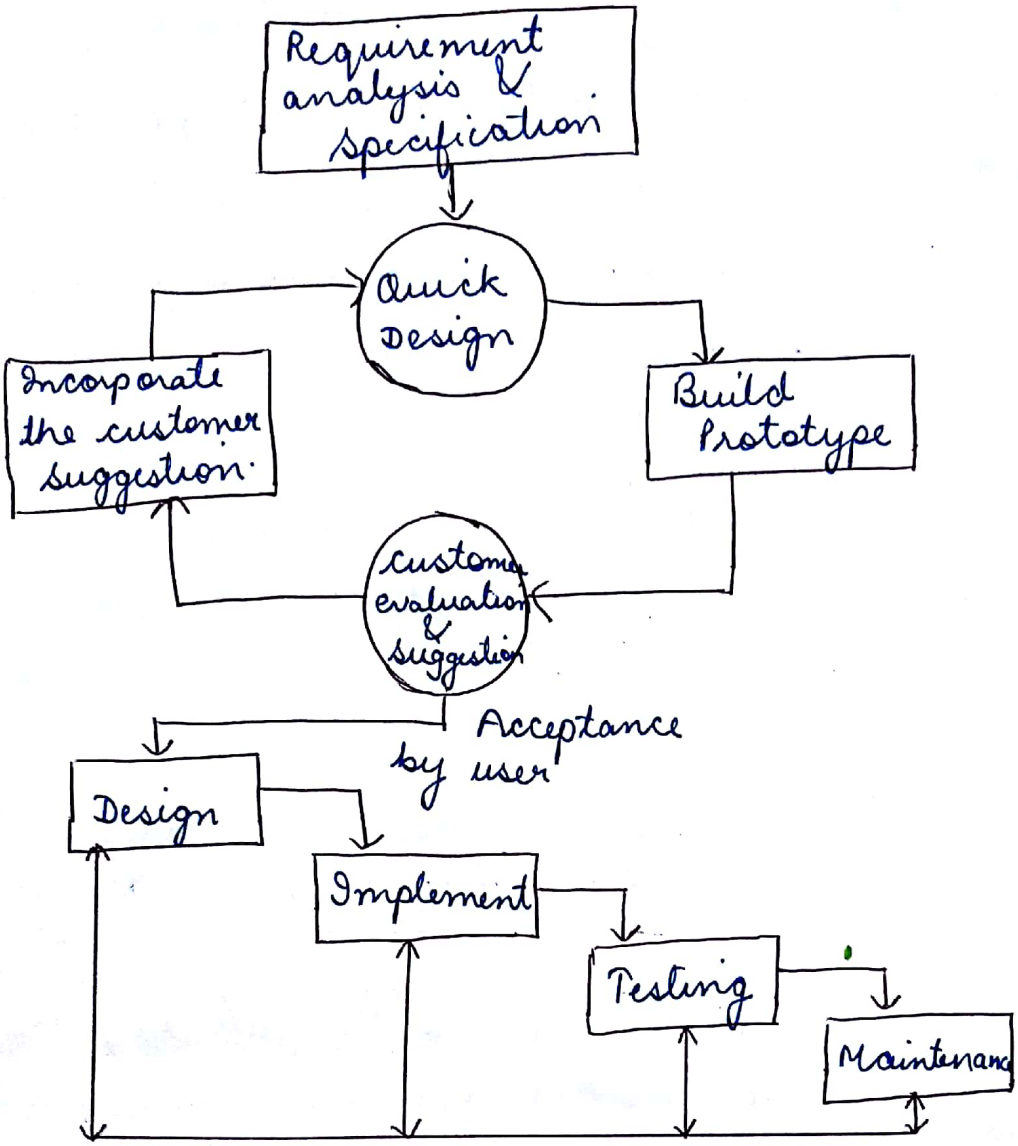

Steps of Prototyping Model :-

STEP 1 :- Identify the User's Basic requirements

In this step the user's Basic requirements are analysed and understood like user expectations, cost of developing the working prototype.

STEP 2 :- Develop the initial prototype :-

The System person develop a interactive prototype quickly which meets the users basic requirements, with the help of latest tools & technology.

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STEP 3 :- Use the prototype for further requirements

In this the protype enables the users to determine as to what extent the prototype meets the users needs/expectation, and if some changes are required, then it can be easily incorporated.

STEP 4 :- Revise and Enhance Prototype :-

The system person takes the due notice of the changes suggested by user and then revises, enhances the prototype accordingly.

Types of Prototyping :-

The two major types of prototyping are 'throwaway' and 'Evolutionary'

Difference between these both will help to explain what these models are actually used.

Throwaway Prototype

* It is developed from an outline of specification
* Its objective is to understand the customer's requirement & hence develop better requirement definition.
* With this a small part of system is developed & then given to customers & end users

Evolutionary

* It is built from ~~an outline~~ of basic requirements gathered from end-users.
* Its objective is to work with customer to explore their requirements & deliver a final system.
* It is a life cycle model in which the system is developed in increments so that it can readily be modified (Robust & constantly refined)

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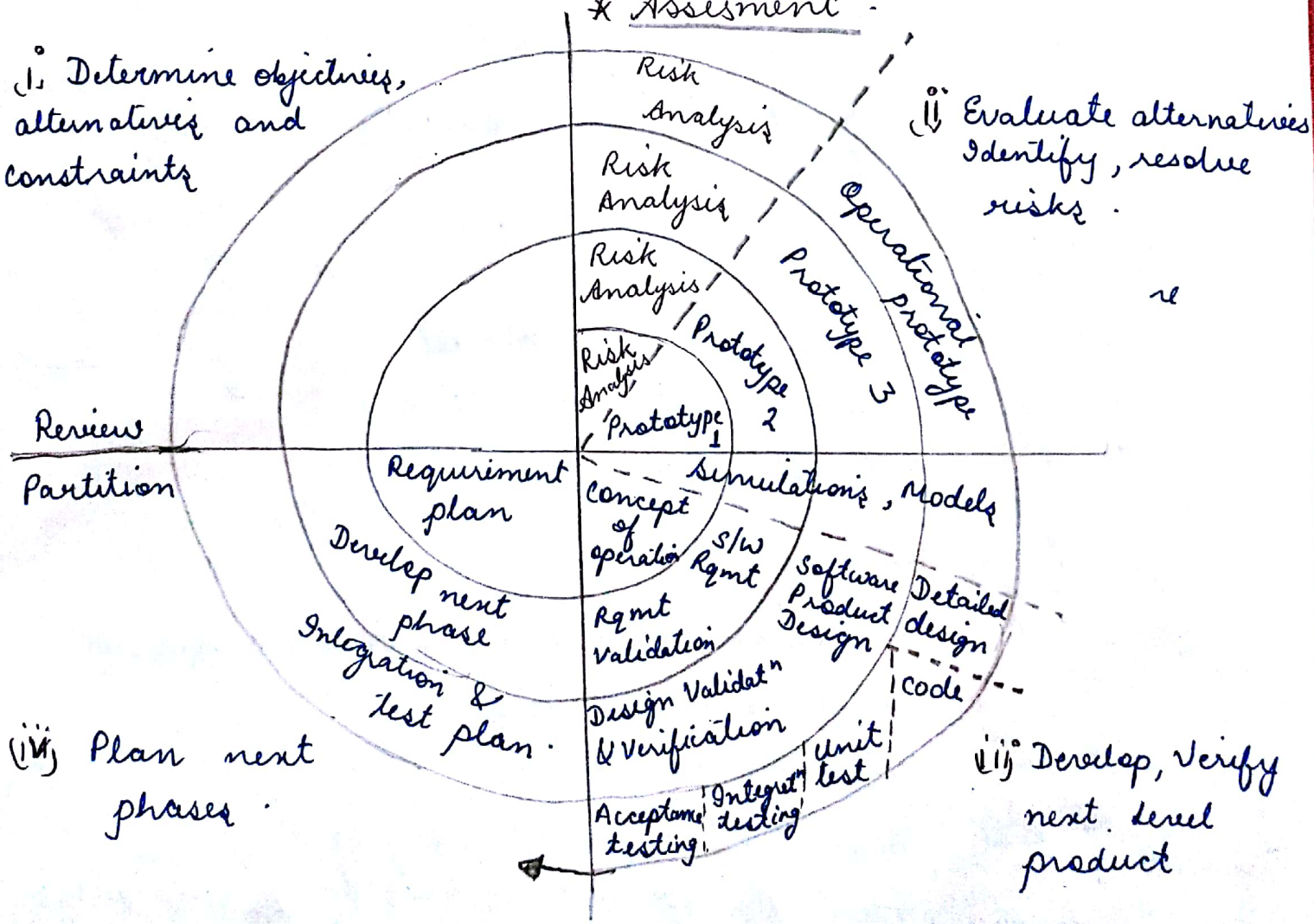
Spiral Model :-

In 1987, Barry Boehm proposed a model for software development. Most of the important software projects failed due to project risk This model was developed and he tried to incorporate project risk factor into lifecycle model.

The spiral model is a evolutionary process model and each phase is split into following activities

* Planning
* Risk Analysis
* Development
* Assesment.



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One phase is roughly split into four sectors of major activities:-

1. Objective Setting (1st quadrant)
   - Identify the objectives of the phase
   - Examine the risk associated.
2. Risk Assesment & Reduction
   - Detailed Analysis is carried out for each identified project risk.
   - Steps are taken to reduce risks.
3. Development & Validation:
   - After resolving the identified risks, the next level of product is developed & validated.
4. Review and Planning.

   Review the results with customer & plan the next iteration.

Advantages:-

- It is a risk driven Model
- Less documentation is needed
- It uses prototyping.

Limitation:-

- No particular beginning or ending, spiral may continue indefinitely
- The model is complex.
- Risk Assesment Expertise may be required.
- Time spent for evaluating risk for small project is large.

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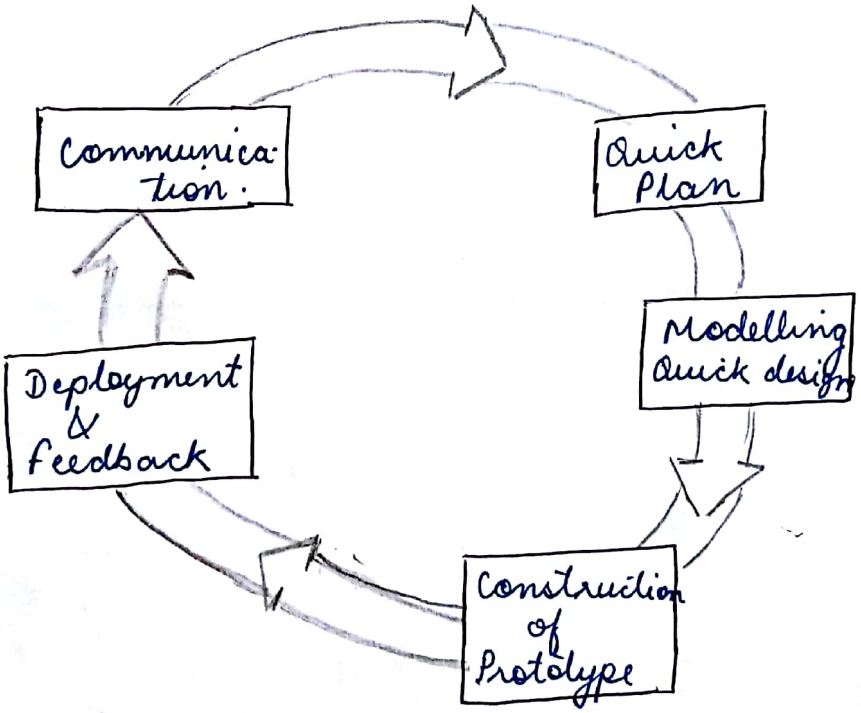
Evolutionary Software Process Model :-

The evolutionary models takes the concept of evolution in software Paradigm. These are built in such a way that enables softwares engineers to develop more complex versions.

An evolutionary approach to development integrates specifications, design & implementation. And in this the customer is also involved in the development process.

The stages in evolutionary process are :-



(i) Formulate an outline of the system requirements

(ii) Develop a system as rapidly as possible, based on this outline specification.

(iii) Evaluate this systems with users and modify the systems functionality untill it meets the requirements.

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Types of Evolutionary development :-

(i) Exploratory development

(ii) Throwaway prototyping

Exploratory development :-

In this type, the development is started from the requirements, and we produce an initial version that fulfills the requirements.

Exploratory development is used to work with customer, to explore requirements & development of final version.

Throwaway prototyping :-

In this, the purpose of development is to understand the requirement and develop better requirement definition. Company creates a prototype based on vague requirements and customer checks it and develops new prototype based on these new requirements.

Problems in Evolutionary development :-

- It is not easy to develop documentation for each prototype as they are created so rapidly.
- Due to continual change in software coding, structure of S/W becomes so poor.

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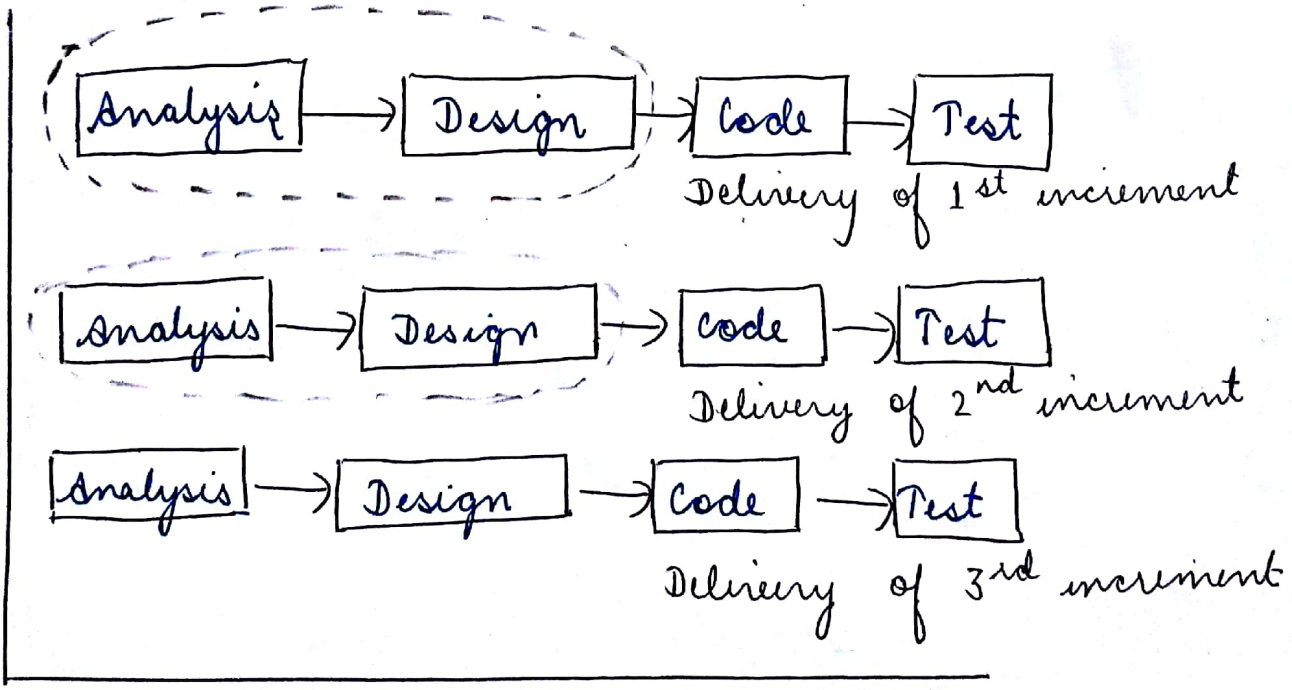
Iterative Enhancement Models :-

Iterative model is developed to overcome the drawback of waterfall model that is once the requirements are specified they can not be change in any other phase.

In this model s/w is developed in increments where each increment adds some functional capability. A partial product is developed on few understandable requirements of overall requirements, then a project control list is made that contains the entire task. This helps in finding out how much product is developed. This product is given to user to work and slowly enhancing functionalities

That's why it is called Iterative Enhancement model.



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Advantages :-

- Testing is done after each increment.
- Product delivered in parts so cost is also distributed
- Low failure risk.
- Development of next phase and evolution of partial product can be done simultaneously.

Disadvantages :-

- Total cost of development is high.
- Well defined project planning is required.
- Testing each model causes extra cost.

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