

Unit 1 Notes

Software is a program or set of programs containing instructions that provide desired functionality.

Engineering is the process of designing and building something that serves a particular purpose and finds a cost-effective solution to problems.

Importance of software

Software not only makes your computer hardware perform important tasks, but can also help your business work more efficiently.

Software Engineering is the process of designing, developing, testing, and maintaining software. It is a systematic and disciplined approach to software development that aims to create high-quality, reliable, and maintainable software.

Need of engineering aspects of software design

- **Efficiency:** Resources should be used efficiently by the program.
- **Flexibility:** Able to modify on changing needs.
- **Consistency:** There should not be any inconsistency in the design.
- **Maintainability:** The design should be so simple so that it can be easily maintainable by other designers.

Software Processes

The term **software** specifies to the set of computer programs, procedures and associated documents (Flowcharts, manuals, etc.) that describe the program and how they are to be used.

A software process is the set of activities and associated outcome that produce a software product. Software engineers mostly carry out these activities. These are four key process activities, which are common to all software processes. These activities are:

1. **Software specifications:** The functionality of the software and constraints on its operation must be defined.
2. **Software development:** The software to meet the requirement must be produced.
3. **Software validation:** The software must be validated to ensure that it does what the customer wants.
4. **Software evolution:** The software must evolve to meet changing client needs.

Software Crisis

1. **Size:** Software is becoming more expensive and more complex with the growing complexity and expectation out of software. For example, the code in the consumer product is doubling every couple of years.
2. **Quality:** Many software products have poor quality, i.e., the software products defects after putting into use due to ineffective testing technique. For example, Software testing typically finds 25 errors per 1000 lines of code.
3. **Cost:** Software development is costly i.e. in terms of time taken to develop and the money involved. For example, Development of the FAA's Advanced Automation System cost over \$700 per lines of code.
4. **Delayed Delivery:** Serious schedule overruns are common. Very often the software takes longer than the estimated time to develop, which in turn leads to cost shooting up. For example, one in four large-scale development projects is never completed.

Software Development Life Cycle (SDLC)

A software life cycle model (also termed process model) is a pictorial and diagrammatic representation of the software life cycle. A life cycle model represents all the methods required to make a software product transit through its life cycle stages.

Need of SDLC

The development team must determine a suitable life cycle model for a particular plan and then observe to it.

Without using an exact life cycle model, the development of a software product would not be in a systematic and disciplined manner. When a team is developing a software product, there must be a clear understanding among team representative about when and what to do. Otherwise, it would point to chaos and project failure.

The stages of SDLC are as follows:

Stage1: Planning and requirement analysis

Business analyst and Project organizer set up a meeting with the client to gather all the data like what the customer wants to build, who will be the end user, what is the objective of the product. Before creating a product, a core understanding or knowledge of the product is very necessary.

For Example, A client wants to have an application which concerns money transactions. In this method, the requirement has to be precise like what kind of operations will be done, how it will be done, in which currency it will be done, etc.

Stage2: Defining Requirements

This is accomplished through "SRS"- Software Requirement Specification document which contains all the product requirements to be constructed and developed during the project life cycle.

Stage3: Designing the Software

The next phase is about to bring down all the knowledge of requirements, analysis, and design of the software project. This phase is the product of the last two, like inputs from the customer and requirement gathering.

Stage4: Developing the project

In this phase of SDLC, the actual development begins, and the programming is built. The implementation of design begins concerning writing code. Developers have to follow the coding guidelines described by their management and programming tools like compilers, interpreters, debuggers, etc. are used to develop and implement the code.

Stage5: Testing

After the code is generated, it is tested against the requirements to make sure that the products are solving the needs addressed and gathered during the requirements stage.

During this stage, unit testing, integration testing, system testing, acceptance testing are done.

Stage6: Deployment

Once the software is certified, and no bugs or errors are stated, then it is deployed.

Then based on the assessment, the software may be released as it is or with suggested enhancement in the object segment.

After the software is deployed, then its maintenance begins.

Stage7: Maintenance

Once when the client starts using the developed systems, then the real issues come up and requirements to be solved from time to time.

This procedure where the care is taken for the developed product is known as maintenance.

SDLC Models

Software Development life cycle (SDLC) is a spiritual model used in project management that defines the stages include in an information system development project, from an initial feasibility study to the maintenance of the completed application.

Waterfall model

Winston Royce introduced the Waterfall Model in 1970. This model has five phases: Requirements analysis and specification, design, implementation, and unit testing, integration and system testing, and operation and maintenance. The steps always follow in this order and do not overlap. The developer must complete every phase before the next phase begins. This model is named "**Waterfall Model**", because its diagrammatic representation resembles a cascade of waterfalls.

When to use SDLC Waterfall Model?

Some Circumstances where the use of the Waterfall model is most suited are:

- When the requirements are constant and not changed regularly.

- A project is short
- The situation is calm
- Where the tools and technology used is consistent and is not changing
- When resources are well prepared and are available to use.

Advantages of Waterfall model

- This model is simple to implement also the number of resources that are required for it is minimal.
- The requirements are simple and explicitly declared; they remain unchanged during the entire project development.
- The start and end points for each phase is fixed, which makes it easy to cover progress.
- The release date for the complete product, as well as its final cost, can be determined before development.
- It gives easy to control and clarity for the customer due to a strict reporting system.

Disadvantages of Waterfall model

- In this model, the risk factor is higher, so this model is not suitable for more significant and complex projects.
- This model cannot accept the changes in requirements during development.
- It becomes tough to go back to the phase. For example, if the application has now shifted to the coding phase, and there is a change in requirement, It becomes tough to go back and change it.
- Since the testing done at a later stage, it does not allow identifying the challenges and risks in the earlier phase, so the risk reduction strategy is difficult to prepare.

Prototype Model

The prototype model requires that before carrying out the development of actual software, a working prototype of the system should be built.

Steps of Prototype Model

1. Requirement Gathering and Analyst
2. Quick Decision
3. Build a Prototype
4. Assessment or User Evaluation
5. Prototype Refinement
6. Engineer Product

Advantage of Prototype Model

1. Reduce the risk of incorrect user requirement
2. Good where requirement are changing/uncommitted
3. Regular visible process aids management
4. Support early product marketing
5. Reduce Maintenance cost.

6. Errors can be detected much earlier as the system is made side by side.

Disadvantage of Prototype Model

1. An unstable/badly implemented prototype often becomes the final product.
2. Require extensive customer collaboration
 - o Costs customer money
 - o Needs committed customer
 - o Difficult to finish if customer withdraw
 - o May be too customer specific, no broad market
3. Difficult to know how long the project will last.
4. Easy to fall back into the code and fix without proper requirement analysis, design, customer evaluation, and feedback.
5. Prototyping tools are expensive.
6. Special tools & techniques are required to build a prototype.
7. It is a time-consuming process.

Spiral Model

The spiral model, initially proposed by Boehm, is an evolutionary software process model that couples the iterative feature of prototyping with the controlled and systematic aspects of the linear sequential model.

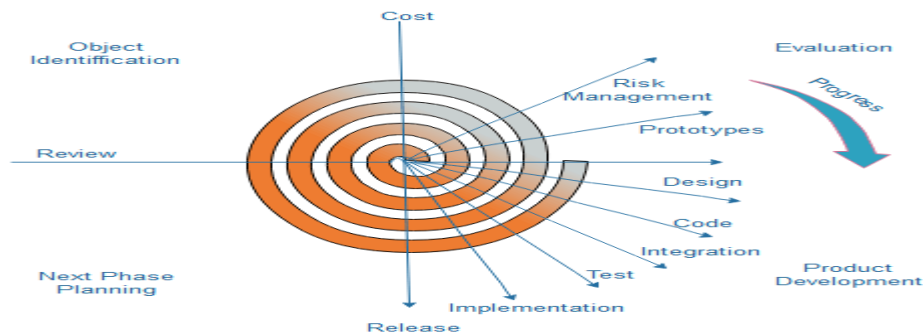


Fig. Spiral Model

Each cycle in the spiral is divided into four parts:

Objective setting: Each cycle in the spiral starts with the identification of purpose for that cycle, the various alternatives that are possible for achieving the targets, and the constraints that exists.

Risk Assessment and reduction: The next phase in the cycle is to calculate these various alternatives based on the goals and constraints. The focus of evaluation in this stage is located on the risk perception for the project.

Development and validation: The next phase is to develop strategies that resolve uncertainties and risks. This process may include activities such as benchmarking, simulation, and prototyping.

Planning: Finally, the next step is planned. The project is reviewed, and a choice made whether to continue with a further period of the spiral. If it is determined to keep, plans are drawn up for the next step of the project.

When to use Spiral Model?

- When deliverance is required to be frequent.
- When the project is large
- When requirements are unclear and complex
- When changes may require at any time
- Large and high budget projects

Advantages

- High amount of risk analysis
- Useful for large and mission-critical projects.

Disadvantages

- Can be a costly model to use.
- Risk analysis needed highly particular expertise
- Doesn't work well for smaller projects.

Iterative Model

In this Model, you can start with some of the software specifications and develop the first version of the software. After the first version if there is a need to change the software, then a new version of the software is created with a new iteration. Every release of the Iterative Model finishes in an exact and fixed period that is called iteration.

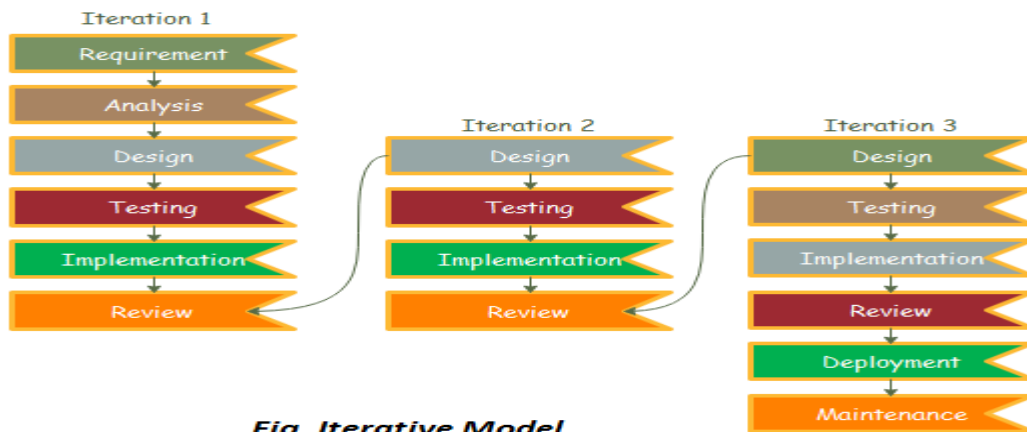


Fig. Iterative Model

The various phases of Iterative model are as follows:

- 1. Requirement gathering & analysis:** In this phase, requirements are gathered from customers and check by an analyst whether requirements will fulfil or not. Analyst checks that need will achieve within budget or not. After all of this, the software team skips to the next phase.
- 2. Design:** In the design phase, team design the software by the different diagrams like Data Flow diagram, activity diagram, class diagram, state transition diagram, etc.
- 3. Implementation:** In the implementation, requirements are written in the coding language and transformed into computer programmes which are called Software.
- 4. Testing:** After completing the coding phase, software testing starts using different test methods. There are many test methods, but the most common are white box, black box, and grey box test methods.
- 5. Deployment:** After completing all the phases, software is deployed to its work environment.

6. Review: In this phase, after the product deployment, review phase is performed to check the behaviour and validity of the developed product. And if there are any error found then the process starts again from the requirement gathering.

7. Maintenance: In the maintenance phase, after deployment of the software in the working environment there may be some bugs, some errors or new updates are required. Maintenance involves debugging and new addition options.

When to use the Iterative Model?

1. When requirements are defined clearly and easy to understand.
2. When the software application is large.
3. When there is a requirement of changes in future.

Advantage(Pros) of Iterative Model:

1. Testing and debugging during smaller iteration is easy.
2. A Parallel development can plan.
3. It is easily acceptable to ever-changing needs of the project.
4. Risks are identified and resolved during iteration.

Disadvantage(Cons) of Iterative Model:

1. It is not suitable for smaller projects.
2. More Resources may be required.
3. Design can be changed again and again because of imperfect requirements.
4. Requirement changes can cause over budget.
5. Project completion date not confirmed because of changing requirements.

Evolutionary Process Model

Evolutionary process model resembles the iterative enhancement model. The same phases are defined for the waterfall model occurs here in a cyclical fashion. This model differs from the iterative enhancement model in the sense that this does not require a useful product at the end of each cycle. In evolutionary development, requirements are implemented by category rather than by priority.

For example, in a simple database application, one cycle might implement the graphical user Interface (GUI), another file manipulation, another queries and another updates. All four cycles must complete before there is a working product available. GUI allows the users to interact with the system, file manipulation allow the data to be saved and retrieved, queries allow user to get out of the system, and updates allows users to put data into the system.

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