A Comparative Study of Different types of Models in Software Development Life Cycle

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*Abstract—*Software engineering approach is used to develop software. It defines the application of engineering to design, development and maintenance of software. It deal with the software management processes that examine the area of software development through the development models, which are known as software development life cycle. It represents four of the development models namely, waterfall model, v-shaped model, prototyping model and spiral model. These models have some advantages and disadvantages as well. Therefore, main objectives of this research is to represents different models of software development and make a comparison between and focuses on security activities involve in developing secure software's.

I. INTRODUCTION

A software development process, also known as a software development life cycle (SDLC), is a structure imposed on the development of a software product. t. It is often considered as a subset of system development life cycle. There are several models for such processes, each describing approaches to a variety of activities that take place during the process. The System Development Life Cycle framework provides a sequence of activities for system designers and developers to follow. It consists of a set of steps or phases in which each phase of the SDLC uses the results of the previous one. A Systems Development Life Cycle (SDLC) adheres to important phases that are essential for developers, such as planning, analysis, design, and implementation, integration and testing, deployment and maintenance. In history various models were proposed. Software development life cycle model have some strength and weakness as shown in table 1.

Table. 1: A comparison of the strengths and weaknesses of SDLC:

Strength and Weaknesses of SDLC	
Strengths	**Weaknesses**
Control.	Increased development time.
Monitor Large projects.	Increased development cost.
Detailed steps.	Systems must be defined up front.
Evaluate costs and completion targets.	Rigidity.
Documentation.	Hard to estimate costs, project overruns.
Well defined user input.	User input is sometimes limited.

II. SOFTWARE PROCESS MODELS ARE

– Waterfall model,
– Iterative model,
– Prototype model,
– Rapid application development model (RAD).,
– Evolutionary development,
– Incremental model,
– V-shaped model,
– Spiral model,
– Agile model.

In this paper we describe four types of models i) waterfall model ii)v-shaped model iii) prototyping model iv) spiral model.

A. Waterfall Model:

The Waterfall model is a conventional, linear, sequential or traditional waterfall software life cycle model. It is a sequential development approach, in which development is seen as flowing steadily downwards through the phases of requirements analysis, design, implementation, testing (validation), integration, and maintenance.

It formed the basis for most software development standards and consists of the following phases:

-Requirement gathering and analysis: It is the first phase of software life cycle. The Aim of this phase to Understand the exact requirements of the customer, Document them properly. The goal of requirement analysis Collect all related data from the customer and analyse the collected data to clearly understand what customer wants.

System design: after Requirement gathering and analysis system design is to done. System design helps in specifying hardware and system requirement and also helps in defining overall system architecture.

-Implementation: Purpose of implementation phase (aka coding and unit testing phase) Translate software design into source code. During the implementation phase each module of the design is coded.

Integration and testing: All the units developed in the implementation phase are integrated into system after testing of each unit. Post integration the entire system is tested for any faults and failures.

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:Maintenance of any software product which requires much more effort than the effort to develop the product itself.
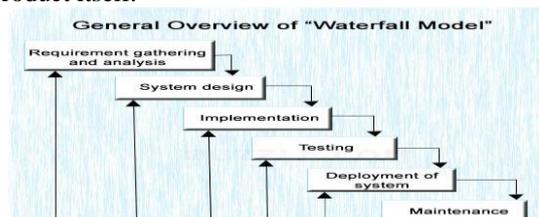

Fig. 1:

1) Waterfall Model Application:
– Product definition is stable.
– Requirement is very well known, clear and fixed.
– Technology is understood and is not dynamic.
– There are no ambiguous requirements.
– The project is short.

2) Advantages And Disadvantages:

Table. 2: Advantages and disadvantages of waterfall model.

Waterfall Model	
Advantages	**Disadvantages**
Simple and easy to understand and use.	Once an application is in the testing stage, it is very difficult to go back and change something.
Easy to manage due to rigidity of the model.	No working software is produced during until late during life cycle.
Phases are processed and completed one at a time.	High amount of risk and uncertainty.
Work well for smaller projects where requirement are clear	Not a good model for complex and objects oriented projects

B. V-Shaped Model:

V-shaped model means verification and validation model. It is just like waterfall model means it is an extension of waterfall model and is based on association of a testing phase for each corresponding development stage. The v-shaped life cycle is a sequential path of execution of processes. Each phase must be completed before the next phase begins. Testing of the product is planned in parallel with a corresponding phase is developed.
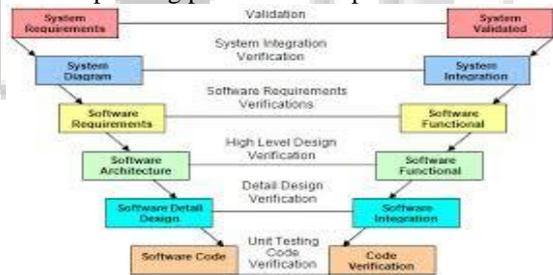

Fig. 2:

1) V-Shaped Model Application:

This model is used in the medical development field, as it is strictly disciplined domain. Following are the suitable scenarios to use V-shaped model:
– V-shaped model should be used for small to medium size project, where requirement are clearly defined and fixed.
– Product definition is stable.
– Technology is not dynamic and is well understood by the project team.

2) Advantages And Disadvantages:
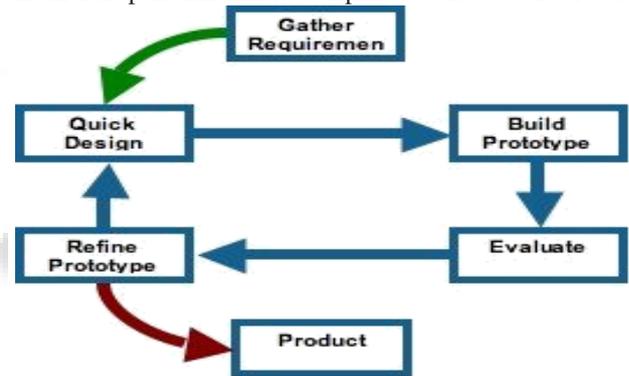
Table. 3: Advantages and disadvantages of v-shaped model

V-SHAPED	
Advantages	**Disadvantages**
Simple and easy to use.	Very rigid like waterfall model.
Each phase has specific deliverables	Little flexibility and adjusting scope is difficult and expensive.

Higher chance of success over the waterfall model due to the early development of test plans during the life cycle.	Software is developed during the implementation phase, so no early prototypes of the software are produced.
Works well for small projects where requirements are early understood.	This model does not provide a clear path for problems found during testing phase.

C. Prototyping model:

Prototyping model is concerns to the activity of creating prototypes of software applications, i.e., incomplete versions of the software program being developed. It is an activity that can occur in software development and is comparable to prototyping as known from other fields, such as mechanical engineering or manufacturing. Prototyping model is a toy implementation of system .It is start with approximate requirements and carries out a quick design.Prototype model is built using several short-cuts.

Short-cuts might involve using inefficient, inaccurate, or dummy functions. Prototyping model is used when requirement is not clear. A prototyping usually turns out to be very crude version of actual system, possibly exhibiting limited functional capabilities, low reliability and inefficient performance as compared to the actual software.

1) Prototyping Model Application:
– It is used for learning like answering question about performance or feasibility e.g. proof of concept model
– Used for communication like demonstration of product for feedback

2) Advantages And Disadvantages:

Table. 4: Advantages and disadvantages of prototyping model

Prototyping model	
advantages	**disadvantages**
Enables a higher output for user	Possibility of implementing systems before they are ready
Cost effective (Development costs reduced).	Producer might produce a system inadequate for verall organization needs.
Increases system development speed.	Often lack flexibility.
Assists to identify any problems with the efficacy of earlier design, requirements analysis and coding activities	Not suitable for large applications.

D. Spiral Model

Spiral model combines characteristics of both prototype and waterfall process model. The spiral model is a software development process combining elements of both design and prototyping-in-stages, in an effort to combine advantages of top-down and bottom up concepts. It is a meta-model, a model that can be used by other models.

Spiral model is used for development of large, complicated and expensive projects like scientific Projects .Since spiral model approach enable the project term to address the highest risk at the lowest total cost. A new model based on spiral model and its risk perception, has been proposed and named as multilevel security spiral (MSS).the main focus of security risks and managing those risks. Each trip around the spiral traverses four basic quadrants: (1) determine objectives, alternatives, and constraints of the iteration; (2) evaluate alternatives; Identify and resolve risks; (3) develop and verify deliverables from the iteration; and (4) plan the next iteration.
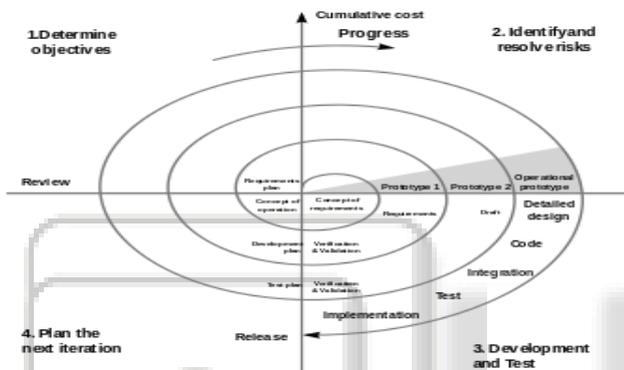

Fig. 3:

1) Spiral Model Application:

− For medium to high –risk projects
− Customer is not sure of their requirements which are usually the case.
− New product line which should be released in phases to enough customer feedback.

2) Advantages And Disadvantages:

Table. 5: Advantages and disadvantages of spiral model

Spiral model	
Advantages	**Disadvantages**
Changing requirement can be accommodated.	A number of risk, constraints, alternatives, models etc. Need to be analyzed but never are these risks or objectives listed and no specific risk analysis technique is mentioned. If risks analysis is poor the end product will surely suffer.
Allows for extensive use of prototypes	Another difficulty of the spiral model is adjustment of contract deadlines using the spiral model.
User see the system early	Risk analysis expertise is vital.

Table. 6: Comparisons of waterfall model,V-shaped model, prototyping model and spiral model.

Features	Waterfall Model	v-shaped model	Prototyping model	Spiral model
Requirement	Beginning low.	Beginning	Frequently	Beginning

		expensive	Changed high	expensive
specification cost				
Understanding Requirements	Well understood	Well understood	Not Well understood	Well Understood
Complexity of system	simple	complex	complex	complex
Overlapping Phases	No overlapping	Yes overlapping	Yes overlapping	Yes overlapping
Risk Analysis	Only at beginning	No Risk Analysis	No Risk Analysis	Yes Risk Analysis
Flexibility	Rigid	Rigid	Highly Flexible	Flexible
Cost Control	yes	yes	No	yes
Changes Incorporated	Difficult.	Easy	Easy	Easy
User Involvement in all phases of SDLC	Only at beginning	Intermediate	High	High
Resource Control	Yes	Yes	No	Yes

III. CONCLUSION

After analysis of all models through the various factors, it has been found that the water fall model is used by various big companies for their internal projects .Since the development team is familiar to the environment and it is feasible to specify all requirements of working environment.. Prototype model used to develop online systems for transaction processing. Prototype model is used when requirement is not clear .V-shaped model should be used for small to medium size project, where requirement are clearly defined and fixed. Spiral model is used for development of large, complicated and expensive projects like scientific Projects .Since spiral model approach enables the project term to address the highest risk at the lowest total cost.

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