Choosing the Right Approach: Comparative Study of Software Process Models

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Abstract: This paper depicts the study of myriad Software Process Model. In the Software Process Model we focus on the activities related to production of the software such as design, coding, testing etc. Organisations find software development to be more convenient to work with. There are mainly four development models that deal with the area of software development, popularly known as Software Project Life Cycle (Waterfall Model, Iteration Model, V-Shaped Model, and Spiral Model). These models have their advantages and disadvantages. This paper shows number of model of software development, comparison between them on the basis of their requirements.

Keywords: Software, Software Engineering, Software Process Models, Waterfall, Spiral, Prototyping, Iteration, V-Shaped Model.

I. INTRODUCTION

The fact cannot be denied that Computers plays a vital role in our life. In fact, it is pervasive now days, as used by many people (entrepreneurs) in many fields such as Commerce, Banking, and Travel and even in Farming too. We have a key called **'Software'**, which provides facility to get the work done in short span of time. Various processes as well as methods have been developed over the last 10-20 years to sophisticate the software quality. But still some of the software projects that are large, complex, and poorly-made and involve some unfamiliar aspects give weakness to large and unanticipated problems [1].A Software Development Process is a structure that fulfills the requirements for the development of a software package (or we can say product). In other words, we can say that, it defines all the resources or tasks required for developing and maintaining of software. To accomplish this task, there are several models that describe the activities of a specific software project such as specification, design, verification, validation etc. [2].

In software development (Software Engineering) we have generally 8 Project Life Cycle Models [3]:

- WATERFALL MODEL

- PROTOTYPE MODEL

- RAPID APPLICATION DEVELOPMENT MODEL (RAD)

- EVOLUTIONARTY DEVELOPMENT

- INCREMENTAL MODEL

- ITERATIVE MODEL

- SPIRAL MODEL

- COMPONENT-BASED SOFTWARE

However, there are only four main models out of these that we have discussed here:

- WATERFALL MODEL

- ITERATION MODEL

- V-SHAPED MODEL

- SPIRAL MODEL

II. BRIEF DESCRIPTION OF SOFTWARE PROCESS MODEL

1. Waterfall model

Waterfall model is the classical model and one of the vintage models. This is used pervasively in Government projects and even in number of companies. This model focuses on planning in early stages and predicts design flows earlier before develop. Because of simplicity of this model, it is easier to understand and use. In this model, each phase must be completed fully before the beginning of next phase. Developer has to correct the error instantly, if any error found in current as well as previous phase [4].

1.1 Phases of Waterfall model

1.   Requirement analysis

In this phase, requirements are recorded in SRS document. Requirements such as resources, hardware, memory etc are analyzed for software development.

2.   System Design

After that, analyzed requirements are studied in this phase and the design of system is prepared. In other words we can say that, 'System Architecture' is defined.

3.   Implementation

Designed system in previous phase, is firstly developed in small set of instructions (Programs) in this phase.

4.   Testing

In this phase, testing is performed. Small programs unit (or we can say small set of instruction) that developed in previous phase are joined together to form a system. Hence, whole system is tested and monitored for any faults and failure (I/O failures).

5.   Maintenance

In the last phase of this model, maintenance is done. Maintenance refers to enhancement of product by releasing sophisticating versions to the client or customers.

1.2 Advantages and Disadvantages of Waterfall model:

1.2.1 Advantages (PROS)

1. Simplicity: It is simple to use and understand.

2. Pervasive Model: It is used widely and present in companies.

3. Task arrangements: Due to simplicity, it is very easy to arrange the tasks of projects.

4. Define before Design: Each phase must be defined before the beginning of the next phase.

5. Convenient for smaller Projects: It works well for small scale projects.

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1.2.2 Disadvantages (CONS)

1. Instant Correction Required: The developer has to correct the error if any immediately in phases.

2. Costly: Small teams and small scale projects may face cost ineffective situations.

3. No satisfaction of Customers: Sometimes the quality of product is not as desired by client. In case, if client want some other changes then it is impossible in one go (during development time).

4. Difficulty in requirements analysis: Model can only be used, if Customer's requirements are clearly well and defined well. Otherwise it may be difficult to design the project.

5. Risk involvement: Lot of risks is involved of not meeting the requirement of customers.

2 Iteration Model

To modify the earlier software development model and to overcome on disadvantages of waterfall model, Iterative Model is introduced. In Iterative model, software is built in number of iterations sequentially. Iterative model is a combination of iterative design and incremental model. By the term Iteration mean, the project can be divided into smaller parts and allows the development team to conclude results earlier and fetch feedback from system users, which leads to be very valuable [5].

2.1 Phases of Iteration Model

1.   Requirements phase

As like in Waterfall model, requirements are collected and analyzed for the development of software.

2.   Design Phase

In this phase, software solution is designed to fulfill the requirements, which are collected in previous phase.

3.   Implementation and Testing

In this phase, generation of code, integration and testing of software is done.

4.   Review phase

In the last phase of this model, software is evaluated and requirements are reviewed then changes as well as addition to requirements proposed.

2.2 Advantages and Disadvantages of Iteration Model:

2.2.1 Advantages (PROS)

1. Earlier results: Project is divided into small iteration that helps development team to get the result in short span of time.

2. Valuable feedback: Development team can fetch feedback from system user that can be very valuable.

3. Flexibility: This model is more flexible and less costly to change scope or requirements.

4. Easy Debugging: As the project is divided into smaller part, it is easier to test and debug iterations.

5. Management of risk: it is easy to manage the risk, as risky substances are identified and handled during its iteration.

2.2.2 Disadvantages (CONS)

1. Rigid: In this model, phases do not overlap each other because each phase of iteration is rigid.

2. Difficult to manage: It is not easy to manage this model. Not all requirements are gathered up front for the whole software life cycle.

3 V-Shaped Model

In V-Shaped Model, the process steps are bent upwards after the coding phase. It is also considered as extension of Waterfall Model, because in Waterfall Process moves down in linear way. V-Shaped Model generally means Verification and Validation model.

. In *Verification,* consistency with the input of the phase is checked.

. In *Validation,* the consistency with needs of user is checked.

3.1 Phases of V-Shaped Model

High Level Design and Low Level Design phase are mainly two phases that are consisted in V-Shaped Model.

1.   *High Level Design Phase*

High Level Design Phase focuses on system architecture and design (structure). In order to test the pieces of the software systems ability, an integration test plan is created in this phase.

2.   *Low Level Design Phase*

Low Level Design Phase lies where the actual software's components are designed and unit tests are created in this phase.

Apart from these two phases, V-Shaped model also consists some other phases:

1.   *Project and Requirement Planning:* In this phase, System requirements are determined.

2.   *Analysis:* In which, analysis of software problem is done.

3.   *Architecture:* Implementation of software functions are defines to get the design.

4.   *Detailed design:* In this phase, algorithms are record for component and then it will be translated to code.

5.   *Coding and Testing:* Then, coding and testing of project is done.

3.2 Advantages and Disadvantages of V-Shaped Model:

3.2.1 Advantages (PROS)

1. Easy to use: It is easy to use, when applied to the suitable project.

2. Compatible for small projects: It works well for small projects, where requirements are easily understood.

3. Rate of success: Rate of success is higher because tests plans are developed earlier during life cycle.

4. Accuracy for progress tracking: It enables project management to track project accurately.

3.2.2 Disadvantages (CONS)

1. Implementation is difficult: Implementation in this model is very difficult, as each phase must be accomplished before the beginning of next phase.

2. Very Rigid: It is very Rigid like Waterfall Model.

3. This model does not provide a clear path for problems found during testing phase.

4. Little flexible and expensive too.

4 Spiral Model

Spiral Model is divided into four phases: Planning, Risk Analysis, Engineering and Evaluation. Spiral refers to term in which, each project passes through each of these phases sequentially and repeatedly in a series of iterations. At the starting point, Spiral initializes the planning, requirement and gathered them. Generally, requirements are collected during planning phase.

4.1 Phases of Spiral Model

1.   *Determination of Objectives and Constraints*

In this phase, defining of system requirements is done and constraints like cost, schedule etc.

2.   *Identification of Risks*

In this phase, risks and uncertainties are resolve and identified.

3.   *Testing*

In this phase called testing, Developer test and inspect the code such as design code.

4.   *Planning of next iteration*

It plan and design the second prototype or we can say planning of next iteration is done in this phase [6].

4.2 Advantages and Disadvantages of Spiral Model:

4.2.1 Advantages (PROS)

1. Compatible for large project: This model is good for large scale as well as critical projects.

2. Early production of software: Software is produced early in the Software Development Life Cycle (SDLC).

3. Risk Management: This model is divided into phases, which help to manage the risk easily.

4.2.2 Disadvantages (CONS)

1. Expensive: It can be expensive or costly model to use.

2. Not compatible for small projects: It does not work well for small-scale projects.

3. Expertise Knowledge: To analyze the risk, highly knowledgeable expertise is required.

III. COMPARISON BETWEEN PROCESS MODELS

Factors	Software Process Models			
	Waterfall	Iteration	V-Shaped	Spiral
Cost	Low ↓	High↑	High↑	High↑
Requirement Understandability	Well	Well	Easy	Well
User Interaction	At beginning only	In starting phase	At beginning	High↑
Simplicity	Very Simple	Intermediate level	Intermediate level	Intermediate level
Flexibility	Rigid	Slight flexible	High↑	High↑
Risk Certainty	Yes, at beginning	Yes	Yes	Yes
Risk Involvement	High↑	Low↓	Varied	Low↓
User Feedback	No	No	Negligible	No
Guarantee of success	Low↓	High↑	Moderate	High↑
Expert Requirement	High↑	Medium↕	High↑	High ↑

IV. CONCLUSION

The researchers are working day and night for the advancement in technologies by developing new software's, applications, algorithms and techniques. We have studied that there are several software process models available for different types of projects on the basis of their requirements, sizes, cost, time and many more factors. Choosing the right approach during software development is our major concern. Risk is the most important factor while choosing the model. Risks are uncertain and they can arise anytime during development. Customer nature is dynamic and it might be possible that during the course of development it may be changed. We have discussed various software process models with their detailed study, advantages and disadvantages. Models are compared on the basis of few important factors like: cost, requirements, flexibility, risk etc.

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