

Software Development Methodologies: An Overview

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Abstract:

This paper focuses on various methodologies of software development. In today's world, technology is growing rapidly and replaced almost everything. To build such powerful technology the management of the project plays an important role. To manage a project efficiently the development team and project manager must choose the software development methodology based on various factors like project size, type, resource availability, and development environment. This paper aims to explain the advantages and disadvantages of the most commonly used software development methodologies. This paper helps to choose methodologies that will work best for the project at hand.

Keywords: Software development methodology, advantage, disadvantage, comparison.

Introduction

At present, the computer becomes an essential part of our life. It helps us to perform tasks in various fields. People depend on a computer because of its accuracy and speed. In this pandemic situation, everything came online that is from education to business almost everything is handling online just because of safety. To perform a certain task on a computer we need software. For software production there are various software development methods are available. Software development

methods are the basis of any software project. It's quite difficult to identify which software development method is suitable for the project. All the methodology has its strength and weakness no methodology works well for all situations. This research intends to show the strength and weaknesses of the most commonly used methodologies so it becomes easy to choose among them based on the project requirement.

Software Development Methodologies

1) Waterfall

The waterfall model is one of the simplest process models proposed by Royce in 1970. Here the phases are organized in a linear order. In this model, the next phase begins only after the successful completion of the previous phase. It will not allow us to get back to the previous phase because of its nature. It is suitable for projects where the requirements are well understood.

Advantages:-

1. Simple and Straightforward approach.
2. Separation of concerns of each phase.
3. Simple to manage.

Disadvantages:-

1. Getting back to the previous phase is not possible.
2. Not suited for projects where customer requirements are changing.

3. Each requirement to be known at an early stage.

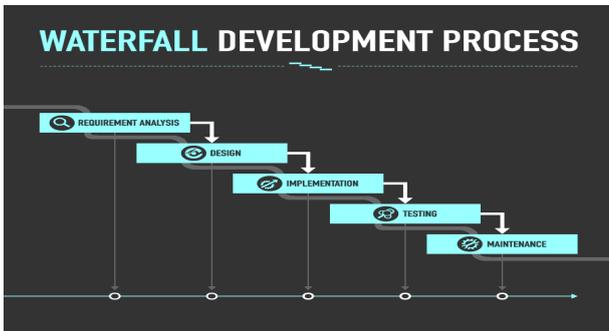


Figure 1: Waterfall Methodology

2) *Prototyping*

The prototyping methodology is useful for large and innovative types of projects. Here prototype is developed by observing the preliminary version of the requirement specification document and an opportunity is given for end-users to use and explore the prototype. Later based on the end user's feedback prototype is modified to include suggested changes. This process continues until an acceptable outcome is achieved.

Advantages:-

1. Reduces the risks that are associated with the project.
2. Suitable for the project where the requirements are not clear.
3. Clients give early feedback.

Disadvantages:-

1. It increases management costs.
2. Increases project complexity.
3. It is time taking process due to excessive change requests.

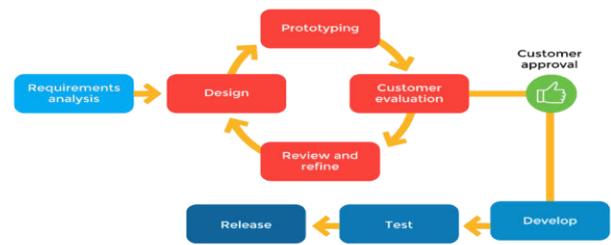


Figure 2: Prototyping Methodology

3) *Iterative and Incremental*

The goal of this methodology is to further improve the software. Each increment adds some more functionality to the system until the system is fully implemented. Here we can get continuous feedback from project owner after each iteration. It is suitable for medium and large projects.

Advantages:-

1. Continuous feedback is available after each iteration.
2. Multiple revisions are done in the entire project.
3. Changes of requirements are easy to accommodate.

Disadvantages:-

1. Not well for small projects.
2. Requires better planning and design.
3. Cost of the system is not lower.

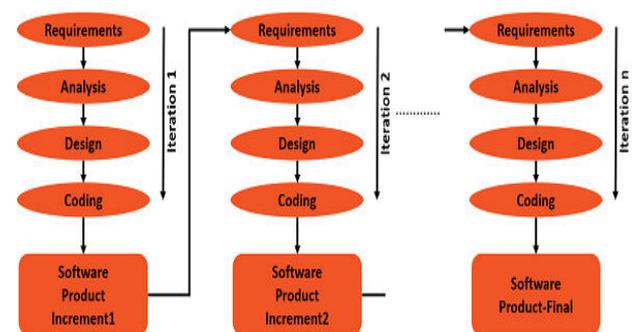


Figure 3: Iterative and Incremental Methodology

4) *Spiral*

This methodology was proposed by Boehm in

1988. As the name suggests this methodology uses a spiral shape to represent the software process. Software process phases are represented in each loop of the spiral. There are four sectors in each loop of the spiral: planning, risk analysis, development, and evaluation.

Advantages:-

1. This methodology is suitable for High-risk projects and also for medium and large projects.
2. Repetition of each phase several times may reduce the risks of the project.
3. In this methodology documentation part of the development is very strong.

Disadvantages:-

1. Risk handling is expensive it causes more costs.
2. Continuation is not possible without analyzing risk accurately.
3. Minimum risk projects are not suited for this model.

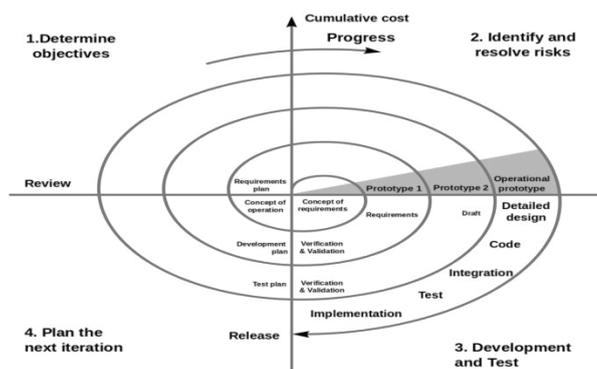


Figure 4: Spiral Methodology

5) *Rapid Application Development*

In 1991 James Martin introduced this methodology. This methodology focuses more on development and less on planning. Here the larger project is divided into small units. The

intention of this methodology is to develop the product in a short span of time. This methodology is best suited for medium and large projects.

Advantages:-

1. Changes can be easily adaptable.
2. Code reusability.
3. Quick feedback is available from the client side for further enhancement.
4. Quick development of the product.

Disadvantages:-

1. Highly skilled developer's team is required.
2. Documentation may be poor due to quickness in development.
3. Requires user interaction throughout the process.

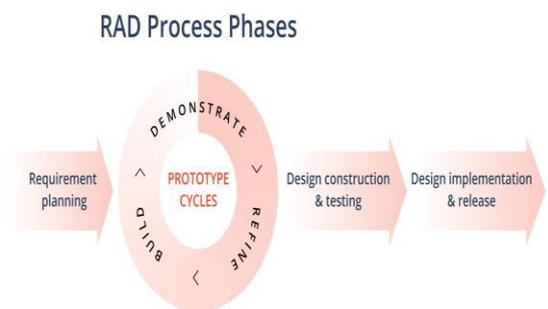


Figure 5: Rapid Application Development Methodology

6) *Extreme Programming*

This methodology comes under the family of agile methods. There are various popular approaches are available in the agile family. The name was proposed by Beck in 2000. Here user requirements are expressed as story cards and different programmers develop new versions of a system many times in a day. Developers work in pairs and developers are

allowed to change any coding even if that was not written by him. It also suits small, medium, and large projects.

Advantages:-

1. Pays more attention to customer involvement.
2. Reduce errors due to pair programming.
3. Work gets fast because of strong communication.

Disadvantages:-

1. Developers need to do pair programming.
2. Requires frequent meetings.
3. It is not a better option if the developers located in different places.

Extreme Programming (XP)



Figure 6: Extreme Programming Methodology

around 15 minutes to know the progress of the product called daily scrum. Based on the feedback they improve the product in the next increment. This methodology is suitable for projects of all sizes.

Advantages:-

1. Development of product is very fast.
2. Reduce errors in code because of sprint review.
3. Easy to notice each member's effort.

Disadvantages:-

1. Need experienced members in a team.
2. Team members may get frustrated by continuous meetings.
3. For large projects, it's quite difficult to estimate the cost at the beginning.

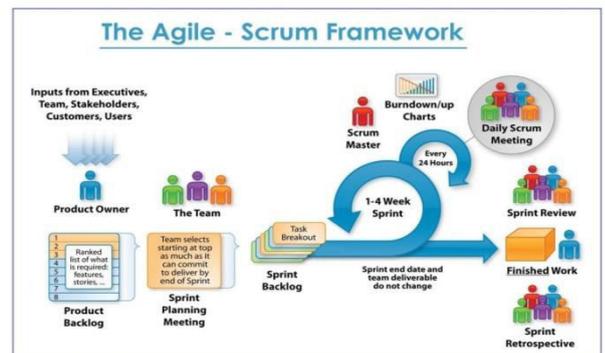


Figure 7: Scrum Methodology

7) *Scrum*

Another popular framework of Agile is Scrum. In this methodology, the development team usually consists of members less than ten. All the members of the team are part of the solution. The developer's team develops a product within a fixed time called sprint and later they demonstrate their work for the product owner to get a review of the product this review process is called sprint review. Also, there is small talk of team members

8) *Dynamic System Development methodology*

It is another Agile framework introduced in 1994. This methodology uses iterative and incremental methods in the development process and at each stage of the project, the development team and project owner communicates to exchange pieces of information. They use a technique called Moscow for prioritizing requirements. This methodology is best for small and medium-size projects.

Advantages:-

1. User involvement is active.
2. On time project delivery.

Disadvantages:-

1. Implementation is costly.
2. Not suitable for small organizations.



Figure 8: Dynamic System Development Methodology

9) *V-model*

The V-model (verification and validation model) is the waterfall model expansion. Here only after the completion of the previous phase the next phase begins. Each step of the project is directly associated with the testing phase. At the end of the development stage, feedback is received from the owner by performing acceptance testing. This is more suitable for small and medium-size projects.

Advantages:-

1. Understanding and using the model is easy.
2. Each phase of development runs parallel with the testing phase.
3. Reduce bugs.

Disadvantages:-

1. Not suitable for a complex project.
2. Risk is high and less flexible.

3. No working modules of the software are available for the owner in the early stage, it is developed later in the implementation phase.

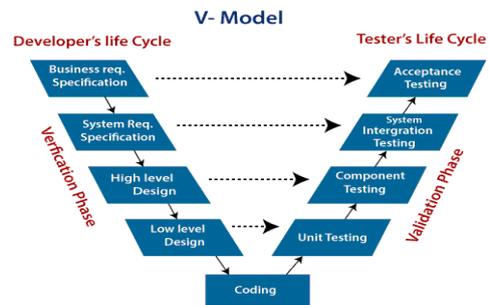


Figure 9: V-Model Methodology

10) *Rational Unified Process*

The model was created by Rational Corporation. It consists mainly of four phases they are, Inception, Elaboration, Construction, and Transition. Each phase is responsible for the product development. This model uses an iterative approach in each of these phases. This is suitable for all three types of projects.

Advantages:-

1. Reuse of components minimizes development time.
2. Change of requirements during development is manageable.

Disadvantages:-

1. Development process is complex.
2. Development team required highly skilled people.



Figure 10: Rational Unified Process

11) Lean Software Development

This is another framework from agile. It follows some principles in the development process. Mainly it focuses on removing the wastes which will not affect the product directly and keeps only what is required for the final product. It is suitable for small, medium, and large projects.

Advantages:-

1. Saves costs and time by removing unwanted things.
2. Increases focus on development.

Disadvantages:-

1. Requires team members with good technical skills.
2. Team discipline matters in the Success of the product.

12) DevOps

Here the Dev refers to development and Ops refers to Operations these two teams combined together to build a quality product. This development methodology helps Organizations to provide faster service. It is suitable for medium, and large projects.

Advantages:-

1. Develops quality products in less time.
2. Improves the efficiency of the team.

Disadvantages:-

1. Needs experienced people in the development process.
2. Requires Strong teamwork to build a quality product.

Conclusion

This paper provides an overview of commonly used software development methodologies with some Pros and Cons. After reviewing some methodology concluded that no methodology works well for all situations. Before choosing the software development methodology we have to consider some of the factors like time, cost, and size of the project. It's better for organizations to choose a methodology based on the nature of the project.

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