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A Study on Software Development Methodologies

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ABSTRACT: This paper mainly focuses on understanding the different software methodologies. Evaluation of a software methodology helps in understanding its features, advantages and disadvantages. Any IT project involves a software development methodology and it is important to choose the correct framework for the success of it. A single methodology is not suitable for all the situations. Each of it is suitable for a specific application. The software development stages are mentioned and the software development methodologies are compared. Conclusions and references are formulated.

KEYWORDS: Software development, development methodologies, Agile Method.

I. INTRODUCTION

Software engineering is the process of analyzing and specifying the requirements, designing, developing, implementing, testing and maintaining a software. [1]

A software engineer need not be an expert in understanding all these phases. But he should be good at coding or specifying the requirements so that the programming part will be carried out in an effective manner.[2].The field of software is developing rapidly with new languages , frameworks, interfaces. A software developer should make sure that he chooses the right technology for his application. The latest version PHP framework called Zend framework is released recently. The developer has to be updated about the latest trends in technology and make the application meet its requirements in an efficient way. Therefore, a software development methodology is required .A software development methodology is a framework that is to plan, and control the entire process of constructing an application or a system.[3].This framework helps in managing each phase of software development in an organized way. While building a software, it is not necessary to have a face to face interaction. Instead the codes can be shared using the file sharing apps like dropbox, 4shared,RapidShare.Any other interactions can be carried out through the social networking sites like the Facebook video calling, Skype video conferencing.[4][5].

II. RELATED WORK

Software development should be organized in order to deliver faster, better, and cheaper solutions.Recently suggestions for improvement have been given by experts which are labelled as agile software development. Williams and Cockburn state that agile development is “about feedback and change”, that agile methodologies are developed to “embrace, rather than reject, higher rates of change”. In 2001, the “agile manifesto” was written by the practitioners who proposed many of the agile development methods. The manifesto states that agile development should focus on core values.[25]



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III. SOFTWARE DEVELOPMENT STAGES:

There are several stages in software development .At each stage a result is obtained which is used for the next stage.

There are 5 main stages in this process.

1. Requirement specification and analysis:

This process involves proper planning of the project .The requirements are specified by the stakeholder to the software developer and he passes it on to the team as a technical specification. These are analyzed thoroughly and any additional requirements are added to address the performance of the software. The project manager and the team evaluates the requirements in a business and technical perspective respectively. Based on the complete requirement the interfaces, programming languages, and other tools are chosen to build the software.

2. Design:It involves the entire process of creating a layout of the software application. It ranges from a simple graphical design to a complex artistic design depending on the complexity of the application. Usually an error in this stage can occur if there is no proper planning. This can be avoided by analyzing the requirements in stage 1 properly.

3. Development or Coding:

This stage involves implementation process where the software is built by coding. It should involve a development environment and a testing environment. The project manager compares the planned stage and the actual development process in order to compare the progress. It is mandatory for the programmer to comment the code so that it will understood by the others.

4. Testing:

The application developed should not be vulnerable to any sort of attacks by an unauthorized person. Therefore testing is carried out. It is an important stage wherein the design and the programming errors are identified and rectified. The design error occurs when the implementation is not carried out according to the specified requirements. Programming errors usually causes application crash which is very critical. Hence it is recommended to carry out the four levels of testing which are unit testing, acceptance testing, integration testing and the system testing.

5. Maintenance:

Once all the 4 stages are completed the next important part is maintaining the software. It involves making suitable changes by adding a piece of code or deleting a piece of code, adding a new functionality in order to make the software adaptable to change. Monitoring the software to ensure that it is working according to the planned parameters. It has to perform the functionality that it is designed for. Any errors that were left undiscovered in the previous stages are discovered and corrected to make the software efficiently perform the task. [5][6]

IV. SOFTWARE DEVELOPMENT METHODOLOGIES

A software development methodology is necessary framework with a set of rules for planning all the stages of the software development. Agile software development is a set of principles under which the requirements evolve through the effort of cross functional teams.[27].The software is developed in increments. The various development methodologies are compared and reviewed.

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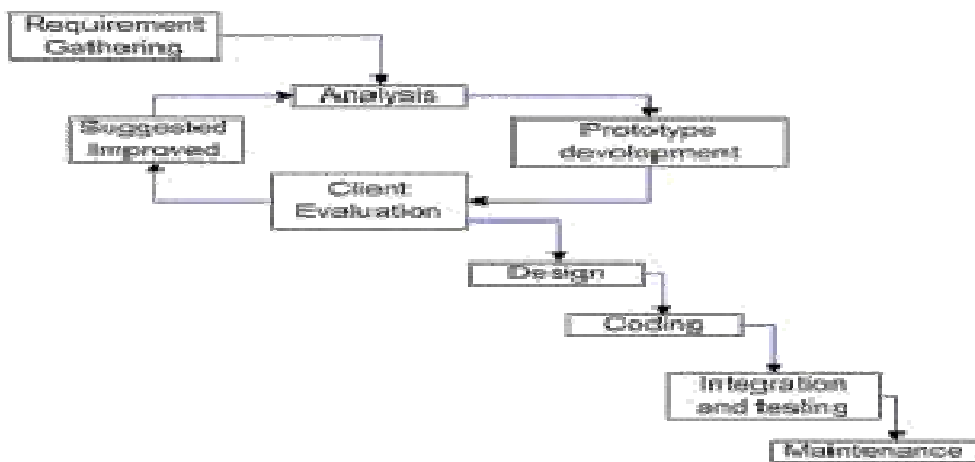
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IV. WATERFALL MODEL

It is the traditional method of software development. It is a linear approach of where the requirement analysis and design is carried out first and then the development followed by the testing process.[8]. There is a goal for each stage of development and once a stage is completed it cannot be revisited again. There is no overlapping between the stages. [9]



Evolutionary Prototyping Model

Fig: Waterfall model [30]

Advantages:

It is useful in the structured systems.

Suitable for development of small applications where a proper planning and analysis is already done. Easy to explain and understand.

Disadvantages:

As the stages cannot be revisited any amendments in the previous stage cannot be carried out.

The data and the process are separated and any modification to the data requires the code to be modified. Reusability is not possible and if any upgrade is required then the entire system has to be modified hence it is an expensive approach.

V. PROTOTYPING

It involves specifying the initial requirements and designing a prototype. Based on the currently known requirements the prototypes are built. These prototypes are used as a general tool for communication between the team and it is not the software product itself. Using the prototype the final product can be developed. Prototyping is necessary when it is required to have a lot of interaction with the end users.

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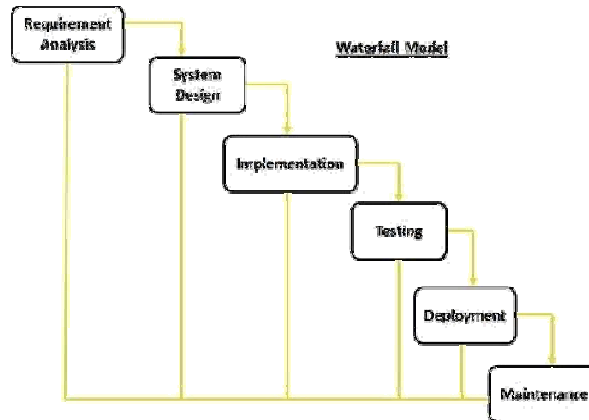


Fig: Prototyping model [5]

Advantages:

- It is suitable when the requirements are not known clearly.
- Suitable for a building large applications.
- Identification of missing functionalities and errors are easier.
- User gets a better understanding of the system.

Disadvantages:

- Increase in complexity of the system. [11]

VI. INCREMENTAL AND ITERATIVE METHODOLOGY:

It is a replacement for the waterfall model. In this method a model is built based on the requirements that are specified initially. The model that is developed is further expanded which is used as the final application. It is expanded based on the feedback and the functionalities that are required. Harlan Mills promoted iterative development and said "it is possible to generate a sequence of intermediate systems of code and functional subspecifications so that at every step, each [intermediate] system can be verified to be correct...".[12]

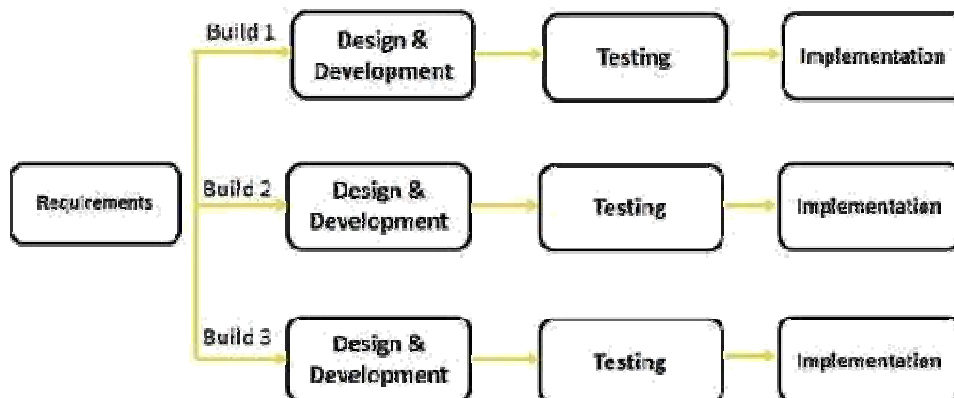


Fig: Incremental and Iterative development model.[22]

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Disadvantages:

High level skills are required for risk analysis.

Relies completely on the ability of the software developers.

High time and cost to implement the final product.[13]

VIII. RAPID APPLICATION DEVELOPMENT

This methodology focuses mainly on the development stage and gives less importance to the planning process. It ensures user involvement in the project. The entire project is broken down into modules and each module is developed in parallel. Once the module is ready it is delivered to the user and based on

The feedback any changes or functionality to be added is handled.

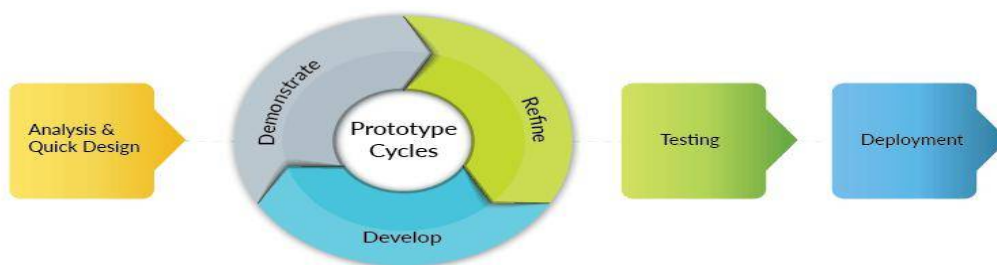


Fig: Rapid application development model[23]

Advantages:

The product can be developed in less time as each module is developed in parallel.
Less failures and errors.

Reusability of code is possible.

Disadvantages:

Not suitable for complex and large projects.[14]

IX. EXTREME PROGRAMMING

The entire development process is broken down into smaller processes. The testers and the developers work in pairs. Customer involvement is necessary. Pair programming is an important feature. Pair programming is a process in which two programmers work together for continuous code review. Collective ownership of the code is done so that anyone in the team can makes changes to the code.[15][16].



Fig: Extreme programming model[5]

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Advantages:

- It produces a high quality, robust software.
- Suitable for small, medium, and large scale projects.
- Pair programming promotes knowledge sharing among the developers.

Disadvantages:

- Need special skills from the team.
- No documentation is maintained at each stage.

X. V-MODEL METHODOLOGY

It's called as the verification and validation model. It is an extended version of the traditional waterfall model where the stages are carried out sequentially. Each software development stage is matched with a testing phase. Acceptance testing is the final stage where the stake holder gives the feedback.

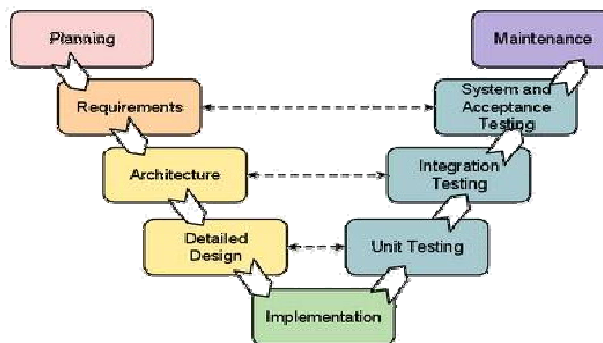


Fig: V-Model [5]

Advantages:

Defects can be detected easily at each stage preventing the downward flow of errors. Time saving method as the testing activities are carried out before coding.

Disadvantages:

- The requirements should be clear and fixed.
- Least flexible model.
- No prototypes are available.
- Involves high risks.

XI. SCRUM

Scrum was developed by Jeff Sutherland. It is an incremental and iterative framework. The requirements are collected and prioritized and are called stories. A backlog is a collection of stories and they are developed based on the priorities. A sprint is the development in cycles of work. The sprint is timeboxed i.e., it is stopped when the deadline time specified is reached. There are three major roles the product owner, scrum master and the team.

The product owner is responsible for prioritizing the requirements, deciding the priority for the next sprint and all the profit and loss. The team is responsible for developing the product under the guidance of the product owner.

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A scrum master manages and leads the entire team and helps them to be successful. He helps them achieve business value by making use of scrum. The scrum master protects the team from outside distractions and also educates the product owner. Team meetings are done on a daily basis [17]

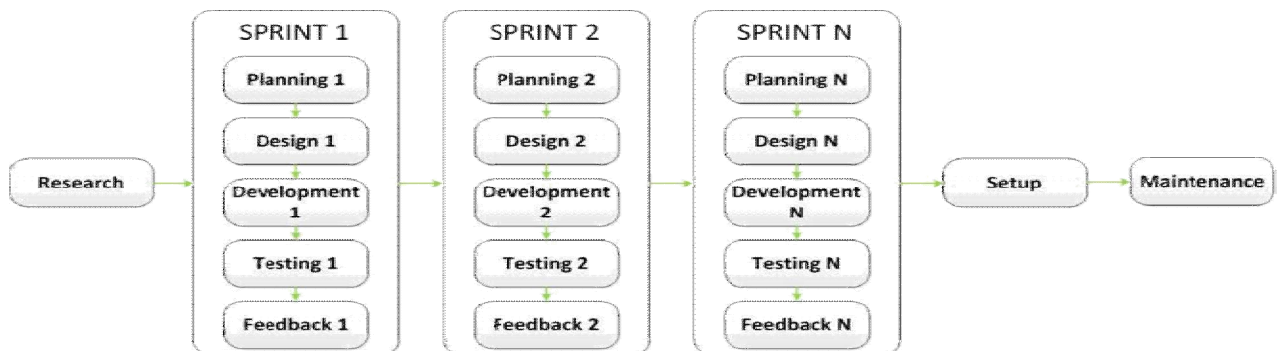


Fig: Scrum Model[5]

Advantages:

Every team member is involved in the project.
Early detection of errors as the team meetings are performed.

Adaptable to changes due the continuous feedback from the user.

Disadvantages:

The project tasks should be well defined otherwise it becomes difficult to predict the time and costs which in-turn causes the spread in sprints.

Requires a well experienced set of workers in the team.

XII. CLEANROOM SOFTWARE DEVELOPMENT:

This method focuses on prevention of defects and hence the name "clean-room". The software product developed using this method does not have any defects. Mathematical models are used to prevent any defect. Here the testing team checks the code for errors and the development team focuses only on the development process. The stages of software development are divided into increments. It uses a statistical approach for testing, formal methods for specification.[18]



Fig: Clean-room Software development model[24]

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Advantages:

Highly reliable software is produced.
Short development cycles.

Disadvantages:

It requires high mathematical knowledge.
Intensive training of team is required.

XIII. DYNAMIC SYSTEMS DEVELOPMENT METHODOLOGY:

In this method cost, quality and time at the start of the project. Its main aim is to deliver the project on the right time. The requirements are prioritized. User involvement is necessary. It is useful for businesscritical systems and it is a time boxed approach. Testing is carried out at an early stages. Incremental and iterative development are carried out. It uses MoSCoW prioritization which is

Must have, Should have, Could have, and Want to have. [19]

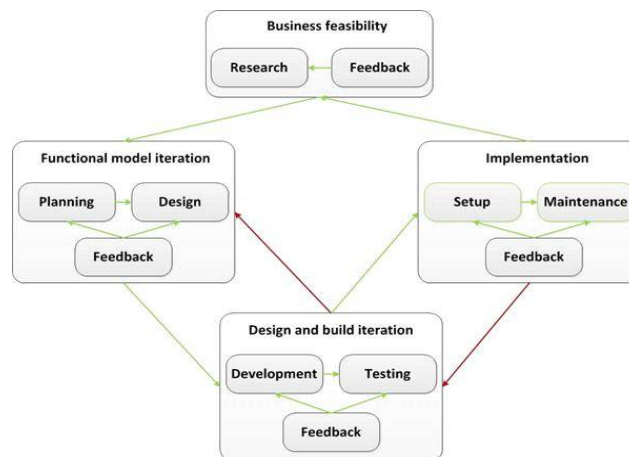


Fig: Dynamic Systems Development Model [5]

Advantages:

User involvement helps in better understanding of the system.

The basic functionality is delivered initially later the other functionalities are carried out. The project is delivered within a specified period of time.

Disadvantages:

Costly to implement as it requires skilled and trained workers and users.
New model hence difficult to implement.

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XIV. RATIONAL UNIFIED PROCESS:

It is an iterative process. It is a disciplined approach wherein the tasks are assigned to the team. This process concentrates on the models rather than the documentation. The entire development process is broken down into cycles. Each cycle consists of the 4 phases viz., inception, elaboration, construction and the transition phase.

The inception phase defines the scope and concept of the system. The elaboration phase analyses the problem and risks involved. In construction phase the implementation and integration of features are done. Transition phase involves the transferring the application to the end user.

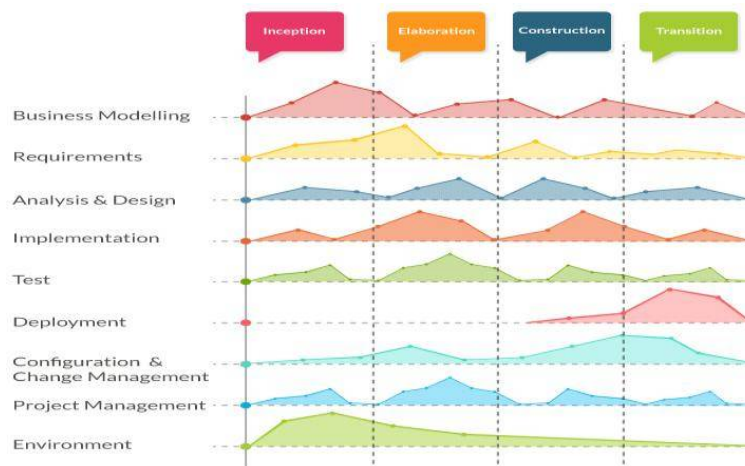


Fig: Rational Unified Process Model [5]

Advantages:

Higher level of Reusability.

Risks are identified earlier.

There is continuous integration and an improved quality of the system is obtained.

Disadvantages:

Heavy documentation is expensive.

The process is too complex because experts are required to adapt to the process.

Disorganized development.[21]

XV. CONCLUSION

Software methodologies are of two major types lightweight and heavyweight. In heavyweight methodology the project requirements are unlikely to change and a proper documentation is provided. On the other hand lightweight methodology is when the project requirements change and it is mostly developed using iterations. In this paper various software methodologies their features, advantages and disadvantages are mentioned. No model is claimed to be the best. Depending on the project or the application to be developed a suitable model is chosen. Before choosing a methodology the project team's expertise, time, costs and project's complexity has to be assessed. Instead of using one methodology a hybrid of two or more methodologies can be used. As the technology is developing at a rapid pace it is necessary to develop new methodologies.



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REFERENCES

1. https://en.wikipedia.org/wiki/Software_engineering.
2. Ivan Rozman Jozsef Gyorkos Tatjana Welzer ,Which Software Design Development Methodology is Appropriate for Engineering Education ,University of Maribor,DOI: 10.1109/FIE.1991.187572 · Source: [IEEE Xplore](#)
3. <http://www.itinfo.am/eng/software-development-methodologies/>
4. <http://www.pcworld.com/article/2692100/these-four-file-sharing-apps-offer-speed-security-and-more.html>
5. Mihai Liviu DESPA mihai.despa@yahoo.com, Bucharest ,Comparative study on software development methodologies, University of Economic Studies
6. <https://www.synapseindia.com/6-stages-of-software-development-process/141>.
7. A Review of Software Development Life Cycle Models ,Shubhmeet Kaur ,B. Tech CE Final Year, Dept of Computer Engineering Punjabi University, Punjab, India
8. David Young ,Software development methodologies .
9. Adenowo, Adetokunbo AA, and Basirat A. Adenowo. "Software Engineering Methodologies: A Review of the Waterfall Model and Object-Oriented Approach." *International Journal of Scientific and Engineering Research* 4.7 (2013): 427-434.
10. <https://melsatar.wordpress.com/2012/03/15/software-development-life-cycle-models-and-methodologies/>
11. <http://searchcio.techtarget.com/definition/Prototyping-Model>
12. Larman, Craig, and Victor R. Basili. "Iterative and incremental developments. a brief history." *Computer* 36.6 (2003): 47-56.
13. Samal, Chetana. "Spiral Model-An Improvement over Waterfall Model."
14. Beynon-Davies, Paul, et al. "Rapid application development (RAD): an empirical review." *European Journal of Information Systems* 8.3 (1999): 211-223.
15. Xu, Bin. "Towards high quality software development with extreme programming methodology: practices from real software projects." *Management and Service Science, 2009. MASS'09. International Conference on*. IEEE, 2009.
16. Wenying Sun ,EFFECTIVENESS OF PAIR PROGRAMMING; PERCEPTIONS OF SOFTWARE PROFESSIONALS , Washburn University, Kansas,George Marakas, Florida International University, Florida Miguel Aguirre-Urreta, Texas Tech University, Texas
17. Jeff Sutherland and Ken Schwaber Co-Creators of Scrum Draft 29 Jan 2011, Paris,The Scrum Papers: Nut, Bolts, and Origins of an Agile Framework,
18. Selby, Richard W., Victor R. Basili, and F. Terry Baker. "Cleanroom software development: An empirical evaluation." *IEEE Transactions on Software Engineering* 9 (1987): 1027-1037.
19. Benjamin J. J. Voigt Zürich, Switzerland S99-728-123 Supervisor: Prof. Dr. M. Glinz Advisor: Dipl.-Inf. C. Seybold Department of Information Technology University of Zurich Zurich ,Dynamic System Development Method, , 20 January 2004
20. Kamphol Wipawayangkool,Rational Unified Process,University of Houston – Clear Lake
21. Steven J Zeil,Software Development Process Models,
22. https://www.tutorialspoint.com/sdlc/sdlc_iterative_model.htm
23. <http://www.wavemaker.com/rapid-application-development-model>.
24. <http://leansoftwareengineering.com/wp-content/uploads/2009/02/cleanroom.png>
25. Tore Dyba* , Torgeir Dingsøy SINTEF ICT, S.P. Andersensv ,Empirical studies of agile software development: A systematic review. 15B, NO-7465 Trondheim, Norway.