A Comparative Study of Agile and Waterfall Software Development Methodologies

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Abstract: *In earlier software development all process is completed and implemented but now this is not a scenario. In modern era changes are frequent to any software product or module which is under development phase, due to market competitions priority of requirement changes Due to the fact that the traditional process models are incompatible with these changes, agile methodology is used instead.. Earlier waterfall model was convenient because of less requirement of features and emergency of the application in the short period of time .This Paper Discusses the comparative Analysis of waterfall model and agile methodologies while agile methodologies are taking over, even the waterfall model is older and time consuming it is still use in many sectors The paper will help other software development process models. Agile method plays important role in the areas of software project management, software schedule management etc. The main aim of the agile is Customer satisfaction as well as faster development with low defect rate. This paper reflects the comparison of the agile processes with waterfall model software development life cycle model. Agile processes aren't always beneficial; they have their own set of downsides. Agile method promotes continuous iteration of development and testing throughout the software developed.*

Keywords: Agile Methodology, Software development lifecycle, Extreme programming, Scrum, water fall model.

I. INTRODUCTION

During the software development process, The software development life cycle has two major components: one emphasizes process, and the other is software and process quality. Agile software development focuses on iterative and dynamic development, its allow to change requirements in response to client demands. It help Adaptive planning, iterative development, and time boxing are all aided by it. It's a theoretical framework that promotes expected interactions throughout the development process. SDLC is a framework that identifies the actions taken at each stage of the software development life cycle [1], and it comes with various models, such as spiral, waterfall, and rapid application development (RAD). Software development operations such as planning, analysis, design, coding, testing, and maintenance must be executed according with the customer's need. It depends on the various applications to select the specific model. However in this paper, we will deal with agile processes and methodologies. The agile process is a software development process of itself [2] .The agile process is an iterative technique in which customer satisfaction is highly prioritized because the customer is directly involved in the product evaluation [3].The agile method follows the SDLC, which includes gathering requirements, analysis, design, coding, and testing, as well as delivering partially implemented software and waiting for feedback from customers.

The waterfall model is the first model for software development it is also called linear sequential model The water fall model each phase must be completed before the next phase

II. LITERATURE REVIEW

Agile methodologies are software development strategies that are used iteratively todeliver high quality software providing adaptability and flexibility with respect to changing condition. It focuses on project management that is informal and more flexible, increase transparency as well as communication. Role of agilemethodologies in software development was described in agile manifesto [4] and includes the following:

- Delivering workable software on time;
- Customer satisfaction

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- Acceptable changes
- Business owners and developers frequently Work together.
- The developments based on motivated individuals
- Continuously test software after each iteration

These are usually achieved by the customers and the developers who worked together in the course of development of the software. In agile development usually the developers' teams are usually small in size as it is usually considered to achieve the following reasons Cost, Schedule, Requirement and quality. Accordingly, software usually failed because of the following reasons as clearly stated by:

- Lack of defined requirements and poor communication;
- Unresolved business requirements issues;
- Requirements changed before the project is finished;
- By-the-developers untested software codes;

Software that the user hasn't test To develop a software that is robust at the same time solve some of the problems listed above we need development methods which represent a new approach for planning and managing large software development projects.

In Other hand Waterfall model is based on step by step phases of defining the requirements, building the Software, test the software and finally deploy the software. These phases are regarded as the oldest model but are regarded as essential methods in traditional method of software development. In waterfall model we move to the next phase only when one phase of the development is completed. It is more suitable for projects whose requirement do not quickly change until whenthe project is finished; therefore, more suitable for projects that has stable or unchanged user requirements for a long period of time.[5]

III. RESEARCH METHODOLOGY

This paper is based on comparative study of two different methodology, their application in different circumstances. The in-depth analysis makes it clear to understand the implementation of agile and waterfall model during different projects. The approach is descriptive and discuss crucial identification of appropriate process used in the software development life cycle

IV. COMPARISON BETWEEN WATERFALL AND AGILE SOFTWARE DEVELOPMENT MODEL

Before discussing the comparison the different properties are needed to be discovered for better study which will help in differentiating between the two models i.e. Waterfall and Agile. [4,5]

Aspect	Water Fall Model	Agile model
Primary goals	Stability, high assurance	Rapid value, responding to change
Fundamental hypothesis	It is Specific predicted and developed using extended and detailed planning	Based on fast feedback andchanges, by small team, software that is of high quality with the use of continue improvement.in design and testing is developed
User requirements	Details and definition before Implementation	Interactively input
Communication method	Formal	Informal
Customer relations	Dedicated onsite customers, focused prioritized increments	Need Customer Interaction Till The contract
Quality control	Not easy to plan, late testing and very difficult	Testing is done as the software is being developed, design, or requirement is permanent
Redeveloped cost	High	Low
Developmentdirection	Fixed	Flexible
Project size	Large project	Small or Medium size project
Testing	At the End Of coding	For each Step

V. ADVANTAGES AND DISADVANTAGES

5.1 Agile

A. Advantages

- Agile methodology is a fairly straightforward concept that is founded on the notion that projects are produced in brief iterations. It is not a collection of technologies. In the form of brief iterations for various sub modules, iterations are effective for breaking down a large problem into manageable sub modules. The user can view a functioning version of the software at the conclusion of any iteration before moving on to the following one, making the project as a whole more adaptable. [6]
- In practice, traditional techniques are rather inflexible. Any tiny modification after requirements are established is not admired since it necessitates redoing the entire project, but by implementing agile mentality, it may be altered whenever the customer or developer sees fit.[6]
- It is possible to create and update the overall progress report frequently. After each iteration, the product's progress can be tracked and evaluated.[6]

B. Disadvantages

- Generally speaking, a very common error that many people think that flexibility and lack of flexibility are at the core of agile. This is untrue in reality because agile methods have their own set of explicit guidelines and standards. Rather than making modifications after careful consideration. Everyone is free to suggest any change at any level only to demonstrate their existence, according to the study simply because everyone claims to be always prepared to adapt to any change, without sufficient responsibilities. [6]
- Regular consumer input may constitute a bottleneck for the project's advancement. Followers of agile philosophy value interactions with customers. However, it might really become a weak point in some situations, such as when the user or customer doesn't have enough time to spend with the developers or when the important client is a senior manager.
- Large projects don't always need to be finished under one roof, making coordinating a challenge. Think of a scenario where two teams are working in several cities at various locations. Is there coordination comparable to two teams physically seated together.[6]

5.2 Waterfall

A. Advantages

- Unlike other methods, the waterfall model follows a specific and specified sequence of steps. Because every project must go through the same series of events, its structure is straightforward. This include obtaining specifications and supporting documentation, as well as designing, implementing, testing, delivering, and maintaining the system. Before moving on to the next stage, a team must finish the previous one entirely, making any obstacles in the way easy to spot. Because each set of steps must be completed before moving on, projects adopting the waterfall approach are less likely to be abandoned halfway through. At the conclusion of the process, your work is more likely to be polished and comprehensive. [7]
- The waterfall approach doesn't call for particular training or certificates for personnel or project managers, unlike other development methodologies. Without having to go through a difficult learning curve that can impede individual success, you can get right into the system. Given that the frameworks encourage team consistency, it is therefore among the most user-friendly systems now in use. [7]
- The waterfall model commits to the final objective, product, or deliverable from the start of the process, which is one of its key benefits. Teams are urged not to stray from such dedication. This feature enables everyone to be aware of the planned outcome from the beginning of the project when you have small initiatives with clear goals. That implies that as each step is taken, there is less chance of getting lost in the minutiae of daily operations.[7]

B. Disadvantages

- A team always moves forward when using the waterfall model, which adheres to a set of steps. There is very little flexibility for modification when using this approach's traditional technique if an unforeseen event occurs during a project. Up until practically the very end of the project, a team may faithfully adhere to each phase before running into an unexpected challenge. Making the necessary pivot to keep going forward can be next to impossible if a change in the objectives or the scope of the job is required.[7]

- The waterfall model, which follows a sequence of steps, ensures that a team always advances. When adopting this approach's traditional technique, there is very limited room for alteration if an unforeseen occurrence takes place throughout a project. A team may stick to each phase diligently up to almost the very end of the project before encountering an unanticipated difficulty. If a change in the goals or the nature of the job is essential, making the pivot that is required to go forward can be nearly difficult.

- The testing step of any project is postponed by the waterfall paradigm until it is absolutely necessary. According to the conventional approach, it is the fourth of six steps. Any negative outcomes might necessitate a large adjustment as the project has probably already taken a long time to finish. Ignoring the proposed value proposition's empirical facts before you consider entering the market may lead to serious user problems that you will need to handle. This drawback is the main impetus behind the creation of agile approaches. There is a lot of potential for issues to go overlooked up until the project is almost finished.

VI. CONCLUSION

In this paper, I have provided two models: a waterfall model and agile methodologies . Both models have their uses, pros, and cons. Small projects are almost always better suited for an Agile methodology than a Waterfall one. When developing medium-sized projects, both the Waterfall Model and the Agile Methodologies have their number of drawbacks. A flexible Agile Methodology may be too easy to use for the same project while the difficult Waterfall Model may add too much overhead to it. A large, complex project with several teams working on various components of the application at the same time is one of the project types that is challenging to handle in an Agile manner. This kind of project is typically a waterfall project. For projects hard to classify as being either Waterfall or Agile other Models need to be investigated

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