

## **A COMPARATIVE ANALYSIS OF AGILE AND WATERFALL SOFTWARE DEVELOPMENT METHODOLOGIES**

**BY**

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### ***Abstract***

*To enhance software development, process a number of software development methodologies have been adopted. Waterfall model was firstly introduced, this was widely accepted by corporate organizations and developers that has many large software projects. However, waterfall was found to be inadequate in solving all the requirement of modern-day complex software and as such a more robust method in form of agile methodology was introduced. This paper draws comparison between waterfall and agile software development methodologies and outline which one is the best in terms of cost, flexibility, maintenance and time.*

***Keywords:*** *Agile Model, Waterfall Mode, Software Development Life Cycle*

### **1.0 INTRODUCTION**

The process that involves organizational process to carry out the necessary steps for the analysis, designing, implementation and maintenance of information systems is referred to as software development methodology. Software development is considered to be a tedious and time-consuming activity which requires huge financial and human resources and as such the need to prepare and plan adequately for software projects to succeed and deliver high quality software and on schedule. This paper compares two major software development methodologies: Waterfall and Agile methodologies. Suffice to mention that other methodologies like Spiral, Extreme Programming, Dynamic system development model, Joint Application Development, Feature Driven Development, Mean Development, Rapid Application Development and Rational Unified Process also exist. While Waterfall methodologies is an old styled meant for small project that lack flexibility documentation and difficulty to

amend mistakes while agile is a step ahead used for large projects that are executed incrementally that are divided into small fragments and as such is faster, flexible and require less up-front information.

## **2.0. Literature Review**

Agile methodologies are software development strategies that are used iteratively to deliver 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 agile methodologies in software development was described in agile manifesto [2] and includes the following:

- Customer satisfaction
- Acceptable changes
- Frequent delivery of working software
- Developers and business owners usually work together
- The development is based on motivated individuals
- Correspondence between developers and business people
- The progress of development is determined by the performance of the software
- Process promote sustainable development
- The performance of the software is measured by the technical team
- Always test the software iteratively as developed

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:

- Unclear Requirements that is not well communicated

- Business Requirements problem that is not solved
- Requirement is changed before the project is completed
- Untested software codes by the developers
- Untested software by the user
- Difficulty in maintaining/modifying project code
- Intended functions for software is used
- Inadequate human resource
- Inadequate hardware resources

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.

On the other hand, Waterfall model is based on step by step phases of defining the requirements, building the solution, 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 when the project is finished; therefore, more suitable for projects that has stable or unchanged user requirements for a long period of time.

### **3.0 Waterfall Software Methodology**

In waterfall model the development is in sequential order i.e. one step has to be completed before proceeding to the next step and therefore to make changes we have to follow a formal process. These steps are recursively repeated until software is completely developed. These steps include the following analysis (Requirement Specification), design, implementation, testing and maintenance. It can be diagrammatically illustrated below:

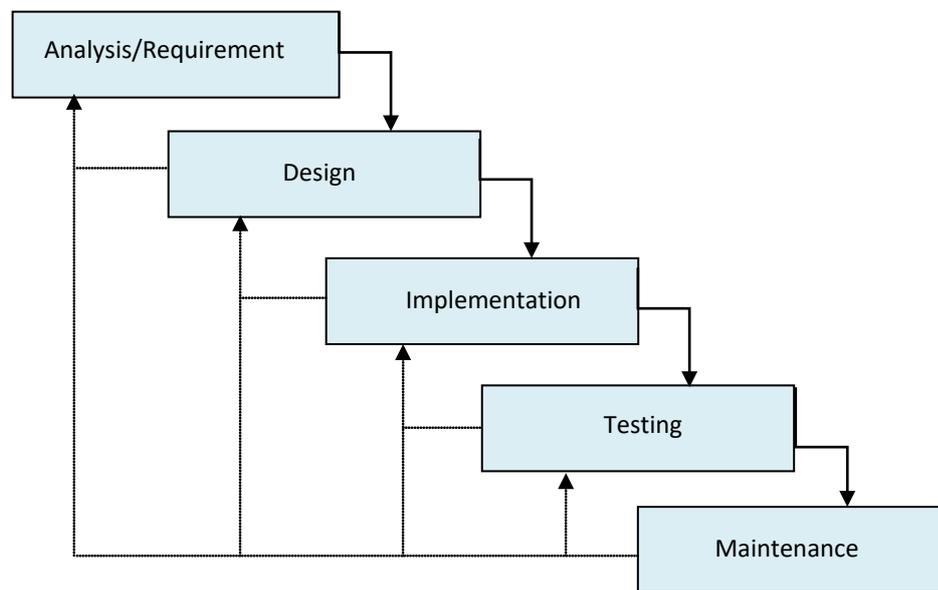


Figure 1: Waterfall Model [8]

It is the oldest model to have been implemented to a large variety of software development projects and the following inadequacies of the model is identified as follows [4,9,10,11]:

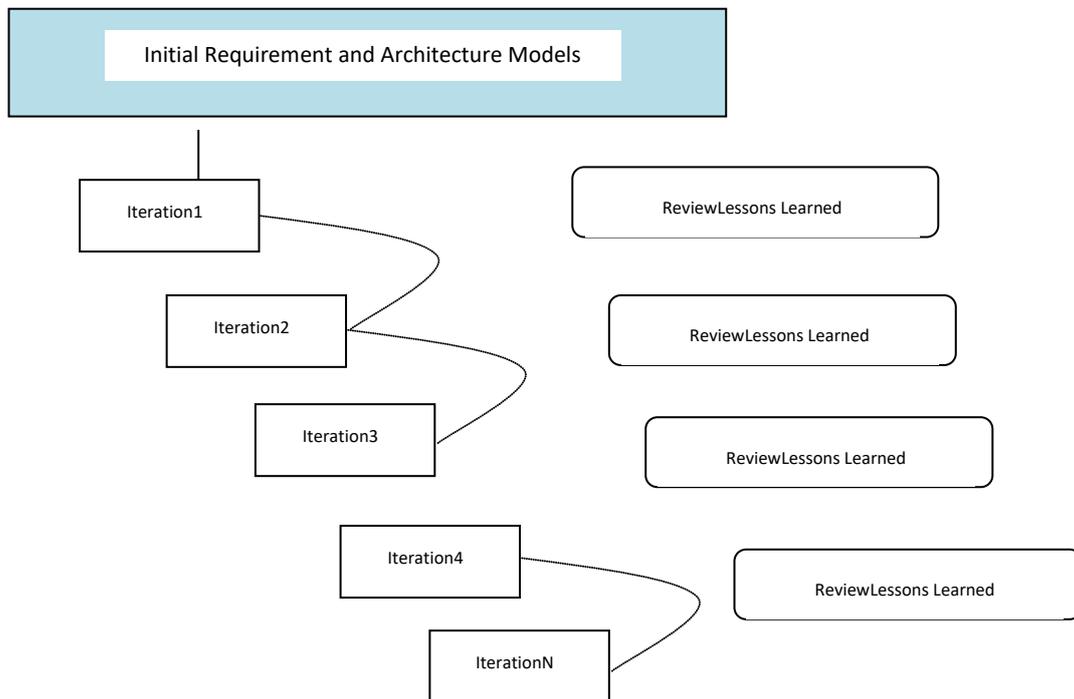
1. **Instability** - fixed user requirements which affect the process of software development.
2. **Can not be tested at a nearly stages**-inability to identify development stage problems.
3. **Prone to undercapacity** - System coding has to finish before we can be able to test the performance of the software.
4. **High cost** -costs increases as missing components and requirement inconsistencies can be identified at design and coding stages which increases the development needs.
5. **Debugging**-Considerable amount of time is expended to identify and fix bugs
6. **Separate teams**- Analysis and coding teams are separated

7. Importance is attached to documentation at every stage
8. Difficult to get customer requirement explicitly
9. IT-Compliant client is required to get good specification
10. Increment in the cost of maintenance

### **3.1 Agile Methodology**

Agile methodology is leap ahead towards advancement in software development. Having identified the shortcomings of waterfall model a more robust and customer/developer centered approach to professionally working software development was outlined in form of Agile Manifesto by (K Beck 2001).

- Adaptive to change in user requirement
- Development to satisfy users
- Software is delivered in releases
- Individuals are highly motivated for successful delivery
- Collaboration with yield successful results
- The progress of the project can be found by measuring the performance of the software
- The agile method encouraged sustainability of the development
- The focus is on design and technical excellence
- The design should always be simplified
- The project development teams are usually self-organised
- Team improvement should be regularly discussed at regular interval



**Figure 2.** Agile Development Methodology. Balaji, Sundararajan (2012) [2]

In this methodology various methods that are implemented include Feature Driven Development, Extreme programming, Dynamic Software Development Mode, Crystal, Lean Development, SCRUM, Adaptive Software Development, Spiral Methodology, Joint Application Methodology, Rapid Application Development, Rational Unified Process [2,3]. Agile methodologies phases overlap and requirements are gathered iteratively which are examined at each iteration which is easy to maintain and more cost effective.

### 3.2 Comparison between Waterfall and Agile Software Development Models

Even though there are advantages and disadvantages of each of the software development models both can be used to complete software development with each having been suitable for a particular scenario. Waterfall requirements are clear, easy in implementation, usage and management. However, the higher volume of documentation, difficulty in changing or updating the project once requirement is defined and it is also meant for simple or adaptive to object-oriented projects but it is better for short term projects. In the same vein Agile is adaptive, requires team face

to face communication but requires that developers with good technical skills are required.

The following table outline the major comparisons between Waterfall and Agile methodologies as adopted from [2, 13,14]

<b>Aspect</b>	<b>Traditional Development</b>	<b>Agile Development</b>
Fundamental hypothesis	It is specific, can be predicted and developed using extended and detailed planning	Based on fast feed-back and change, by small team, software that is of high quality with the use of continuous improvement in design and testing is developed
Style by the management	Control and command	Collaboration and leadership
Management of the knowledge	Clearly illustrated	Tacit
Communication method	Formal	Informal
Development model	Life cycle model is adopted (waterfall spiral, modified models)	Evolutionary-delivery model
Structure of the organisation	Mechanic (bureaucratic in nature, formal and high), meant for large organization	easy to use and inclusive, makes provision social cooperation, it is meant for small or medium organizations
Quality control	Not easy to plan, strict control, late testing and very difficult	Testing is done as the software is being developed, design, solution, control or requirement is permanent

User requirements	Details and definition before coding/implementation	Interactively inputted
Restart cost	High	Low
Development direction	Fixed	Can be changed
Testing	At the completion of coding	For each iteration
Client participation	Low	High
Required development abilities	There is no need	Business knowledge and interpersonal abilities
Project size	Large project	Low or medium size project
Development team	Well experienced with good technical skills.	Cooperative having a sound knowledge about the system with agility..
Clients	Have access to knowledge, representative, cooperative and empowered	Knowledgeable, Dedicated cooperative, empowered and representative
Requirement	Well known and stable	Rapid to changes and emergent
Architecture	Meant for predictable and current requirements	Meant for current requirement
Remodelling	Too costly	Not costly
Size	Project teams are large	Project teams usually small
Primary objectives	Safety is usually high	Rapid

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Page 117 Comprehensive Analysis of Software Development Life Cycle Models Harshad S. Modi<sup>1</sup>, Nikhil Kumar Singh<sup>1</sup>, Harsha Pradeepbhai Chauhan<sup>2</sup>

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