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Waterfall vs agile methodologies for research projects

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# Literature review

## Keywords

* Waterfall
* Agile
* Scrum
* Research

## Introduction

Whilst there are many programming methodologies each are used for certain situations and deciding which to use can be very important for any project. Here the discussion will be limited to just waterfall and scrum methodologies, and which one is more suitable for a research project.

## Waterfall

Waterfall according to (M. Mahalakshmi, 2013) is a methodology where a project is developed on a set path with no deviation. The methodology is made up of 5 stages first being the requirements stage where all of the project features, software and hardware requirements are assessed this is done to aid the next step. the design stage is where the development of the features is planned out often with pseudocode and diagrams to help developers understand how the project will work. next is the implementation stage where the designs are implemented, in terms of programming this is taking the pseudocode and the diagrams from the design phase and physically programming it to develop the project, next is the verification stage where the project is tested to see if it meets the requirements from the first stage and is it fails the verification then the project would be repaired to meet the requirements. The final stage is the maintenance stage where the project is released and maintained to ensure it still works as the original requirements asked for.

This model is very useful for developing a project with that can or should be fully planned out as the advantages for a project created using the waterfall methodology as stated by (M. Mahalakshmi, 2013) are that because it is a sequential model with no deviations in its development means that development can be comparatively fast compared to other models like scrum as all of the features are planned out and just need to be applied stopping the scope of the project from getting larger than expected bringing development times down. However, there are also some disadvantages to using this model which are that because it is sequential once one stage of the methodology is complete you can not go back to a previous stage meaning any issues that are found from one stage of the project can not be changed resulting in poor quality project unless plenty of time and resources are given to ensure that the project has no or at least few mistakes. This is also an issue as if a client or project manager wants any additional features halfway through development there is no mechanism within the waterfall methodology that would allow for those features to be added.

## Agile

According to (Khalil & Kotaiah, 2017)the Agile methodology is an adaption of waterfall to help avoid the issues of the Waterfall methodology as mentioned above, while the stages on an Agile project are similar there is a major difference with the Agile methodology is that previous stages can be revisited to add additional features allowing any project to be expandable resulting in a better project overall this can also be backed up by (Khalil & Kotaiah, 2017)showing the total number of failed projects using the waterfall and agile methodology as well as challenged projects i.e. incomplete project and a successful project with all required features added and as seen in appendix 1.1 the average fail rate for agile(9%) is lower than waterfall (20%) with success rates being 54% for Agile and 35% for Waterfall showing how Agile can be have better odds of being either successful or at least partially successful project. However according to (Sheetal Sharma, 2012) the disadvantages of an agile project are that the time and cost requirements can go greatly over the target if managed poorly as the project is poorly planned as the scope is increasing causing unpredictable time and development costs which can cause the project to fail. Also due to the constantly changing project it may be harder to document the project as the documentation is also constantly being changed and expanded making maintenance of the project harder.

## Which is better for the research project

Choosing a methodology for this research project is crucial as a bad choice may cause this project to fail as according to (Kaushal Chari, 2017) many projects fail due to not choosing a methodology compatible with the type of project being made. As this is a research project waterfall could be useful as the research for the project could be for its design elements however there is a risk in utilizing this methodology as mentioned before there is no back-tracking allowed on a Waterfall project, if the project fails then there is no more planning whereas Agile allows for a failed project to be reiterated on although at the cost of extra time. Another reason to use an Agile framework for this project is that extra features and discussions can be had if time is available. However Agile is a whole group of methodologies and picking a specific methodology should be considered. According to (Igor Ribeiro Lima, 2012) Scrum is a methodology that could be useful in research setting as it allows a project to be developed in a series of sprints to get individual tasks done. This makes it useful as a research project is difficult to define the scope of early on and having this be the methodology for researching and developing the artifact means that the project can be expanded for as long as there is time. An important feature of the scrum methodology would have to be changed however as according to (Marchesi, Mannaro, Uras, & Locci, 2007)Scrum works with teams for example a Scrum master, product owner and individual team members however this is a research project with only one member of the team meaning that many of these roles are redundant and are not required is the planned implementation of the Scrum.

# Conclusion

Overall Agile should be used in the research project as it allows flexibility in a field currently being studied and likely to need reiteration and redesigns to create the project successfully as well as further discuss potential features that could be added to the project or alternate ways for the project to be implemented. The specific Agile methodology chosen shall be Scrum as it provides the ability to sprint through features that can be expanded on as the research expands giving more liberty as a research to add to the project.

# Appendix

## 1.1

Table

Description automatically generated

Figure : figures from (Khalil & Kotaiah, 2017)showing the rates of success and failure of projects using the waterfall and agile methodologies

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