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Agile Methodology Adoption in Software Development: A Literature Review

Yogeswari Suppiah, Norzita Binti Duriat, and Setyawan Widyarto, *Founder, ICF*

***Abstract* –Agile software development have an important applications in the area of software development. It supports many activities in software development such as planning, analysis, coding, testing and maintenance. Successful agile adoption leads to producing higher quality software, enhancing developers moral and at a lower cost than other model approach. The aim of this paper is to provide a literature study on how agile methodology could benefit the software development processes. It emphasize on the benefits and advantages of adopting agile methodology in software development.**

Keywords: **Agile Methodology, Software Development, Agile Software Development**

I. INTRODUCTION

Agile software development is based on a group of software development methodologies that use iterative and incremental approach, where requirements and solutions evolve through collaboration between self-organizing, cross-functional teams. It's an iterative and incremental approach to software development which is performed by collaborative team members in self-organizing teams within an effective framework with simple rules that produces high quality solutions in a cost effective and timely manner to meet the changing needs of project stakeholders.

Agile processes are intended to support early and quick production of working code. This is accomplished by structuring the development process into iterations, where an iteration focuses on delivering working code and other artifacts that provide value to the customer and, secondarily, to the project[9].

Yogeswari Suppiah is with Faculty of Computer Science and Information Technology, University Selangor, Selangor, Malaysia.

Norzita Binti Duriat is with Centre for Foundation and General Studies University Selangor, Selangor Malaysia.

Setyawan Widyarto is with Faculty of Computer Science and Information Technology, University Selangor, Selangor, Malaysia.(e-mail: swidyarto@unisel.edu.my).

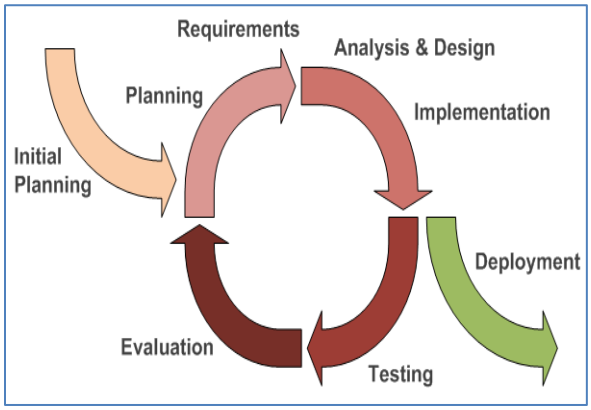

Figure 1: Iterative and incremental agile development process (source: http://agile-development-tools.com/)

An iterative and incremental (evolutionary) approach to software development which is performed in a highly collaborative manner by self-organizing teams within an effective governance framework with "just enough" ceremony that produces high quality solutions in a cost effective and timely manner which meets the changing needs of its stakeholders [8]. Agile software development is actually a group of software development methods based on iterative and incremental development, where requirements and solutions evolve through collaboration between self-organizing, cross-functional teams[6].

Agility, for a software development organization, is the power of software to choose and react expeditiously and fittingly to various changes in its surround and to the demands imposed by this surround. An agile process is one that readily embraces and supports this degree of flexibility. So, it is not simply about the size of the process or the speed of delivery; it is mainly about flexibility[7].

In this paper, the author will firstly define agile software development. Then, the authors discuss the method applied in this review paper. The main objective of this paper focuses on the benefits and advantages of agile software development, which will

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be discuss in the following section. Finally, the authors conclude their opinion about agile methodology.

II. METHOD

This study has been undertaken as a systematic literature review based on the original guidelines as proposed by [3]. The steps in the systematic literature review method which documented below.

A. Research Questions

The research question addressed by this study is:
What are the benefits and advantages of adopting agile methodology in software development ?

B. Search Process

The search process was a manual search of specific conference proceedings and journal papers from year 2010 till year 2016. The keywords such as "Agile Methodology", "Agile Methods", "Benefits of Agile", "Advantages of Agile" and" Agile Software Development" were used for selecting the papers. The selected journals and conferences are shown in Table 1.

Table 1: Selected journals and conference proceedings.

No.	Source
1	International Journal of Computer Science and Information Technologies (IJCSIT), 2014
2	Proceedings of the 2014 International Conference on Software and System Process - ICSSP 2014
3	International Journal on computer science and Engineering,2012
4	International Journal of Research in Engineering and Technology(IJRET)
5	International Journal of Advanced Research inComputer Science and Software Engineering

C. Inclusion and exclusion criteria

Articles on the above topics, published between year 2010 and 2016 were included. The articles about Agile Methodology, which does not emphasized on the benefits and advantages were excluded from the study.

D. Data collection

The data extracted from each study were:

- Title of Paper
- Journal
- Publication(Year)
- Problem Statement
- Proposed Hypothesis
- Research Methodology
- Research Questions
- Performance Measurement Used
- Data Used
- Specific Tools Used
- Analysis and Findings
- Future works

All the extracted data were summarized in a tabular format for analysis purposes. An extensive study conducted to extract all the benefits and advantages of Agile Methodology highlighted in the selected articles.

III. RESULTS

This section summarizes the result of the study analyzing the benefits and advantages of adopting Agile Methodology.

No.	Benefits and Advantages	Source (Author)
1	**a. Evolutionary Approach** Agile software development of short iterative cycles offers an opportunity for rapid, visible and motivating software process improvement. **b. Lightweight Methods** Generalize agile methods are lightweight processes that employ short iterative cycles, actively involve users to establish, prioritize, and verify requirements, and rely on a team's tacit knowledge as opposed to documentation. **c. Rapid Delivery of product** Agile development methodologies emphasize rapid delivery of software products to the clients **d. Highly tolerant of change requirements** It is the ability to respond to change that often determines the success or failure of a software project. **e. Accept prioritizing requirements** Agile methods break development tasks into small increments with	[6]

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	minimal planning and do not directly involve long-term planning. Iterations are short time phases that typically last from one to four weeks. **f. Active customer involvement a and feedback** Customers are actively involved, and get higher priority in agile approaches,face to face communication and continuous feedback from customer (product owner) always happen in agile approach. **g. Reduce cost and time** Agile development involves less cost of development as rework, management, documentation and other non-development work related cost is reduced. **h. Short Design phase involves early feedback from clients** Customer gets to know regular and frequent status of the application and delivery is defined by fixed timescale. **i. Self organized team** Agile product development practices introduce changes in team culture in an attempt to bringing reciprocal effects of royalty and commitment to the team and projects. **j. Documentation** Agile approaches, emphasis more is on developing the application only, and not on documentation. **k. Design Simplicity** Agile approach design is simple .Since change is inevitable, planning for future functions is a waste of effort. **l. Improves software quality** Agile developers take responsibility for the quality of the code they write. Inaddition to producing cleaner code, it means that if there are testing specialists on the project, they will start their testing with better software, which always results in more effective testing and a better resulting product. **m. Increase Business value, visibility, adaptability and reduce cost Agile** Agile software development	

	accelerates the delivery of initial business value,and through a process of continuous planning and feedback, ensures that value continues to be maximized throughout the development process. **n. Success possibility** Agile practices benefit in terms of increased project success rate and user acceptance, better risk management, delivery of quality content on time and most important adjust to changing requirements .	
2	**a. Improved communication** Improved communication and coordination among team members. Improved awareness of team members' activities. **b. Quick Releases** Developers create demo-able releases every few weeks instead of every few months or years. This makes it easier to keep track of progress and monitor software quality. **c. Flexibility of Design – Quicker Response to Changes** Short sprints combined with more emphasis on customer feedback led to better agility and efficiency in responding to changing requirements, internal processes, reorganizations or politics, and flushed out bad designs more quickly. **d. More Reasonable Process** The process supports "real-time tracking of progress and ability to adjust future forecasts based on real data." Agile methodologies are more dynamic and incur less overhead. **e. Increased Quality** The quality of the software is a strong concern of developers. The effects were manifested as fewer bugs, and a more stable set of features.	[1]
3	**a. Rapid, iterative and incremental delivery** Project delivery is divided into small functional releases to check functionality, to manage risk and	[2]

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to get early feedback from customer and end users. Project plans, requirements, design, code and tests are created initially and updated incrementally as required to adapt toproject changes. This helps in checking andmonitoring the software functionality progress frequently rather than at end of long milestones.

b. Increased performance

Daily stand-up meetings provide an opportunity to exchange valuable information and to fine tune improvements continuously. Frequent and better communication leads to increased knowledge sharing and trust among team members which increases the team productivity and generates better performance in terms of good Return on Investment.

c. Flexibility of design

Flexibility is based on the development process used for the project and is defined as ability to change directions quickly. The main feature of Agile approach is to adapt to changing requirements quickly which enables the design to be made flexible that can handle changes easily.

d. Adaptive to the changing environment

Using agile software development approach, software is developed over several iterations. Eachiteration is characterized by analysis, design, coding and testing. The working software is delivered to the customer and end user for their use and feedback after every iteration. Agile approach encourages and implements any change requirement from the customer at any stage of development to upgrade the software.

e. Reduces risks of development

As the incremented mini software is delivered to the customers after every short development cycle and feedbacks are taken from the customers, it warns developers about the upcoming problems which may occur at the later stages of development. It also helps to discover errors quickly and they are fixed immediately.

f. Working software

Agile development's commitment to the delivery of working, tested software at recurrent intervals ensures a much greaterreliability andopportunity to incorporate the user and technology- driven feedback. Agile practices focus on working software that provides greater feedback which makes agile projects easier to manage and customer gets the best product as learning is incorporated.

g. Ensures customer satisfaction

Agile methodology encourages active customer involvement throughout the software development lifecycle. The deliverables developed after each iteration is given to the user for use and improvement is done based on the customer feedback only. So at the end what we get as the final product is of high quality and ensures the customer satisfaction as the entire software is developed based on the requirements taken from customer.

h. Avoids over production

The traditional system requirement document is still built where many features are not wanted or required. These "low" or "no" value features are at the bottom of the backlog but they still get built in Waterfall. On contrary, Agile approach builds the best product by building it for now and not later.

i. Improvement in quality

Breaking down the project into manageable units or sprits allows the project team to focus on high quality development, testing, and collaboration. Quality is also improved by producing frequent builds and conducting continuous testing and customer feedback during each iteration. Test-driven

	development and refactoring is often used in finding and fixing defects quickly and identifying expectation mismatches early that leads to higher code reuse and better quality. **j. Least documentation** The documentation in agile methodology is short and to the point as internal design of the software is usually not documented. The main content in the documentation are product features list, duration for each iteration and date which saves the development time and deliver the project in least possible time **k. Fault detection** Organizationalprocesses demandhigh quality bug free software.A continuous testingand integrationcharacteristic of agile methodologies such as XP enforces the delivery of high quality bug free software. As testing is performed during each iteration, error and faults are identified earlier and are fixed instantaneously before it increases in severity. **l. Best practices** Incorporating some well-known Agile practices can help the teams employ highly competent, well-tested applications across the required spectrum of platforms and devices. Agile forces "architecture killers" to the start of the project. Better to fail early, not late - when all the money has been spent, most changes have low cost of change.	
4	**a. Adaptive to the changing environment** In agile software development method, software is developedover several iterations. Each iteration is characterized by analysis, design, implementation and testing. After each iteration, the mini project is delivered to the customer for their use and feedback. Any changes that upgrade the software are welcome from the customer at any stage of development and that changes are implemented.	[9]

	b. Ensures customer satisfaction This methodology requires active customer involvement throughout thedevelopment. The deliverables developed after each iteration is given to the user for use and improvement is done based on the customer feedback only. So at the end what we get as the final product is of high quality and it ensures the customer satisfaction as the entire software is developed based on the requirements taken from customer. **c. Least documentation** The documentation in agile methodology is short and to the point though itdepends on the agile team. Generally they don't make documentation on internal design of the software. The main things which should be on the documentation are product features list, duration for each iteration and date. This brief documentation saves time of development and delivery the project in least possible time. **d. Reduces risks of development** As the incremented mini software is delivered to the customers after every short development cycle and feedbacks are taken from the customers, it warns developers about the upcoming problems which may occur at the later stages of development. It also helps to discover errors quickly and they are fixed immediately.	
5	**a. Adaptability** Agiledevelopment takes more emphasis on adaptability.Agile willing to accept changes, even in the latter process ofsoftware development. Its own methods of system design and system builders can quickly respond to changes in customer demand. It ensure that the results of the last iteration is the customer's really needs, and it meets changes of market. **b. Teamwork** Agile software process is people-	[4]

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	centered rather than process-centric.They believe that individuals and their inter- actions important than processes and tools.The center of Agile development is to establishment project team with positive staff. Give them the necessary environment and support, having full of confidence to their work. In the project group, the most useful and most effective way of communication is face to face conversation. It embodies the principles of human-centered.	
6	**a. Customer satisfaction** ASD is giving high importance to customers.The agile practices aim to satisfy customers by producing valuable pieces of the final product early in the development lifecycle than handing in a finished product towards the end of the contract, as is normally done by traditional software development practices. As the customers are concerned about the working software, the ASD practices do not give importance to artifacts such as requirements and design drafts. TheASDpractices emphasize fast and early delivery of pieces of software incrementally in shorter timescales. **b. Changing requirements** ASD practices to continuously accepting changing requirements even late in the development.The ASD practices are targeted to cope withthe turbulences and uncertainties that typically accompany modern-day dynamicbusiness environments.	[5]

IV. CONCLUSION

Agile Software Development is based on iterative and incremental development approach in a highly collaborative manner to produce high quality software in a cost effective and timely manner which allows the project to adapt the changes quickly. Agile methodologies emphasized on delivering the smallest working piece of functionality as early as possible and constantly improving it and adding additional functionality throughout the project lifecycle. Agile helps in minimizing and mitigating the overall risk, and allows the project to adapt to changes quickly and does not require a requirements freeze upfront unlike waterfall model. Work is carried out in iterations, which typically last one to six weeks.Agile methods emphasizes effective communication over written documents. The key benefits of the agile methodology are rapid delivery of products, high tolerant of change of requirements, improve software quality, improved communication, reduce risk, ensure customer satisfaction, least documentation, fault detection and etc.

V. FUTURE WORK

The research has studied the findings of researcher's of Agile Methodology and Agile Software development in order to understand its benefits and advantages. In future , the finding from this study need to be validated by conducting research for a selected project that had been adopting to this methodology. Only then, it would be possible to confirm the result extracted from this study. Future research also could explore and compare the benefits and advantages of agile methodology in different variants such as project size, organizational environment etc.

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Yogeswari Suppiah was born in Selangor, Malaysia, in 1977. She received her first degree, B.Sc. (Hons) in Computer Science from the University Putra Malaysia, year 2000. Currently she is pursuing Master in Information Technology at University Selangor. Her current research interest includes cloud computing, big data analytics and agile software development. In 2000, she joined Department of Academic, Systematic Education Group of Colleges
(SEGI), as a Lecturer. She had became course coordinator and promoted as Head of Department. She was appointed as senior lecturer at KLMU (Kuala Lumpur Metropolitan University) in year 2008. Then, in 2012, she was attached with Asia Pacific University(APU) .

Norzita Duriat was born in Selangor, Malaysia in 1978. She received her first degree from University Malaya, Malaysia in 2003. She is a Master in IT student affiliated with the Faculty of Computer Science and Information Technology, University Selangor. In 2009, she joins University Selangor as an assistant lecturer at Centre for Foundation and General Studies. Her interest in research includes agile software development, mobile and web application.

Setyawan Widyarto was born in Purwokerto, Central Java, Indonesia in 1963. He received first degree from IPB Bogor in 1986 and M.Sc. degrees in Manufacturing System Engineering and Management from University of Bradford (UK) under Chevening Awards (British Council) in 1998. In 2008 he finished his Ph.D. degree in Computer Science from University Teknologi Malaysia. in 2008, he joined University Selangor (Unisel). Since 2012, he has been an Associate Professor with the Computer Science Department (Industrial Computing), Unisel Bestari Jaya, Kuala Selangor. His research interest includes (agile) software engineering, virtual environment/reality and image processing. He is an editor member of some journals.