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# Analysis of Adapted Agile Methods Based on Mobile Application Development Process

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> *Received: May 19, 2017 Accepted: July 18, 2017*

# ABSTRACT

Mobile application is increasing in popularity due to the emergence of smart phones. The mobile application development has to accommodate the rapid changes based on the user needs and demands. Methods and tools are crucial to develop mobile application faster. Agile is one of the methods that robust and suitable in developing mobile application. This paper aims to review the existing agile methods that include Extreme Programming, Dynamic Software Development Method, Scrum, Crystal, Feature Driven Development, Test Driven Development, Lean Software Development and KANBAN. Besides, discussion about the phases of mobile application include MobileD, RaPiD7, Hybrid, MASAM, SLeSS and Lean Six Sigma. These adapted agile methods are then compared based on the mobile application development phases. In conclusion, most of the adapted agile methods emphasis on the development and testing phases, and give minimal time for design phase. **KEYWORDS:** Agile, Agile Methods, Mobile Application, Mobile Application Development Process.

# INTRODUCTION

Mobile application is a term used to describe any Internet application that run on the smart phones and other mobile devices. It gets the attention of the users because it is easier and faster to help them in their daily activities [1]. The mobile application features and functions change fast and tremendously due to the users' demands. Therefore, the mobile application developers need to produce mobile application that suit and meet the requirements every time it changes or improves. Mobile application development has to be fast growing from time totime and developed rapidly [2-4]. The developers need to deliver faster to the users in order to get the latest updates of the application [3].

To compete and produce mobile application faster and quicker, most of the developers implement the agile methods. Agile methods help to build software rapidly and continuously. Basically, agile methods focus on programming and development phase. The developers take two to four weeks to develop the application and then start to add new features. In the development phase, it divides into smaller parts to reduce risk, allow rapid changing requirements and develop application within time frame and cost [4].

The most common agile methods [5-6] that are used in the software development include Extreme Programming (XP), Dynamic Software Development Method (DSDM), Scrum, Crystal, Feature Driven Development (FDD), Test Driven Development (TDD), Lean Software Development and KANBAN. Some agile methods have been adapted to suit the mobile application development process. These adapted methods [4,7] include MobileD, RaPiD7, Hybrid, MASAM, SLeSS and Lean Six Sigma. This paper aims to compare these adapted agile methods based on the mobile application development processes to highlight their strengths and weaknesses.

### **AGILE METHOD**

With the rapid changes of requirements, the software development models also need to support delivery of software within the reliable time frame [8]. Agile method is one of the popular models in software development, which is able to develop application that rapidly changing, short development period and in small teams [2, 8-9].

# **Extreme Programming**

Extreme programming (XP) is a well-known agile method that focuses on user requirements. XP always responsive to the changing of user requirements and the role of user or customer is really important when implementing XP as the development model [5, 9-13]. XP suits small team with small development project within short time period of development [5,11]. The team normally consists of two expert programmers that do

all the design, coding, testing and release of the application. As rapid changing of mobile application requirement, XP is really suit to mobile application development too. Its processes include Planning, Managing, Coding, Designing and Testing [9,11-13]. In planning phase, the developer discusses with the users to gather all requirements. Then, the project divides into smaller modules, and the team members need to complete their tasks. During development phase, the users can request any changes to the application and the developer has to do it based on the requirements. XP also focuses on coding phase and simple designing for the application. Then, it continues with the testing phase to fix the bugs or errors besides entertaining the user's feedback, and lastly release the application.

#### **Dynamic Software Development Method**

Dynamic Software Development Method (DSDM) is a framework for building and maintaining large systems, which is implementing in tight schedule [14]. DSDM is incremental and iterative framework and have flexible and adjusted for changing requirement [5,14]. DSDM develops application with efficient management of budget and time. It has four phases, which are feasibility, functional model iteration, design and build iteration, and lastly implementation [8,14]. In feasibility phase, the objective of project is defined and discussion about the project model, technical and other aspects is conducted. In functional iteration model, the model and software component is built and analyzed. The testing of application is carried out during system engineering phase, the sub-phase of system design and build iteration phase. Lastly in the implementation phase, it migrates the application from the development environment to operational environment includes training to the users and handing over the system.

#### SCRUM

Scrum is an agile method framework that applicable on managing iterative and incremental development. Scrum quick delivers the application to the end user. Development time in scrum is within two weeks to one month. Meetings are conducted every day to discuss progress of the teams [2]. Besides, this method focuses on user satisfaction. The priorities of application will be determined by the user. The team will decide the sequence of development. Lastly, the final product will be delivered and documented and the team continues to develop next priority of product [8].

#### **Crystal Method**

Crystal method is a toolkit of methodology, which suits on individual project, focusing on communication in small teams [5,13]. Usually, this method is implementing in small projects that are not critical and the development process can takes up to four months. There are two rules which the incremental cycle must within four months and reflection workshops are conducted after delivering the products to ensure the methodology will self-adapting. In crystal method, the focus is on people, interaction, community, skills, talents and communications which emphasis on performance.

### **Feature Driven Development**

Feature Driven Development (FDD) focuses on application features. FDD concentrates more on planning and design. The process is started when FDD team has user requests and requirements. Then, they list the features of the application. The development normally takes few hours or days but less than two weeks to complete. The application can deliver in short time because the team is divided into small teams based on their works and responsibility. They work parallelly. FDD has five phases which are developing an overall model, building a feature list, planning by feature, designing by feature and building by feature [15].

#### **Test Driven Development**

Test Driven Development (TDD) focuses on testing during development [16]. After running the test successfully, the codes will be refactored to improve and this cycle continues until the whole functionality is completed. TDD consists of six phases which starts with writing the test, running the test, writing code passes the test, running the test to verify, refactoring the code and run all tests to see the results.

#### KANBAN

KANBAN is a simple agile method that manages the development with minimal work to the development team [17]. KANBAN visualizes the workflow, limit work in progress, manage flow, make policies explicit, create opportunities for feedback and improve collaborative and experiment of the development application.

The review of agile methods gives general idea of software development phases and it is useful for the matching steps with the mobile application development process in this paper.

## MOBILE APPLICATION DEVELOPMENT PROCESS

Mobile application is a trend now and gets the attention of the users because it makes life easier, simplify the works and can be entertainment to the all categories of users. Normally, the vendors develop the software based on software development lifecycle process and framework as lifecycle model [18]. Examples of models in developing process are waterfall, spiral, iterative, incremental, V model, agile model and RAD model. However, recently most of the mobile application developers tried to use agile methods because of its nature. In developing mobile application, the common phases in developing mobile application are discovery phase, design phase, development phase, testing phase and deployment phase [18-19].

# **Discovering Phase**

In the preliminary phase, it starts with requirement analysis, system definition, and prototyping. The idea is being categorized and the developer will put a rank based on their priority [18]. The requirements are collected from the developers' team or the users of the application by conducted meetings and discussions between them. The developers prepare the framework and specification of the application to make the next phase smooth and easy. The developers also plan the period of time development, the costing, improve the usability to meet the users' needs and expectations. The collection of requirements are then analyzed by using 5W's of problem statement: who, what, where, when and why, then the statements will be ranked based on priority.

### **Design Phase**

The process will continue with design phase. In this phase, it includes the process of system design, database design; define the availability of application on multiple platforms before select the platform [18]. Using the prototype, the application is divided into smaller modules and storyboard for user interface interaction. Then, architecture design is ready and the integration of existing data, functions and systems has to be decided. All the design works are then documented and the development team will proceed to implement coding [18-19]. The right choice of application platform is important in this phase to make sure the application is going to success in the market.

#### **Development Phase**

In development phase, the design will transform into coding [18-19]. During the development, modules in the application can be developed in parallel. There are two stages which are coding for Functional Requirement, and coding for User Interface Requirement [18]. Development of application is based on the requirements and decided designs. After coding, the developer will complete the documentation of development phase.

## **Testing Phase**

The testing phase is really important to ensure the application meet the functional requirements and user requirements. When the application is tested and needs some changes, it will send back to the developer. The tester will create test cases to test the application. Then, the test cases will be documented and send to user for feedback [18]. Testing phase needs to be done carefully because the tester has to ensure the application can work well either on functionality of application or based on requirements. Besides, the task of tracking and audit process is documented to keep track all the changing tasks and change control.

#### **Deployment Phase**

Deployment phase is the final phase of mobile application development. The application will be uploaded into the market or application store to be subscribed and downloaded by the users [18-19]. Before the developers deploy the application, they need to ensure the following steps [18] which are:

- Register as developer and pay the fee;
- Check and understand the rules and regulation for deployment process at the application store;
- Refine the application by removing all log files and comments;
- Design the icon and wallpaper to be used on the application store;
- Create the file format required in operating system platform.

After deployment process, the developer continues to maintain the application based on the user feedbacks or changes to improve it from bugs and fulfill the user needs. These five common phases in developing mobile application will be used as the comparison criteria in the next section.

# AGILE METHODS FOR MOBILE APPLICATION

Agile method has advantages when implemented in the mobile application development due to its nature. Mobile application is changing rapidly to meet the user demands. It is suitable to implement agile method as model during development because agile takes shorter development time and accommodate changes according to the user requirement. Besides, agile supports incremental development of product.

Agile allows development of application that change rapidly, move quickly, short development period and in small teams [2,8-9]. All agile methods comply with the manifesto which focuses on four core values for high performance, efficiency and good outputs [5,8,13,15,20]:

- Individual and interactions over processes and tool.
- Working software over comprehensive documentation.
- Customer collaboration over contract negotiation.
- Responding to change over following a plan.

These core values are further derived in 12 agile principles which are customer satisfaction through early and frequently delivery, scope for changes even at a later stage in the project, sort delivery cycle, collaboration between businessmen and developer, motivation among individual, face to face communication, working software-primary measure of progress, promoting sustainable development face, continuous focus on technical excellence and good design, simplicity, self-organization to obtain best result and self-improvement [8,13,15,20].

Therefore, any extended agile methods used in the development of mobile application have to comply with these core values and principles. The following section continues to review adapted agile methods, which are used to develop mobile application.

### MobileD

MobileD is an adapted agile approach to develop mobile applications. MobileD is related to Extreme Programming, Crystal and RUP [4]. MobileD is suitable to be implemented in small project and the short cycle development. Therefore, MobileD is good to be implemented in mobile application development because life cycle of development is short and fast. MobileD takes two to eight weeks to deliver a product and work in small team, which less than ten members. Table 1 shows the development phases in MobileD. MobileD focuses in reducing the development cycle so the product can be delivered faster. As a result, this method will be less emphasis on assuring the security, safety and performance [21].

# Table 1: Phase of development in MobileD

Phase	Process Description
Explore	Planning the strategy and project component; Decide the development team; Assign the user that will act as operative during development.
Initialise	Conduct meeting with user to get the requirement and user's needs; Complete the project set up, initial planning, trial day.
Productionise	Development process, prioritising and analyse the requirement, iteration content and testing; Release application that proved by acceptance testing.
Stabilise	Final product complete; May occur modification.
System Test and Fix	Testing the application; Ensure the application meet the user requirement.

# RaPiD7

RaPiD7 is agile method that focuses on rapid comprehensive documented and improves the documentation of project [22-23]. In RaPiD7, they do not assign many people or customers to do the documentation like traditional way. The users that responsible on documentation have been assigned in the early stage of document writing so they will know how and what they need to do [23]. In RaPid7, a workshop or set of meetings will be conducted to brief and practice the documentation. In the workshop, a small group of editorial works will be finalized. The life cycle of documentation runs sequentially with the project life cycle because the objective is to approve and produce the documentation within one week. RaPiD7 takes one week to complete and the members are less than nine. There are seven phases include preparation phase, kick off phase, idea gathering phase, analyzing idea phase, detailed design phase, decision making phase and closing phase [20,22-23]. Table 2 shows the processes occur during every phase.

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Phase	Process Description
Preparation	The goal and team will be prepared and assigned; Planning the project details.
Kick off	Understanding of the project including goals, scope and terminology.
Idea Gathering Phase	Collecting the idea by discussion, brainstorming in the workshop.
Analyzing Idea Phase	Analyse the idea by remove duplicate idea; Making cluster or group type of idea.
Detailed Design Phase	Briefly discuss about process of the project; Writing the documentation in right format to ease the next phase.
Decision Making Phase	Finalise the decision to final result; The best solution will be selected.
Closing Phase	Decide the goal is achieved or not; Decide to have next workshop or not.

# Table 2: Phase of development in RaPiD7

# Hybrid Methodology Design

Hybrid Methodology Design (HMD) is agile method that based on combination of two existing agile methods, which are Adaptive Software Development (ASD) and New Product Development (NPD). HMD applied top down development, iterative incremental process, gives priority to requirement and always looks at methods have been built, revision and decide next priority for next iteration [20]. HMD consists of seven phases [20] as in Table 3. HMD is suitable for large project. It can be completed between four to eight weeks and less than nine members in the team.

Table 3: Phas	e of develop	ment in HMD
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Phase	Process Description				
Idea Generation	Collect the idea.				
Project Initiation	Understanding of the project including goals, scope and terminolog Preliminary analysis; Business analysis.				
Analysis	Detailed analysis; Creation of Functional Prototype.				
Design	Architectural design; Detail design.				
Implementation	Adaptive Cycle Planning; Concurrent Component Engineering; Updates to Component Library.				
Test	Quality Review; Market Testing.				
Commercialisation	Published application into market.				

### MASAM

MASAM is another agile method in developing mobile application. MASAM is the combination of Extreme Programming, AUP, RUP and system process engineering meta-data [4]. MASAM implements simple project cycle that is suitable for small project and company for mobile application development. It works on small team and takes three to twelve weeks to finish. MASAM has four phases which are preparation phase, embodiment phase, development phase and commercialization phase [4, 20]. Table 4 shows the processes and brief description for each phase.

# Table 4: Phase of development in MASAM

Phase	Process Description
Preparation	Define the product; Assign role and responsibility of the team member.
Embodiment	Define and understand the user requirement; Define the architecture of project; Design for user interface design.
Development	Develop application; Environment of application will be setup; Release planning; Iteration cycle.
Commercialization	Acceptance and user testing; Product will launch and focus of sales.

#### SLeSS

SLeSS can meet the changing of requirements during development phase. SLeSS focuses on performance and the quality of the project [4,20]. SLeSS is an integrated agile method between Scrum and Lean Six Sigma (LSS). SLeSS has two approaches which are customization product backlog for customization during mobile application development process and LSS product backlog for improvement of the process [20]. SLeSS allows the changing requirement in the later stage of project. It also reduces the time of mobile application development that helps in meeting deadline. This method also makes the development cycle shorter so the delivery process will be more rapidly.

Phase	Process Description
Definition	Revise the planning and discuss the intial analysis of development.
Measurement	Collect the requirement from user; Discuss the input ant the output of the project; Discuss the process and map of the project, measure and inspect the system.
Analysis	Analysis the inputs and requirement of the project.
Improvement	Development phase and final capability of the processes.
Control	Do the control plan.

SLeSS ensures high performance and high quality of mobile application, increase productivity within short time of development cycle, reduces the cost with fewer defect and failures of the projects. SLeSS development cycle is normally between one to two weeks. The team in the project should be four to nine members. They conduct a meeting with the users to discuss issues and decide the priority of the application.

# Lean Six Sigma

Lean Six Sigma (LSS) is one type of SLeSS, which is different from Scrum. LSS is a framework that complements Scrum as a development methodology [20]. LSS is a measure of quality, disciplined, data-driven approach and method to eliminating defect in the applications. It has tools and techniques to improve the quality of mobile application [24]. LSS can complete the project between one to two weeks and work on small team.

LSS has Define, Measure, Analyze, Improve and Control as the phases of mobile application development [20, 25]. Table 6 shows the phases and brief description about the processes.

Table 6: Phase of development in LSS				
Phase	Process Description			
Definition	Define the problem; Define the goal of project.			
Measurement	Measure the existing project; Collection of data.			
Analysis	Analysis the input of processes; Analysis the factor of problem or issues.			
Improvement	Action plan; Decide solution.			
Control	Maintain the improvement achieved and monitor; Deploy improvement.			

### **RESULTS AND DISCUSSION**

Based on literature, all the existing agile methods and adapted agile methods focus on short cycle of development. Phases in every method include user requirements and it allows the changing requirements during development phase. Table 7 shows the comparison of agile methods in mobile application in term of project characteristics.

Table 7: Comparison between adapted agne methods							
Characteristic	MobileD	RaPiD7	HMD	MASAM	SLeSS	LSS	
Project Size	Small	Small	Large	Small	Small	Small	
Time (weeks)	2-8	1	4-8	3-12	1-2	4	
Number of Member	2-10	3-9	3-9	2-10	4-9	4-9	
Number of Phase	5	7	7	4	5	5	

Based on the comparison, most of adapted agile methods focus on the small project, with number of working team members from 2 to 10 persons. Besides, for small projects, the shorter time to complete the development is one week and the longest time is around 8 weeks. From the table, there is different number of phases across the adapted agile methods based on the mobile life cycle development phases.

Table 8 shows the mapping and comparison of mobile life cycle development phases with the adapted agile methods. Based on the comparison, every adapted agile method has discovery phase, although different terminologies are used. It indicates that the priority is given to the user requirements gathering process. It is aligned with the manifesto of agile method which emphasis on the customer collaboration, responding to change requirement based on users' needs and giving the highest priority to user satisfaction.

Phase	MobileD	RaPiD7	HMD	MASAM	SLeSS	LSS
Discovery	Explore Initialize	Preparation Kick Off Idea Gathering Analyse Idea	Idea Generation Project Initiation Analysis	Prepara-tion	Definition Measure-ment Analysis	Definition Measure-ment Analysis
Design	-	Detailed Design Phase	Design	Embodi-ment	-	-
Development	Productio-nise Stabilise	Decision Making Phase	Implemen- tation	Develop-ment	Improve-ment	Improve-ment
Testing	System Test and Fix	-	Test	-	Control	Control
Deployment	-	Closing Phase	Commerciali- sation	Commerciali- sation	-	

#### Table 8: Mappling of mobile application life cycle and agile methods phases

All the adapted agile methods have allocated very minimal time for design. It is due to the requirement keeps changing even during development process in mobile application. The team focuses on quick response to change and continuous development. Besides, simple and minimal design in mobile application makes the application easy to use and the most important is the functionality and update with current requirements.

In development phase, all the adapted agile methods focus on coding, implementation and fast delivery. Most of adapted agile methods concentrate on discovery, development and testing phases of mobile application because they need to deliver application based on user's needs and the application must run successfully without any errors.

MASAM emphases on test-first development, which minimize the error rate after deployment. After completed all phases in MASAM, the mobile application will be deployed. The team will survey the current market to ensure their product will get attention and feedback from users. Only MASAM and HMD have commercialization process in deployment phase, which they focus on sales of the product. After completed all

phases, the phases will iterate to discovery phase. In term of the documentation, only RaPiD7 gives more attention to complete the documentation.

MobileD can be categorized as the most comprehensive agile method, which fully implemented all the phases in mobile application development based on short life cycle of development and fast delivery. However, the design phase in MobileD needs to be improved because of attractive and user-friendly mobile application interface design can influence the user to download the application.

# CONCLUSION

Mobile application is a trend and needs to be developed quickly and fulfilled the changing demands of the users. The paper reviews agile methods as an option for rapid software development. Besides, the common development phases in mobile application are also reviewed. This paper highlights the comparison of adapted agile methods based on mobile application development processes. All agile methods have basic mobile application development. The most important phases are discovery, development, and testing phases in adapted agile methods for mobile application development. The comparison found that the adapted agile methods are less focus in design and deployment phase. The main focus is on coding and testing to produce workable application based on user requirements in shortest time and deliver fast to the market.

# ACKNOWLEDGEMENT

The authors express appreciation to Ministry of Higher Education (MOHE), Malaysia through Fundamental Research Grant Scheme (600-RMI/FRGS 5/3 (163/2013)) and UniversitiTeknologi MARA for sponsoring this paper.

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