Proceedings of the Third International Conference on Trends in Electronics and Informatics (ICOEI 2019)
IEEE Xplore Part Number: CFP19J32-ART; ISBN: 978-1-5386-9439-8

# An Analytical Comparison of Mobile Application Development using Agile Methodologies

Bhavit Mathur[1], Shashank Mouli Satapathy[2*]
School of Computer Science and Engineering
Vellore Institute of Technology, Vellore
Tamil Nadu, India.
[1]bhavit.mathur2017@vitstudent.ac.in
[2]shashankamouli@gmail.com

***Abstract*—Purpose and Motivation:** **The rapid progress in mobile applications and the highly competitive environment increase the number of mobile application projects. *Problem Statement:* The purpose of the study is to find an appropriate approach that meets the requirement of mobile application systems. *Methods:* We will study agile processes to meet the requirements, making mobile application development simple and well-suited wit the characteristics of mobile devices. It was discovered that agile methodologies are best suited to the development of mobile applications as they are small time, need suppleness reduces misuse and promotion of time. *Results:* We have studied several agile approaches, but no research provides specific reasons to adopt Agile as necessary model for development of mobile applications. *Conclusion:* For mobile application development, we have proposed the modified Agile methodology that would the best Agile approach and that meets the strengths of each selected approach for mobile software engineering and removing the weakness.**

***Keywords*—Agile Hybrid Approach; Agile Methodologies; Crystal; Feature-driven Development; Mobile Software Development; Scrum.***

## I. Introduction

The evolution of software development methods have been taken place since seventies. Agile techniques have been adopted to put up the active needs of business and for better understanding of software application development. The Agile methodology additionally offer services to firms to create the correct product which makes them aggressive within the market place. Therefore the main aim of this report is to full fill the needs throughout the development. It is been regarded that agile techniques are roaring in analyzing many cases where there has been some contradictory reports that believed that agile methodology is not sufficient to for complete success. This study is a trial in reconsidering the literature published on agile techniques operations for the event of mobile software package event as the researchers supposed that agile methodology solves the problem of mobile specific applications that needs high quality development processes [1].

The agile approach is regarded as one of the best fitting approach for mobile application development [2], [3]. Recently because of the growing competition of software market more flexible methods have been is search by the researchers that can accommodates dynamic things wherever computer code necessities changing dynamically over time. The aim of the agile approach is help software development practices where at any point changes are acceptable and inescapable biological process changes may be identified [4].

The agile methods can also facilitate software development processes, where at any stage the changes are accepted. Many unavoidable development changes could also be identified [5].

## II. Agile Methodologies

In the past few years several Agile methods have been implemented by researchers in various fields [6]. A several most popular agile processes include:

- **Extreme Programming (XP):** A method which emphasis on software development and in which society of application programmers is growing to deal with the issues of fast delivery of good software, so developing it suit the business wishes constantly changing. The most of the XP features consists small iterations with few publication and quick reactions [7].
- **Scrum:** associates degree empirical approach supported flexibility, ability and productivity during a unstable setting [8]. The certain techniques, methods for the implementation technique opt by the programmers for the particular code development.
- **Agile Modeling (AM):** This methodology creates progressive models to help acute style desires and by turning them small [9].
- **Crystal:** It consists of several ways to pick out the foremost appropriate one and craft them for every single task [10]. Larger comes are doubtless to kindle further management and difficult ways than simpler ones.
- **Dynamic systems development methodology (DSDM):** It adjust the time and resources to achieve the practicality rather than adjusting its quantity in an exceedingly product [11]. It is most popular for mend time and resources.
- **Adaptive software package Development (ASD):** The production and development of software package is done by ASD methodology. ASD is an element of speedy software advancement and stress on speedy production and development of software package systems [12]. The crisis of huge and complicated systems

can be solved by progressive and unvaried improvement.

- **Feature-driven development (FDD):** This methodology lay stress on the planning and constructing phases, focus quality aspects all over the method. They help in advancement of project with correct observations by containing quick and concrete delivery of software [13].

## III. Mobile Software Development

The progression in the mobile application project is due to the rise in mobile application systems and strong fight between firms. The development of mobile functions is very difficult due to quickly dynamical business needs and some limitations for mobile systems. Therefore, programmers highlighted the challenge of a dynamic surrounding and therefore change the needs of mobile features .Many studies are advised an answer to the higher than threats. Hence it has been reported that Agile methodology could be the perfect match for mobile features.

The standard, capacity and restricted consideration of suitability of various software system follows for mobile featuring development create opportunities for readers and researchers in computer science and companies looking for a model which is appropriate for mobile applications development. Agile method have provide quality software to programmers in past decade, while the investigations and results revealed are still rather limited. It has been seen that the development of mobile applications is same as the software engineering for some embedded applications [2].

## IV. Related Work

According to Nari Kannan [3] Agile Development perfectly fits Mobile Software Development. He describes plenty of ways confirming that agile techniques suites validation and experimentation of mobile applications. Holler [2] believes that agile processes creates many opportunities for development of mobile application. For this he introduces trivial development methods and reduces interfering processes. The necessary needs and limitations related to mobile software development bring new obstacles to application development as there are many changes in the system for efficient mobile software development.

The study in agile approach developed by Abrahamsson et al. in 2005 [14] established that agile technique is best for mobile development surroundings and projected a novel technique Mobile-D. Mobile D approach consists of five phases each of which further have various stages and jobs. Even if the Abrahmasson approach on mobile application development is very helpful but even though the description of the technique is superficial and incomplete. The fitness of Agile approaches for mobile application development is completely studied by Spataru et.al in 2010 [6]. Various amounts of improvements is required in the existing Mobile-D methodology and working on these improvements with proper experiments and testing for mobile application development.

A distinct approach called Hybrid Method Engineering to mobile software development proposed by Rahimian et al [15]. Methodology Engineering is also a regulation committed creating methodologies applicable for numerous development things, driven by the idea that no individual methodology fits all things. This hybrid approach by Rahimian and Ramsin solves many of the limitations experienced before but this approach still contain some boundaries. No specific tasks are proposed for the stages of agile techniques. MASAM(Mobile Application Software Agile Methodology) proposed by Jeong et al. [16] that gives the method for developing the application software for various mobile stages. It develops the Software and Systems Process Engineering Meta-model which comprise various agile approaches like RUP, XP etc. The employment of a selected method framework suggests that a vital aid for vogue and managing a project, however the venue situations of the tool does not help it to populate. This technique may prove to be beneficial for the small firms but Jeong et al does not provide a case study or research report for the definite implementation which can be accepted in real world scenario.

An integration approach of Scrum and Lean Six Sigma SLeSS in 2011 by Cunha et al. [17], which utilized a novel process of developing embedded package style for mobile devices. This methodology is tested in only one mobile software company and even not provide the results of its use. It improve the performance of development process and provide a high quality framework to achieve the projects aim. Scharff et al. [18] projected the application of Scrum approach for developing mobile applications. He outlines an innovative collaboration model with a classy environment in Pace University which included an industry-certified Scrum Master and a true product owner. The whole requirement of proposing Scrum and it need in mobile application development is described in brief. It limitation is targeting the rising mobile business in Africa.

Hussain et al. [19] explains that the Agile software technique is proved to be user oriented by mixing Extreme Programming XP with UCD(user centered design) and accenting unvaried UI development involving handling engineers. Norshuhada Shiratuddin and Sarif [20] projected a tool to handle a mobile application development process in order to help the mobile software developers specially the novice, to decide the agile approach that help the necessities of mobile application projects. The researcher analysed that graduates arriving the nature of mobile development believes to understand the functionalities of mobile application development that influence software design decisions making choices regarding package style.

Analysing the above mentioned research articles, it is observed that there is no research study which proves that Agile is the fitting model for developing mobile applications.

## V. Mobile Application Development Process - An Agile Approach

Agile methods displayed in Table I have been proposed that uses combination of agile and non-agile techniques for the development of mobile applications by numerous scientists in last decade.

### *A. Mobile-D*

The study in aglile approach developed by Abrahamsson et al. in 2005 [14] established that agile technique is best for

TABLE I: List of Mobile Application Development Process

| Mobile Process | Mobile Development Process | Techniques |
|---|---|---|
| MobileD | An Agile Approach for Mobile Application Development | XP, Crystal, RUP |
| Hybrid Methodology Design | A Hybrid Method Engineering Approach | ASD, NPD |
| MASAM | Mobile Application Development Based on Agile Methodology | XP, RUP, SPEM |
| SLeSS | A integration approach of Scrum and Lean Six Sigma Integration | Scrum, Lean Six Sigma |

mobile development surroundings and create a novel methodology called 'Mobile-D'. Mobile-D approach consists of five phases each of which further have various stages and jobs. These comprises Explore, Initialize, Productionize, Stabilize and System Test and Fix.

The review summaries the challenges in producing mobile application and how the characteristic features and restrictions affect the mobile application approach. The analysis also produces a software development technique for fulfilling the needs of highly volatile mobile environment. It is foreseen on agile methods like Extreme programming, Crystal methodologies and Rational Unified Process. The appropriate agile method for mobile application development, which brings some changes to establish Mobile-D approach evaluate by Spataru [6] a nd provide tool to apply these changes.

***Gap Identified:*** Even if the Abrahmasson approach on mobile application development is very helpful but even though the description of the technique is superficial and incomplete. Based on this study other researchers have suggested further enhancements also the model may additional be changed exploitation hybrid agile strategies.

### *B. Hybrid Methodology Design*

A distinct approach called Hybrid Method Engineering to mobile software development proposed by Rahimian et al. [15]. Methodology Engineering is also a regulation committed creating methodologies applicable for numerous development things. The idea is that not all the things fitted by the separate methodology. Hybrid methodology uses the previous developed approaches as inputs to iteratively produce the proposed technique.

In short the mobile development approach consists of four iterations. During the initial round, the proposed approach and the methods involve described related to agile techniques. In the second iteration activities from New development, and the methods for replacing the market products and services and in third round, the concepts ASD were assigned into the concept. The last iteration consists of overlapping of prototypes to reduce the amount of risks based on technology.

***Gap Identified:*** This hybrid approach by Rahimian and Ramsin solves many of the limitations experienced before but this approach still contain some boundaries. No specific tasks are proposed for the stages of agile techniques. The longer term work includes activity more iterations to induce lower-level tasks at intervals the tactic. More theoretical concepts are explained. There is no case study or experimental setup that could provide the testing to this technique.

### *C. MASAM*

In the year 2008, a novel methodology i.e.,MASAM (Mobile Application Software Agile Methodology) have been proposed by Jeong et al. [16]. MASAM helps in developing the application software for various mobile stages. It develops the Software and Systems Process Engineering Meta-model which comprise various agile approaches like RUP, XP etc. From the series of ideologies in this approach totally different development processes is made public in step with the context of associate agile computer code development firm. This approach have some sort of connection with the previous methodology Mobile D and produce some changes based on the structure and implementation. MASAM also introduces a simple development cycle consisting of four phases, which all include a main phase of the event method. The first stage provides the preparatory approach that defines a scheme and a main notion of the merchandise and explain the duties of the preparation part in the approach. The next stage is implementation part which consists of designing the application software according to the customers needs.

***Gap Identified:*** The selected method framework employment is proved to be necessary for managing project, but the locale situations does not spread it universally. This technique may prove to be beneficial for the small firms but Jeong et al does not provide a case study or research report for the definite implementation which can be accepted in real world scenario.

### *D. SLeSS*

An integration approach of Scrum and Lean Six Sigma SLeSS in 2011 by Cunha et al. [17] utilized in real comes of developing embedded package style for mobile phones. This approach allows compliance with performance and quality objectives for the progressive outcomes of the project and improves the development process. Scrum in SLeSS- Scrum is widely used agile technique proposed for development of mobile software. The execution of SLeSS is done by 1st implementing the commencement alone.

Lean Six Sigma in SLeSS- Once commencement is well settled at intervals the organization to enhance the development technique Lean Six Stigma(LSS) is applied as a top quality framework. Scrum is now used widely in software development and it has been growing in the field of mobile software development [18].

***Gap Identified:*** Only one mobile company tested it and even does not provide the results of its use. It improve the performance of development process and provide a high quality framework to achieve the project's aim.

## VI. Proposed Model

We are proposing agile hybrid approach that consists of agile methods such as XP, Scrum, Crystal, FDD to full fill the wants of volatile agile mobile application development and also helping mobile software engineers and mangers. To propose it, a versatile and extensible process map is projecting which would choose appropriate agile approaches for mobile application development, which mobile industries can adapt and implement even more as they like. The projected agile hybrid approaches are by trial and error tested and valid on

TABLE II: Process map for selecting Appropriate Agile Methodology

| Sl | Task | Description | Duration | Result |
|---|---|---|---|---|
| 1 | Agile Technique | XP, Scrum, Crystal, Feature Driven Development, Adaptive Software Development, Dynamic Software Development Method are the various agile techniques studied by the researchers for mobile application development. | 60 | Get an idea about all the agile techniques which would fit for mobile application development. |
| 2 | Mobile Application Development | Study mobile application development process. | 60 | Finds out the to which mobile process the appropriate agile technique could be applied. |
| 3 | Questionnaire | Prepare questionnaires for survey and interview. | 30 | Clears all the doubts about applying agile methodologies. |
| 4 | Survey | For more robust understanding of development processes various surveys regarding mobile application development could be conducted and establish the issues and limitations in creating choices associated with application development which is generally faced by mobile specialists. | 90 | It gives us all the information about the suggested mobile process and find out the issues associated with the mobile process. |
| 5 | Survey Analysis | Collect the data regarding mobile applications and analyse it. | 60 | Helps to finds out the solution for the limitations. |
| 6 | List Issues and Challenges | Outline the specified performance, describe the performance gaps after the examination of survey and decide the foundation cause and drawback mobile application development trade is presently facing. | 30 | Finds out which specific agile technique could help to solve the issue of specific mobile process. |
| 7 | Select elements for designing a model | For every part of mobile application processes investigate the appropriate agile technique. | 60 | Finds out that did the applied agile technique is suited for the mobile process. |
| 8 | Design a hybrid agile mode | To fulfil the requirements of mobile application development a hybrid agile technique is proposed that integrates agile methods to meet the needs. | 90 | Select suitable agile techniques for mobile software development which mobile industries can adapt. |
| 9 | Mobile App development and Testing | Java laguage program mobile app is developed for testing the agile approach. | 60 | Ensures the working of hybrid agile approach on the mobile process. |
| 10 | Case Study | Wherever the projected methodology is through empirical observation tested and valid, select the mobile software development corporations. | 30 | Shortlist the mobile application development company which confirms the testing. |
| 11 | Perform experiment | The projected agile hybrid approaches are by trial and error tested and valid on latest portable in real organization to understand its result. Further testing of results would take place. | 120 | Finds out that the selected agile approach is successful in the applied mobile process. |
| 12 | Estimation of results | To indicate the applying of the projected methodology in mobile software development various case studies could be conducted to estimate the results. | 30 | Confirming that projected methodology is appropriate in all aspects for the mobile process. |
| 13 | Final Report | Summarize, report generation, report analysis and suppression | 30 | Report is generated for the applying of projected agile methodology for mobile application development. |

latest portable in real organization to understand its result. Further testing of results would take place.

To achieve the goal the following steps are followed:

1) Data Acquiring tactic:- In this methodology the mobile software development companies examine the literature and collecting the feedbacks of software engineers and mangers after researching the current approaches. By developing and victimization an Internet form by collection the problems and challenges sweet-faced by mobile software system development corporations. To collect more information concerning the subject several interviews with developers and engineers can also take place.
2) Tools:- The information gather during literature, online question-answers are collected as separate methods. The information collected during survey and feedbacks will be review using the software SAS, SPSS and stata. To form a method map that's needed for the productive completion of the projected analysis the software like DIA other than Micro Visio can also be used.
3) Theoretical Virtualized Methodology:- The software's like SPSS, MS Excel etc will analyze the collected data. A model will developed employing a new hybrid Agile methodology and to benefit to mobile software system development method, loosely in terms of price, time and energy. A most appropriate Agile technique will be selected for constructing the method map for every section of mobile software system engineering method.
4) Experimental Technique:- The new hybrid agile approach is projected to assist finding the matter of mobile application developers and mobile project managers:
    a) By group action mobile process methods with most fitted agile technique, a versatile and protractile method map may be developed. The most appropriate agile technique could be chosen for mobile software development by this map.
    b) The project agile hybrid approach will be tested in various mobile software companies. The testing will be based upon speed, coast, flexibility, accuracy and functionality.
    c) To indicate the applying of the projected methodology in mobile software development various case studies could be con-

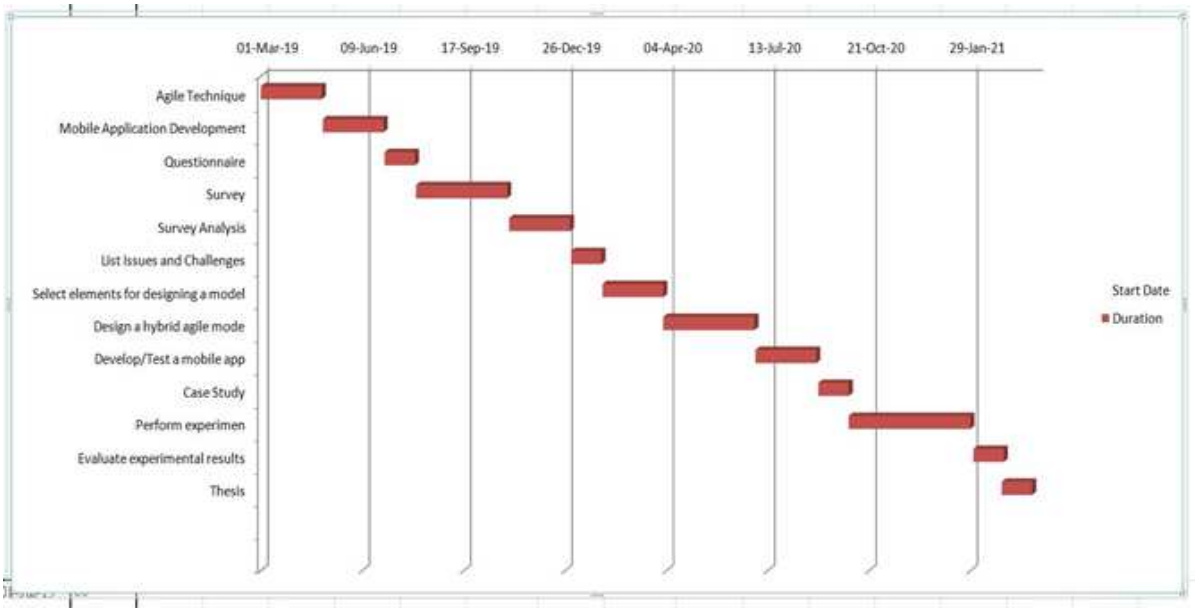


Fig. 1: Gantt chart of the process map for the proposed hybrid agile methodology

ducted.

5) Errors is Experiment and Accuracy of Results:- It will depend upon modern scenario.
6) Validation of Results:- The data acquired is valid against any favoritism and misunderstanding.

## VII. Process map for Selecting Appropriate Agile Approach

By integrating various mobile development processes with appropriate agile techniques, versatile and flexible process map is developed and depicted in Table II. This processes map is capable of modeling and selecting suitable agile technique for mobile application development.

By analyzing the process map drawn for selecting suitable agile technique, a gantt chart is presented in Figure 1, which shows the duration of each tasks present inside the process map.

## VIII. Threats to Validity

The project methodology wants feedbacks from programmer and manager to the survey of mobile development companies through meeting in person or online contact. The planned improvement through the planned Agile technique ought to be by trial and error tested in three to five mobile firms

There is still a requirement to discover other agile techniques other than these proposed approaches that can be included in development of mobile processes. This may be achieved by suggesting commercial surveys, interviews and discussions with Agile specialists.

## IX. Conclusion

The modified hybrid agile approach that consists of agile methods such as XP, Scrum, Crystal and FDD is proposed to meet the requirements of agile mobile application development for the assistance of mobile developers and managers. Flexible and versatile process map is developed which is capable of modeling and selecting suitable agile techniques for mobile application development. Additionally, this study is expected to be successful for mobile software development performances, quality that bring various observations which indicate the considerable scope for additional analysis in the research.

## References

[1] P. Abrahamsson, A. Hanhineva, H. Hulkko, T. Ihme, J. Jäälinoja, M. Korkala, J. Koskela, P. Kyllönen, and O. Salo, "Mobile-d: an agile approach for mobile application development," in *Companion to the 19th annual ACM SIGPLAN conference on Object-oriented programming systems, languages, and applications*. ACM, 2004, pp. 174–175.

[2] R. Holler, "Mobile application development: a natural fit with agile methodologies," *VerisonOne LLC, Alpharetta*, 2006.

[3] N. Kannan, "Mobile development: Why using an agile methodology makes sense," *Online: http://searchsoftwarequality. techtarget. com/tip/Mobiledevelopment-Why-using-an-Agile-methodology-makessense*, 2011.

[4] R. C. Martin, *Agile software development: principles, patterns, and practices*. Prentice Hall, 2002.

[5] L. Williams and A. Cockburn, "Agile software development: its about feedback and change," *IEEE Computer*, vol. 36, no. 6, pp. 39–43, 2003.

[6] A. C. Spataru, "Agile development methods for mobile applications," *Master of Science Thesis submitted to Computer Science School of Informatics, University of Edinburgh*, 2010.

[7] B. Boehm, "A survey of agile development methodologies," *Laurie Williams*, vol. 45, p. 119, 2007.

[8] K. Schwaber and M. Beedle, *Agile software development with Scrum*. Prentice Hall Upper Saddle River, 2002, vol. 1.

[9] S. Ambler, "Effective practices for extreme programming and the unified process," *Ist. Ed. John Wiley & Sons, Inc*, 2002.

[10] J. A. Highsmith and J. Highsmith, *Agile software development ecosystems*. Addison-Wesley Professional, 2002, vol. 13.

[11] J. Stapleton, *DSDM, dynamic systems development method: the method in practice*. Cambridge University Press, 1997.

[12] J. R. Highsmith, *Adaptive software development: a collaborative approach to managing complex systems*. Addison-Wesley, 2013.

[13] S. R. Palmer and M. Felsing, *A practical guide to feature-driven development*. Pearson Education, 2001.

[14] P. Abrahamsson, "Keynote: Mobile software development–the business opportunity of today," in *proceedings of the International Conference on Software Development*. Citeseer, 2005, pp. 20–23.

[15] V. Rahimian and R. Ramsin, "Designing an agile methodology for mobile software development: A hybrid method engineering approach," in *2008 Second International Conference on Research Challenges in Information Science*. IEEE, 2008, pp. 337–342.

[16] Y.-J. Jeong, J.-H. Lee, and G.-S. Shin, "Development process of mobile application sw based on agile methodology," in *2008 10th International Conference on Advanced Communication Technology*, vol. 1. IEEE, 2008, pp. 362–366.

[17] T. F. V. da Cunha, V. L. Dantas, and R. M. Andrade, "Sless: A scrum and lean six sigma integration approach for the development of sofware customization for mobile phones," in *2011 25th Brazilian Symposium on Software Engineering*. IEEE, 2011, pp. 283–292.

[18] C. Scharff and R. Verma, "Scrum to support mobile application development projects in a just-in-time learning context," in *Proceedings of the 2010 icse workshop on cooperative and human aspects of software engineering*. ACM, 2010, pp. 25–31.

[19] Z. Hussain, M. Lechner, H. Milchrahm, S. Shahzad, W. Slany, M. Umgeher, and P. Wolkerstorfer, "Integrating extreme programming and user-centered design." in *PPIG*, vol. 8, 2008, pp. 107–113.

[20] N. Shiratuddin and S. M. Sarif, "The md-matrix: a learning tool in the mobile application development course," *International Journal of Mobile Communications*, vol. 7, no. 4, pp. 494–514, 2009.