Chapter 3 – Research Methodology

Over the last decade, there has been a constant increase in the number of software engineering researchers exploring a faster and efficient way of developing mobile applications. For the development of mobile applications using Agile practices, several important objectives were considered and this chapter provides the aims and objectives of this research. It also presents the flowchart of research methodology used, the steps involved in the process of developing research questionnaire and describes the development process of the proposed AgileMAD model, including, procedures used for literature review, questionnaire design, data collection and its analysis.

3.1 Research Objectives

The research gaps have been identified based on the literature reviews of the individual studies. Following research objective(s) were outlined that commences with understanding of mobile application process in detail and also includes various mobile application characteristics, issues and challenges, and best practices adopted by mobile development community for a successful mobile application development process.

a. To study the mobile application development process using Agile software development methodologies, such as XP, Scrum, Lean, Kanban, AUP, AM, DSDM, FDD and Crystal. Each of these Agile approaches is focused on different aspect and comparing these methodologies is imperative.

b. To conduct a technical survey for gaining a better understanding of prevalent development practices for mobile applications thereby identifying the problems and challenges faced by the mobile professionals related to application development.

c. To investigate and implement a robust approach for each phase of mobile software engineering process using various Agile methodologies; identifying various challenges faced by mobile developers and best practices followed to build and deliver a successful mobile app.

d. To identify the best fitting Agile approach and integrating specific Agile practices, to meet the needs of volatile mobile projects and to assist mobile developers and managers during the mobile application development process.
e. To propose a flexible and extensible process model capable of modelling and selecting suitable agile techniques for mobile application development projects. This can further be tailored and implemented by mobile industries to their best convenience.

f. To evaluate the proposed model from Expert/Academic Researcher(s) and to validate the proposed model by developing and empirically testing a mobile application on the latest mobile phone in real organization to actually appreciate its result.

3.2 Research and Development Process

Figure 4 presents the flowchart of research methodology and the proposed model development process used in this study:

![Flowchart of Research Methodology and proposed model development process](Image)

Figure 4: Flowchart of Research Methodology and proposed model development process

3.3 Proposed Model Development Process

This section describes the development process of the proposed AgileMAD model, which includes, procedures used for literature review, questionnaire design, data collection and its analysis.
Criteria for Literature Review

Before proposing a new model for the development of mobile applications, a systematic investigation of the existing literature was performed. The study instigated and focused on the development of Agile approach for Mobile Application Development (MAD) for which, the literature review of the subject along with the technical review of the people working in this area was conducted.

Literature review emphasized mainly on the mobile application development, Agile software development, existing mobile software development model using Agile approach and other software development products using Agile methodologies (or its combinations). Whereas, for the technical interview, mobile application development community, including top level management, developers and Agile experts were selected and their views, opinion and comments was collected and processed therein (Figure 5). The standard sources used for literature search included online journals and published literature.

Survey and Interview

Based on the objectives of the research work (as mentioned in section 3.1), the research methodology utilized in the current study comprised of an online survey that consisted of questions covering the entire mobile application development lifecycle. Since in order to build a great mobile application, it is critical to understand the following and the questionnaire for the
online survey was thus drafted in consultation with the experts in the area of mobile application development and Agile software development:

- key features that define good mobile applications including different types, categories and the unique characteristics of these apps
- mobile application development process
- issues and challenges faced while developing a mobile app
- mobile software development best practices which expose the mobile phones from potential threats and attacks
- reasons of adopting any particular software development methodology in the development of mobile applications, and
- concerns or barriers regarding using a particular approach

In general, Agile principles and practices are considered to be most suitable for mobile application development because mostly, the mobile projects are short-time and require flexibility as they usually have frequent change requests.

Based on the above mentioned objectives, the questionnaire for the online survey was drafted in consultation with the experts in the area of mobile application development. The main aim for conducting the online research survey study was to contribute towards a greater understanding of the mobile application development process and to determine suitable Agile software development methods currently being practiced by mobile companies for the development of mobile applications. The complete survey is listed in Appendix C.

Alreck and Settle (1995) identified three primary techniques to collect data for questionnaire based survey studies that include personal interviews, telephonic interviews and mail data collection. Although, presently the most popular approach of data collection is to conduct web based surveys (Nardi et al., 2003). The proposed research study presents several motivations for opting online research data collection procedure. First, web based survey enables the data or participants responses to be stored in an electronic form and provides instant and direct access to the database. This further helps to observe study and maintain daily track of the received responses from the participant's. Second, web based survey eradicates the human errors and costs
related to offline surveys. Also, web based data collection prevails certain limitations of mail or paper surveys in terms of time and budget. Third, direct mail data collection shows a low response rate in contrast to web based surveys that show an enhancement in the response rates.

The online survey used in the current study was descriptive in nature providing an eloquent analysis. It is noteworthy that descriptive surveys do not explicate or illustrate fundamental relation between variables although they concentrate on elucidating what percentage of a sample has a certain view or how often certain events take place and are associated with each other (Oppenheim et al., 1996). The survey having extensive questionnaire was designed based on the available literature related to mobile app development process and also after evaluating several online surveys conducted in past by various academic and commercial organizations researching on mobile application development. The design of the questionnaire was evaluated and validated by several experts from mobile development community with familiarity or experience in Agile software development before it was handed over to the participants.

In selecting the survey respondents, a purposive sampling was used. Purposive sampling involves selecting a unique sample purposely due to its particular feature that is important for the research work (Nardi, 2003). In this study, the industrial participants were those known to have actual mobile application development experience, having in-depth familiarity with Agile software development procedures or the one’s interested in exploring it, and those involved in the ongoing research on mobile application development using Agile software development methods.

Data Collection, Analysis and Findings
The respondents were invited to participate in the survey via mobile application development forums which covered multiple mobile app platforms development aspects. More than 130 responses were received during the data collection period and the participation in the survey was entirely voluntary. The data was analysed using SPSS Statistics, versions 16.0. The results of the analysis are given in Appendix D. Each response was studied individually, and then detailed analysis was performed on all the responses collectively. The validity of the study and findings was assessed by relevant experts in areas. The results of the survey were utilized as a starting point to identify specific requirements in the area of mobile software engineering for new and revolutionary business practices. In addition, the specific demand of using Agile approach in the area of mobile software engineering was also identified.

Figure 6: Research findings of current study

Based on the literature review and technical interviews conducted from mobile development community and Agile experts respectively with mobile development experience, various important research findings were established and reported which led to the development of the proposed AgileMAD model as shown in the Figure 6.
Validation of the Proposed Model

The analysis of the research findings resulted in proposing an AgileMAD model for the development of mobile applications by integrating specific Agile principles and practices.

Figure 7: The Proposed AgileMAD Model for MAD

Figure 7 depicts the methodology adopted to verify and validate the proposed model and to prove its obligation and exigency. The proposed model was evaluated, verified and validated after performing following actions:

a. **Comparison with existing Models**: Firstly, the proposed model was compared with existing models as proposed by various academicians and researchers for the development of mobile applications using various Agile methodologies (in combination with non Agile techniques). This comparison helped in justifying the necessity of AgileMAD model as a result of this study.

b. **Evaluation of proposed model**: Secondly, the proposed AgileMAD model for the development of mobile applications using various Agile approaches was theoretically evaluated and appraised by academicians, mobile development community members and various professionals in the area. The comments, feedback and observations received was qualitatively analyzed and ideographically summarized. The final AgileMAD model was proposed in the light of the suggestions and recommendations received from respective experts in the area.

c. **Implementation and validation of the proposed model**: Finally, the proposed AgileMAD model after being theoretically evaluated from academicians and industrial experts was empirically tested by implementing and performing case studies in actual mobile development setting in two mobile companies for the final verification and validation.