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A Systematic Study on Software Requirements Elicitation Techniques and Its Challenges in Mobile Application Development

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ABSTRACT Software Requirements Engineering has paved its roots in both industry and academia, as today's complex systems are programmed to provide efficient user-centric functionalities. This also refers to the emergence of challenges in Requirements Elicitation techniques, approaches, and tools while performing them. Particularly, in the area of Requirements Engineering for software development, a number of techniques and approaches have been observed in literature but for mobile application development, which is different from the traditional software development, has not been discussed much in past studies. Short development cycle, device limitations, and less development time for mobile application development are some of the issues to which there is no 'silver bullet' available. Therefore, the Requirement Analysts are in dire need of defined guidelines for Requirement Elicitation in mobile application development. With this study, we aim to provide a detailed overview of Requirements Elicitation techniques and its challenges. We have conducted a systematic literature review by surveying 4507 initial and 36 primary studies. A comprehensive set of 22 elicitation techniques were measured based on quality assessment criteria, including time and cost factors, resource effectiveness, and domain understanding. Furthermore, the challenges in Requirements Elicitation were also grouped into eight different categories based on their applicability. Our study effectively contributes in highlighting Software Requirements Elicitation Techniques and its challenges in mobile application development.

INDEX TERMS Requirement elicitation, requirements engineering, software engineering, android application, software development life cycle, requirement gathering.

I. INTRODUCTION

Tremendous increase in pervasive demand of software applications from last few decades' have outseen a rapid growth of software development industry. From system software to mobile application, software development is increasingly gaining attention of researchers. According to the survey presented in [1] mobile applications penetration has increased up to 99% in 2015, which is around 7.3 billion of total GDP. Outwardly, this percentage is expected to increase in coming years due to different advents of software development techniques and approaches in mobile application. Comparatively the process of software development is different from mobile application development because of volatile user requirements and limited device capabilities. Not only the device limitations exist but overall mobile application lifecycle is faster than any web based or desktop application [3].

Software development starts with requirements engineering that holds utmost importance and for smooth execution of software development, efficiently gathered requirements play an important role throughout the process [5]. Not only efficient requirement results in efficient system but also cost effective system. But it is also important to know what a requirement is. According to IEEE, requirement is ''a condition or capability needed by a user to solve a problem or achieve an objective'' [19]. Hence, meeting user need is the baseline of any quality software product.

Requirement elicitation is the initial step of requirements engineering in which all concerned users and stakeholders of

the system gathers to elicit basic system requirements [6]. Requirement elicitation also covers another important part of requirements engineering which is requirement gathering; consisting of certain steps that are mentioned in [5], requirement elicitation, requirement analysis, requirement documentation, requirement validation and requirement management. By properly following requirement elicitation and gathering techniques, high quality mobile applications can be produced. Mobile application development, therefore, has its own boundaries that limit the application of traditional SDLC methodologies [17]. Some of these limitations are short development life cycles as compared to traditional software development life cycle, limitations of device including processor, battery, touch screens, user experience in terms of touch screens, user context and interactive behavior and others [23].

The researchers are now working on dynamic behavior of the system by studying changing requirements in order to support iterative development in mobile applications. As technology advances the requirements to develop software are becoming ubiquitously complex [2]. Some studies show that the software development process used for mobile applications is somehow similar to the conventional software development process [4] but the changing needs and user expectations are making mobile development more complex in nature.

There are certain issues while dealing with requirement elicitation in mobile applications specifically in gathering requirements. From ambiguous requirements to gold plating, insufficient involvement of user to poor planning and overlooked requirements, requirement gathering comes with number of challenges [6]. The past studies have shown that researchers explored many challenges in requirement gathering under different scenarios like medical, education, and others [7]. Therefore, no such bridge exists in literature to fill the gap of selecting suitable method for requirement gathering in mobile applications and finding out the challenges in requirement gathering with context to mobile applications. The main objective of our study is to present theoretical guidelines in form of guidelines to requirement analysts, designers and researchers in order to select appropriate technique in any particular scenario. Our contribution is unique in its way because there are no defined guidelines for requirement elicitation in mobile application development.

A systematic literature review has been conducted to identify the existing gap of requirement gathering methods and challenges in past studies. Based on available benchmarks, different methods and challenges were studied and review is presented in detail. This review is divided in five sections and the structure is: section 2 is focused on foundation concepts of requirements engineering, section 3 and 4 comprises of research methodology and research questions respectively and the structure of review process, section 5 covers the analysis of primary studies and results, section 6 discusses the validity of this study and lastly section 7 concludes the review into lessons learned.

II. BACKGROUND

In this systematic literature review (SLR), a pilot study was conducted and recognized that there were multiple methods present for requirement elicitation in mobile applications [8]. It is necessary to provide explanation of basic concepts discussed in SLR in order to ensure the effectiveness of research before starting the study [9]. Following are the three basic concepts defined in this study:

i. Requirement gathering methods in mobile application development
    a. Benchmark method in requirements gathering
ii. Challenges in requirement gathering

The discussion presented here covers mentioned concepts in detail.

The study presented on NASA in [60] and [61] stated that without requirement management adequacy projects may suffer and effects the system as a whole. Hence, requirement gathering is initial step towards software development. Requirement gathering method should be simple with all levels of abstraction. In mobile application development, requirement gathering helps the developer to completely understand the system, and user, to understand the content of the system [10]. The aim of this activity is to discover as many requirements as possible by identifying user needs and system context for early design phase [11]. According to the author [57], needs are the expectations and constraints perceived by the stakeholders in targeted system. RE process is implemented by including technical viewpoints, specification of model and activities, support tools and performance of tasks. That is the reason requirements are divided into two main categories: User requirements and System requirements [12].

Some of the methods to gather requirements are: **Interviews**– closed and open: It is a method of direct interaction between the user and the interviewer. Interviews are considered to be one of the most efficient ways of getting user needs. **Questionnaire**: Another important elicitation method is questionnaire. Questionnaires proved to be more effective in scenarios where face-to-face interaction is not possible. It is also helpful when requirements engineer has a developed understanding of the system. **Social analysis:** To understand the user's environment including political and social, social analysis is conducted. **Prototyping**: prototype initially models the system to let user understands the system execution. Prototyping performs better when customer want to become part of the system and involves in the development process. **Requirement reuse:** Requirement reusability is possible where a system intends to build is having similar requirements to the system that was already been built. It gives an opportunity to reuse the requirements from chunk of available requirements [13[–[15]. Some of other gathering

methods are scenarios, brainstorming, joint application development and card sorting [16]–[18].

A benchmark is set of standard used as a guideline for this review. An article [20] published in IEEE International Requirements Engineering Conference with 268 citations was selected as a benchmark for this review. The authors have derived results conducted in systematic review and based on these results, few methods were selected as a benchmark. The benchmark is used in this review is Interviews. But along with this, some other methods [21] are also used to validate the study.

Next concept in this discussion is challenges in requirement gathering. One of the major challenges in requirement gathering is selection of method [22] that is inherited by the complexity of mobile application development. Significant obstacles have arisen for conduction of requirement gathering [23]. Adaptation of mobile application is yet another big challenge which requires requirements to be dynamically changing so user involvement is another challenge in requirement gathering [24]. The challenges that has been frequently discussed in literature are: **Stakeholder related** [37]: These challenges occur due to participation of user, staffing and stakeholder involvement in the process. Another study [58] focuses on importance of stakeholders in requirement elicitation process. It further states that not only identification of stakeholders is necessary but identification of business owner, candidate stakeholder, evaluation and selection of stakeholders, understanding the role, responsibility and relationships among stakeholders, stakeholder representative, prioritization, stakeholder management strategy and plan are also important and relatable. According to INCOSE System Engineering Handbook [62] one of the biggest challenges in requirement elicitation is identification of the stakeholder. **Requirements related** [39]: These issues are mostly technical and deals with problems like prioritization of requirements, traceability of any particular requirement and schedule overhead in the process. **Communication related** [38]: it is one of the common challenges in requirement gathering where due to different cultural and language barriers issues occur. Some of the other challenges are, **knowledge, scope, change, human factor** and **organization related** [39], [40], [42]. In [25] some of the discussed challenges are: communication, collaboration, and coordination. Another perspective of requirement gathering challenges is research challenge [59] and requirement verification activity during scope definition [63] that widely covers method and technique along with above mentioned challenges.

III. RESEARCH METHODOLOGY

The research methodology of this study is simple yet it covered all aspects of SLR. The methodology has been majorly divided into following five steps:

i. Research Question Formulation
ii. Data Source Selection
iii. Past Study Selection
iv. Evaluation and Analysis
v. Results

FIGURE 1. Research methodology.

Figure 1 shows the process of research methodology in this study:

In figure 1 the research methodology of this study has been presented. Step I covered formulation of research questions. After the gap, identified from literature, two research questions were formed in order to keep study focused to its center. In step II, scientific databases related to research area were finalized. This step also defined search strategies including keywords, synonyms and search queries to mentioned databases. Step III, one of the major steps, has helped in defining selection of articles and related material from past studies. As multiple refinements and filtered have been applied to the study, selection of studies was done in filters e.g. initially 4507 studies were selected. Initially abstract has been studied and downloaded if any article was found relevant to this study. In final filter, only 39 related studies were finalized. Step IV, evaluation and analysis was conducted on 22 requirement gathering techniques and 8 requirement gathering challenges. This step also covered the quality assurance criteria upon which research question 1 and 2 findings were mapped. Finally, in step V the results of both research questions have been discussed. The guidelines of software requirements engineering for mobile application development has also been presented for requirement engineers, analysts, developers and future researchers in order to selection and study of requirement gathering technique and its challenges easier than before.

IV. RESEARCH QUESTION AND REVIEW PROCESS

The structure of this review was formed after adapting guidelines from literature [28]. In this section two research questions related to software requirements engineering guidelines in mobile application development were composed and discussed in detail. These questions address state of the art problems in requirements engineering.

A. RESEARCH QUESTIONS

While doing pilot studies, it was witnessed that multiple studies have been conducted to explore various requirement gathering methods and challenges but so far there is no study available to cover requirement gathering methods and challenges for mobile applications.

To bridge this gap, following research questions were formulated:

RQ1: Which method is best for requirement gathering that holds fundamental of mobile applications development?

RQ2: What are requirement gathering challenges while developing mobile applications?

The search string used was:

(*Elicitation* OR *Requirement Gathering* OR *Requirement Elicitation* OR *Requirement Acquisition)*
AND
(Method OR *Technique* OR *Way)*

(Problems OR *Challenges* OR *Issues)*
AND
(*Mobile Application* OR *Mobile Software* OR *Software Development)*

In above mentioned research questions the aim of this study was to provide systematic review on requirement gathering methods for mobile applications. The challenges in gathering process were also covered. In this way a set of standard method was formed to guide requirement analyst, developers and researchers.

B. DATA SOURCE AND SEARCH STRATEGY

For conducting a concrete review, clarity in data sources and search strategy was important to define. To perform search queries, scientific database and search engines from authentic publishers were used. Following scientific database were used to select material from:

i. IEEE Electronic Library (ieeexplore.ieee.org);
ii. SpringerLink (www.springerlink.com)
iii. ACM Digital Library (portal.acm.org/dl.cfm);
iv. Google Scholar (https://scholar.google.com.pk/)
v. Elsevier Science Direct (www.sciencedirect.com) and
vi. Emerald (www.emeraldinsight.com);

Apart from this, some of the known database were also considered but not included because of accessibility problems.

The search queries were formed for the selection of related articles. Following list of item were formulated:

For RQ1: mobile application development, requirement gathering, requirement elicitation, elicitation techniques, gathering methods, elicitation tools

For RQ2: mobile application development, elicitation challenges, requirement gathering problems, requirement elicitation issues

Along with the search queries, synonyms of the selected terms in the search strings were also used. It is important to compose search strings using logical expressions between various search terms. For this study, search strings were composed using such expressions. Due to constraints on suing specific database for this study, each search string has been carefully formulated.

The approach used in this study for searching strings, states set of instructions and different checks that are observed and followed during the collection of primary data. Following is the list of criteria adapted as inclusion and exclusion in the study:

1. Data selected for conducting primary study belongs to the area of Software Engineering majorly covering Requirements Engineering
2. Full length research material and book chapters published in journal and conference were considered to provide authenticity of this study and evidence based review
3. To overcome the linguistic barriers, the selected data is only in English language
4. It was tried to cover the current trends in selected area, therefore, publications from the year 2010 and onwards were considered to be included
5. Only accessible articles – free and openly available with the courtesy of Higher Education Commission (HEC) Pakistan, were considered for this study

C. SELECTION OF ARTICLES

In this phase, the title and abstract of the selected article is read by the researcher for its relevance, whereas, the full article is read for its validity and to get desired information. In case of duplication of any article retrieved from more than one databases, it is necessary to remove the duplication. The results of particular article are ensured to be part of evidence based research.

D. INCLUSION AND EXCLUSION CRITERIA

This section includes the criteria to ensure that the relevant articles have been selected to conduct the review.

a. The publications related to the domain of requirement engineering are selected
b. Technical papers, surveys, grey literature and case studies are included
c. Papers where abstract is available but full text is unavailable are excluded
d. Papers not written in English language are excluded
e. Position papers, posters and letters are excluded

E. PROCEDURES OF QUALITY ASSURANCE

To improve the relevance and reduce the biasness level of selected material, some quality assurance (QA) constraints have also been followed in the form of benchmarking studies in [20] and [26]. Furthermore, QA standards for conducting both research questions were different and has been taken from literature. These are mentioned in sub-section A of section III.

F. SCHEME OF DATA EXTRACTION

In scheme of data extraction, all useful relevant information gathered from selected primary data has been described. Not only publication details, but other details were also covered. This section covers how useful information from each study was extracted. Appendix B shows the initial scrutiny of successful primary studies through quality assessment criteria given in appendix A.

G. PLAN OF DATA COMPOSITION

The results have been compiled from the data collected during the selection procedure. The articles have been selected from

different sources but the final results are presented in tabular form. Details are included in section III.

V. RESULTS AND DISCUSSION

For execution of search strings and data retrieval process from different databases, it took three months to complete– August 2017 to October 2017. The research structure was pre-defined which covered each phase of review activity. In response to research question 1, this process yields 2116 articles and for research question 2, it is 2391 relevant material. The steps followed in data collection method are depicted in figure 1:

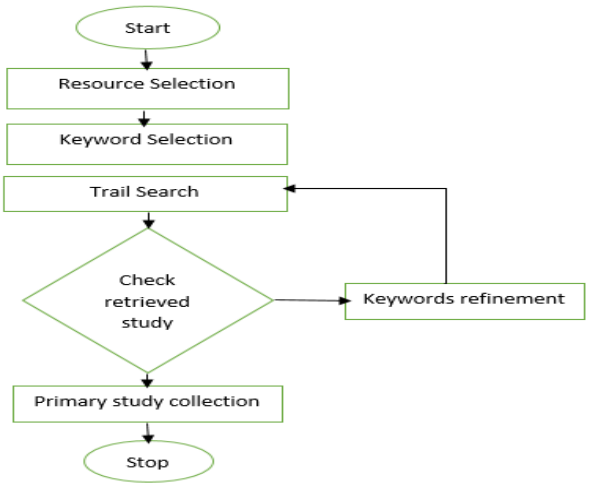

FIGURE 2. Data search strategy.

TABLE 1. List of retrieved articles.

Sr. no.	Data Source	Initially Scanned		1st Filtered		2nd Filtered		Finally Selected	
		SS1	SS2	SS	SS2	SS1	SS2	SS1	SS2
1	IEEE Explore	779	564	24	29	12	20	5	10
2	Google Scholar	1142	1438	15	21	24	10	12	4
3	ACM Digital Library	113	218	09	11	0	0	0	0
4	Science Direct	58	103	5	8	5	5	1	1
5	Springer	24	68	2	4	0	0	0	0
Total		2116	2391	55	73	37	35	18	18

The selection of data presented in this study has been applied to 4507 research articles selected from specific databases. The chosen articles after reading the abstract are 128 in number. Further in the process, 72 studies have been selected, among which 33 studies were discarded because their scope doesn't fulfil the requirement of this study.

The following table 1 shows list of retrieved and selected articles:

In table 1, the results after multiple application of multiple filters have been shown. Initially scanned material was 2116. After two scans, the number reduced to 18 for RQ1 and same for RQ2.

According to quality assurance standards defined in D, eighteen research articles have been selected depending upon relevancy to research question 1 and fifteen research articles for research question 2 have been selected. Research articles mentioned in table 2 refers to the primary studies that have been selected for conducting systematic literature review.

TABLE 2. Selected research articles.

ID	Ref. No.	Articles selected for RQ1	Ref. No.	Articles selected for RQ2
1	[4]	(Ahmed H., 2008)	[37]	(N.C., 2011)
2	[5]	(M. Usman, 2013)	[38]	(N. Sabahat, 2010)
3	[7]	(MuthairN., 2013)	[39]	(L. Liu., 2010)
4	[10]	(Sadia R., 2015)	[40]	(U., Sajjad, 2010)
5	[11]	(Norbert S., 2011)	[41]	(S., Raghavan, 1994)
6	[12]	(Sai G., 2008)	[42]	(Ashraf A., 2010)
7	[16]	(Lindoerfr, 2017)	[43]	(R. Colomo, 2010)
8	[17]	(Babbly D., 2016)	[44]	(Al-Rawas, 1996)
9	[18]	(Paivi P., 2003)	[45]	(N.K. 2011)
10	[21]	(Shadab K., 2014)	[46]	(A.Finkelsteian, 994)
11	[22]	(M.Mathews,2008)	[47]	(T.C.Lethbridge,2003)
12	[31]	(LKarlsson, 2007)	[48]	(W.J. Lloyd, 2002)
13	[32]	(Omar I., 2017)	[50]	(D. Damian, 2007)
14	[33]	(Saurabh T., 2017)	[51]	(Sawyer, 1997)
15	[34]	(TabbasumI., 014)	[52]	(L. T. Sorensen, 2009)
16	[35]	(Ann M., 2002)	[53]	(A Haron, 2010)
17	[36]	(Zahra S., 2017)	[54]	(Anthony I, 2010)
18	[55]	(Anthony I., 2010)	[56]	(Anam A., 2015)

Table 2 represents the selected articles for both research questions along with their respective references. This table 2 helped in refining the study in order to focus on the selected articles.

All the data extracted from primary studies have been stored in predesigned form (Appendix). This form contains general information that was extracted from primary studies.

A. COMPOSITION OF DATA

This section is focused on composition of data extracted from primary studies. Various requirement gathering methods are presented here based on their frequency of occurrence in primary studies selected before. The percentage of each requirement gathering method has been calculated to check its usability [26], [20]. Following criteria [5], [26] was selected to evaluate select requirement gathering methods: Time and Cost effective; Resource effective; Audience Reached; Direct/Indirect; Qualitative/Quantitative Data; Communication; and Understanding of the Domain

The methods of requirement gathering were extracted from primary studies and depicted in table 3 as the widely used requirement gathering methods for mobile application development. Whereas, the source selection of table 4 has majorly covered from literature with inclusion criteria of: discussion on RE issues and challenges, challenges in requirements engineering and focus on issues in specific elicitation technique [29], [30].

B. REQUIREMENT GATHERING METHOD FOR MOBILE APPLICATION DEVELOPMENT

This section refers to research question 1, which was on identification of requirement gathering method. In table 3, different methods of requirement gathering from various studies

TABLE 3. Identified requirement gathering methods.

Requirement Gathering Method	Primary Study	N=18	%
Interviews and Direct Discussion	[5], [7], [12], [31], [16], [22], [18], [4], [21], [32], [34], [33], [35]	13	72%
Prototyping	[12], [18], [17], [4], [21], [34], [33],[35]	8	44%
Use Case Scenarios and User Stories	[5], [12], [18], [11],[4], [32], [33], [35]	8	44%
Questionnaires	[12], [22], [10], [21], [34], [33]	6	33%
Brainstorming	[5], [12], [32], [34], [33]	5	27%
JAD/RAD	[5], [12], [32], [33], [35]	5	27%
Ethnography	[12], [32], [34], [33]	4	22%
Direct Observations	[22], [18], [21], [33]	4	22%
Surveys	[5], [10], [11], [33]	4	22%
Laddering	[7], [32], [34], [33]	4	22%
Passive Observation	[12], [32], [33]	3	16%
Active Observation	[12], [32], [33]	3	16%
Card Sorting	[32], [34], [33]	3	16%
Protocol Analysis	[32], [34], [33]	3	16%
Social Analysis	[12], [32], [33]	3	16%
Similar System Analysis	[5], [36], [33]	3	16%
Document Analysis	[21],[32], [33]	3	16%
Requirement Reuse	[12], [32]	2	11%
Application logging	[22], [55]	2	11%
Repository Grids	[33]	1	5%
Think Aloud	[22]	1	5%
User Notebooks	[22]	1	5%

are mentioned. Almost 22 methods were identified from 18 selected studies. The criteria to select these methods has already been mentioned in section A. According to table 3, Interviews and direct discussion method holds the fundamentals of mobile application development in requirements engineering with 72% of acceptability and usage rate. Similarly, Prototyping, Questionnaire and Survey are common practice but not widely used as compared to Interviews.

Table 4 is in continuation of table 3 and covered major challenges faced by requirement engineers while gathering requirements as given in [27], [29], and [30].

C. REQUIREMENT GATHERING CHALLENGES FOR MOBILE APPLICATION DEVELOPMENT

Table 4 refers research question 2, in which the challenges faced in requirement gathering for mobile application development were identified from 18 primary studies. Eight categories of challenges were identified based upon the criteria given in A. According to the table, the most common challenge is issues related to the stakeholder. Under this category, user participation in requirement gathering process,

TABLE 4. Identified requirement gathering challenges.

Requirement Gathering Challenge	Primary Study	Frequency N=18	Percentage
Stakeholder related *(user participation, staffing, stakeholder)*	[37],[39], [40],[42], [45],[50], [51], [52], [53]	9	50%
Requirements related *(prioritization, schedule, skill, traceability)*	[37],[39], [47],[48], [49], [51]	6	33%
Communication related *(articulation related, unawareness of needs, verbal and presentation skills, culture and language barrier)*	[37],[38],[40], [41], [42],	5	27%
Knowledge related *(domain related, problem analysis)*	[39],[41],[44], [45], [54]	5	27%
Change related *(Management and political rules, acceptance criteria changes, unstable requirements, change in user needs and understanding)*	[37],[38],[39], [40] ,	4	22%
Scope related *(over scoping and ill-defined scope)*	[42], [45], [46], [56]	4	22%
Human Factors-related *(conflicts, ambiguities among stakeholders, intra group conflicts, communication, participation)*	[41], [43]	2	11%
Social, Organization related *(Policy and Structure, complexity, cultural and time zone differences)*	[38], [42]	2	11%

staffing problems and stakeholder identification are most common. With 50% of widely encountered challenge, stakeholder related challenge is leading the list, followed by requirement related, communication related and knowledge related challenges.

D. GUIDELINES FOR SELECTION OF SOFTWARE REQUIREMENT ELICITATION TECHNIQUES IN MOBILE APPLICATION DEVELOPMENT

Sub-sections B and C presented detailed overview of the results shown in table 3 and 4 respectively. Requirement elicitation methods have been discussed and evaluated on

given criteria. Requirement elicitation challenges have also been focused. The outcome of this study has been presented in the form of guidelines mainly for mobile application development.

There are following guidelines:

a. Mobile application development life cycle works differently from traditional software development process

b. Using interview and direct discussion requirement gathering methods form fundamentals of mobile application development

c. Focusing more on stakeholders while gathering requirements may overcome the most challenging issue in the process mobile application development.

VI. THREATS TO VALIDITY

There may exist the following threats to this study.

1. The article's selection and data collection was manual and done by single researcher only. However, the contribution of multiple authors has reduced the weakness of subjective evaluation of selected articles.

2. Another threat was that the results generated can be repetitive because different databases were accessed to get primary and secondary studies but doesn't necessarily produced same results every time. Section III has defined the criteria used for evaluations of main questions.

3. We haven't proposed any unified model or framework. Hence, at this stage our review is indicative.

VII. CONCLUSION

In any software development, requirements engineering is the initial step towards defining stakeholders' needs and wants. Poor requirements may lead to high user dissatisfaction and low software quality. Hence, efficient guidelines and practices helps the practitioners to adapt selective methods for gathering requirements. In this article, requirements elicitation methods and its challenges in mobile applications were identified by analyzing past studies. The main focus of this study was to nominate state of the art requirements elicitation method for mobile application development. Because the development cycle of mobile applications is different as those of traditional methods. Some of the reasons of defining guidelines for mobile applications in software requirements engineering includes difference of user context and interaction, limitations of touch screens, difference in platforms, short development cycle, device limitations etc.

The extensive systematic literature review was conducted aiming to achieve maximum validity of the study. For this purpose, selection criteria were defined and used to extract 4507 articles from different renowned databased. After thoroughly reviewing the studies, 36 articles were selected in response to research question 1 and 2. Critical review was done on these studies. Based on the defined criteria, 22 requirement gathering methods and 8 different categories of requirement gathering challenges were identified. Each method and challenge was given a frequency number based on their occurrence in studies selected from the literature. Percentage was given against each occurrence value. After that, requirement gathering method and challenge was critically analyzed in sections B and C.

It was tried hard to cover maximum number of requirement gathering methods and challenges, that are available from literature. These identified methods and challenges are expected to guide researchers and requirement engineer to use the widely accepted and valid requirement gathering method while developing a mobile application. The list of identified methods may grow with the evolvement of requirement gathering process with larger samples of selected studies. Another benefit of this study is to support the research in improving the paradigm of requirement gathering in mobile application development. It can also guide them towards better requirements specification for requirements gathered through different methods.

In future this work can guide requirements engineers, analysts and developers to work according to the guidelines defined in the paper. Furthermore, this work may lead to defining a new framework for software requirements engineering in mobile application development.

APPENDIX A

Quality Assessment Form RQ1

S/n	Quality Assessment Question	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
1	**Research Problems**																		
	Does the study explicitly stated its problems?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Does it recommended future work?	1		1	1	1	1						1	1	1				
2	**Literature Reference**																		
	Do the study present a satisfactory literature review?	1	1		1	1	1	1	1		1	1	1	1	1	1	1		
3	**Research Methodology**																		
	Is the research comprehending on a specific research methodology?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Is evaluation technique is stated?	1	1	1	1		1	1	1	1	1	1	1		1	1	1	1	1
	Is any statistical technique is applied?		1		1	1	1				1	1			1		1		1
4	**Outcomes**																		
	Has a handful evidence provided after the analysis?	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Does the extracted evidence justify the conclusion?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	**Total Score**	7	7	6	7	7	8	6	6	5	7	7	7	6	8	6	7	5	6

Quality Assessment Form RQ2

S/n	Quality Assessment Question	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
1	**Research Problems**																		
	Does the study explicitly stated its problems?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Does it recommended future work?	1		1					1	1	1	1	1	1	1				
2	**Literature Reference**																		
	Do the study present a satisfactory literature review?		1		1	1	1	1	1		1	1	1	1	1	1	1		1
3	**Research Methodology**																		
	Is the research comprehending on a specific research methodology?	1	1	1		1		1	1	1	1	1	1	1	1	1	1	1	1
	Is evaluation technique is stated?	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1	1
	Is any statistical technique is applied?		1			1		1	1	1				1	1		1		1
4	**Outcomes**																		
	Has a handful evidence provided after the analysis?	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1
	Does the extracted evidence justify the conclusion?	1	1					1		1	1	1	1	1	1	1	1	1	1
5	**Total Score**	6	7	5	4	6	3	7	6	7	7	7	7	8	8	5	7	5	7

APPENDIX B

RQ1				
Study ID	**Study Title**	**Author(s)**	**Journal/Conference**	**Publication Year**
[1]	Method Assisted Requirements Elicitation for Context Aware Computing for the Field Force	Ahmed Hassan Afridi Saleem Gul	Conference	2008
RQ2				
Study ID	**Study Title**	**Author(s)**	**Journal/Conference**	**Publication Year**
[1]	Requirement Elicitation: Identifying the Communication Challenges between Developer and Customer.	NC AM Zin	Journal	2011

ABBREVIATION

SS: Searched study.

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