

Literature Review on Requirement Elicitation Technique

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Abstract - Requirement Elicitation is considered to be an essential stage of system development. The analyst acts as a liaison between users and the developers. The software engineering process decides the cost and time constraint for the project. The focus of this study is to facilitate analysts in choosing the RE technique. We have surveyed different literature to conduct a systematic literature review on the Requirement Elicitation technique (RE). The articles are selected from peer-reviewed Journals from other databases like ABI Inform/Science Direct/IEEE XPLORE/Francis and Taylor/Springer and Google Scholar. We have compared eight RE techniques (dependent variable) like Prototype, Use Case, Interviewing, RAD, JAD, Workshops, focus group, and brainstorming on various parameters (independent variable). Those are the time taken for elicitation, the analyst's experience, the number of stakeholders, and the number of functionalities. The study conducts a detailed content analysis of the relevant literature. The study reports the total number of Empirical/Survey/ Conceptual research articles, respectively. In addition, it reports the journal that carries a maximum number of articles on RE. The research report provides the total number of articles published in different years, and how the research topic has gained interest over the years will be analyzed. A similar analysis is done conducted Country/ Industry- wise. Citation analysis identifies the most cited article in this area of research. Cross-tabulation study of the dependent versus independent variable analyzes the relationship between the two variables. The obtained results guide the analyst to choose the Requirement Elicitation technique.

Keywords — Agile, Analyst, Functional points, Requirement Elicitation, Stakeholders, Systematic Literature review, functional points

I. INTRODUCTION

In the last 50 years, gradual changes have occurred in Requirement Engineering. Requirement Elicitation has included numerous innovations and new techniques in the industry practices. In contrast, past studies have paid less attention to empirical research on Requirement Elicitation. This negligence may be accepted because the RE technique is less important for software projects. Because of these reasons, very little literature discusses RE techniques. Only four empirical papers have been published on RE techniques. In recent years, few researchers have conducted empirical research in this area. Two of the four empirical studies belong to 2016. The researcher aims to study

1. The existing literature on the Requirement Elicitation area.

2. Organize the articles according to the place of publication, year of publication, Publication title, and methodology of the study.

3. To identify the gap in the existing literature.

The research question posed by the researcher supports the above objectives.

1. What are the existing theories in the area of our study?

2. What research methods are adopted in the study?

3. Which are the relevant articles to our study?

The paper is organized as follows. It defines the concept of Requirement Elicitation in the beginning, and then the article classification is conducted. Later the findings and conclusion are discussed.

Concept of Requirement Elicitation

[1] Describes Requirement Engineering as the field of study and expertise associated with compiling and

assessing software requirements. An iterative method of conceptualization evaluates and translates system requirements into a specification of requirement specification, performance characteristics, and a software configuration. Most of the survey's findings indicate that software projects fail (or are terminated) because they cannot fulfil the project's quality, cost, or schedule requirements. 18% of software projects, according to a Standish Group Report, failed at various stages of software development [2].

The table below summarises [5] research report from 2004 to 2012.

Table 1.1: Year-wise analysis of project success

	2004	2006	2008	2010	2012
Failed	18%	19%	24%	21%	18%
Challenged	53%	46%	44%	42%	43%

Source: (Group, 2013)

1.2 Rationale: Systematic theory development is lacking in the Requirement Elicitation area. Significantly few papers have compared the RE technique. None of the studies have compared all the eight RE techniques. It may be due to two main reasons. First, Research on RE techniques is relatively tiny. Second, the researcher's primary focus was on framing a conceptual framework and developing new RE techniques or collaborating two or more RE techniques to meet the situation requirements. The review identifies twenty-eight conceptual papers. [4] Conducted appropriate systematic research by comparing the RE techniques. It allows the development of a systematic theory for choosing the Requirement Elicitation technique. Hence there is a scope to conduct empirical research in RE techniques.

II. REVIEW OF LITERATURE

Many of the analyst interviewing techniques is the most preferred RE technique. Past studies categorized the interview technique as a technique required for Pre-elicitation conditioning, as seen in [3]. Analysts use the interview technique more often when the knowledge is tacit. [4] Studied the interview technique relationship with tacit requirements and found that as the complexity of knowledge to be elicited increases, the effectiveness of interviewing technique decreases. The result is significant, with a correlation coefficient between complexity with effectiveness indicating a correlation of .47 ($p=.005$). However, this may not necessarily mean that interview techniques only elicit tacit knowledge. For instance, [5] theorized that interview techniques were very influential in determining conceptual requirements. When a user is willing to recall and communicate the requirements, the conversational technique elicits conceptual requirements

because it involves verbal communication. George Allen [6] also suggested that this is true. In their study focusing on requirement elicitation techniques and their relationship with conceptual knowledge, they found that the interviewing technique has high access to the expert's cognition. The author concentrated on a research question: Which elicitation approach is most successful in a certain setting? The findings of this study are as follows: (I) the most effective RE technique is interviewing, which is mainly structured (ii) Interviews are more successful than card sorting and ranking; (iii) the analyst's prior expertise with RE is not a meaningful factor; and (iv) the assessed studies do not indicate any benefits from using prototyping during the elicitation. According to this research paper and considering these results, we can conclude that since they allow analysts to get more information than the other evaluated strategies, interviews are the most successful technique in RE.

Additionally, by combining the findings of previous empirical investigations, [6] produced information regarding the applicability of elicitation approaches. The authors offer some suggestions about the circumstances in which needs elicitation approaches are helpful. These suggestions came from an SLR to address the following research question:

Which elicitation methods work the best? The results show that: (i) Using scaling approaches are far more challenging than using unstructured interviews. (ii) scaling techniques and laddering techniques are equally efficient; and (iii) structured interviews are more effective than unstructured interviews. (iv) The scaling and laddering strategies provide the same level of complexity when employed, whereas unstructured interviews are more straightforward to use than the laddering approach.

III. METHODOLOGY

[7] Describes in his literature that literature review must be systematic. It should mention the procedure of reviewing the literature and describe the scope of including sample literature. The researcher followed [2] for conducting a systematic literature review. The review process has four phases.

The researcher has searched Requirement Elicitation and Agile projects (abstract/document text) in databases like Elsevier Science Direct, IEEE XPLORE, and ProQuest. The search included relevant keywords, and then other keywords were added. Initially, many articles were listed based on keyword searches. However, as it was impossible to review all the articles, different keywords were added to the existing search to filter the articles further. Scoping of the review process was done as follows:

1. Only peer-reviewed journal articles were selected.
2. Only past 30 years(1988-2018) literature were considered
3. Only full-text literature articles were considered

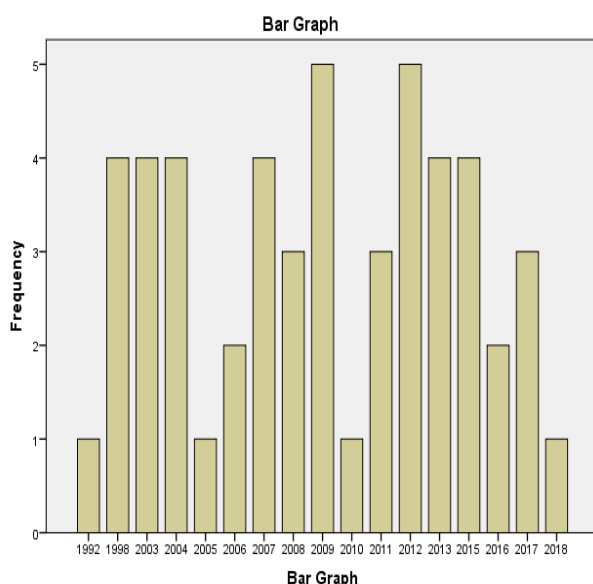
The keyword search was done in title and abstract. The database search did not show any literature on Requirement elicitation and agile project. Then the keyword search was conducted anywhere in the document; 412 literatures were found in Proquest, 100 articles were obtained from Elsevier Science Direct, and 63 articles were identified from IEEEExplore. Each article carried a keyword that is requirement elicitation. Different screening levels were applied to identify the relevant papers to the area of the research. The researchers read each literature, and then the relevancy was determined. The researchers identified that 524 articles were not relevant to the study. The researcher identified five articles more than once; hence, they were eliminated. Finally, 51 articles were considered for the study because they carried the keywords like Interview, JAD, RAD, Brainstorm, Focus Group, Prototype, Use Case, Number of functionalities, Number of Stakeholders, Time spent to elicit requirement, and experience of the analyst. These keywords were discussed in the scope of our discussion.

IV. RESULTS

4.1 Organization and description of the literature:

Fifty-one articles were selected by the researchers using by Systematic Literature review method. The literature is classified based on the publication year, publication place, citations, and their research methodology. The author identifies the gap in the research area.

Figure 4.1: Year-wise publication of the article



Analysis on the basis of the publication year: The articles were analyzed according to the year of their publication. The researcher observed that the articles on the relevant topic were in between 1992 to 2018. The bar graph in the Bar graph indicates that very few articles were published from 1992 to 2003. 2003 onwards there has been a gradual increase in the publications in this area. Most articles were published in 2009 and 2012.

4.2. Analysis based on research methods: Elicitation has a substantial impact on the nature of the requirements since it is the method of capturing customer requirements and communicating such needs to computer experts as in [5]. Analysis, design, integrating, and testing of the criteria are frequently done after elicitation, which is a critical phase in the RE process. The main objective of this procedure is to enumerate a system's conversational and cost effective functionality along with its limitations. The effectiveness of this procedure is based on selecting the appropriate stakeholders from a variety of backgrounds and evaluating their needs. All interested parties must be included in the information gathering process; otherwise, certain points of view may never be disclosed. The literatures considered for our study emphasizes this aspect of the research. The researcher aimed to study the research methodology of each of these literatures.

Frequency distribution in figure 4.2 depicts the methodologies used in different pieces of literature. The researcher has studied 51 articles and identified the research methodology of each article. It was identified that research on RE techniques was conducted based on brainstorming, case study, conceptual, empirical, experiment, literature review, survey, and workshop. Out of 51 articles, about 56% of the articles were conceptual articles. Only four articles have used Empirical methods using correlation and regression analysis. 4 Articles are based on the survey method. Hence there is a scope for Empirical study on the requirement elicitation technique.

According to observation and understanding, there are a variety of effective RE tactics that are used to develop new, superior ideas and improve needs comprehension.

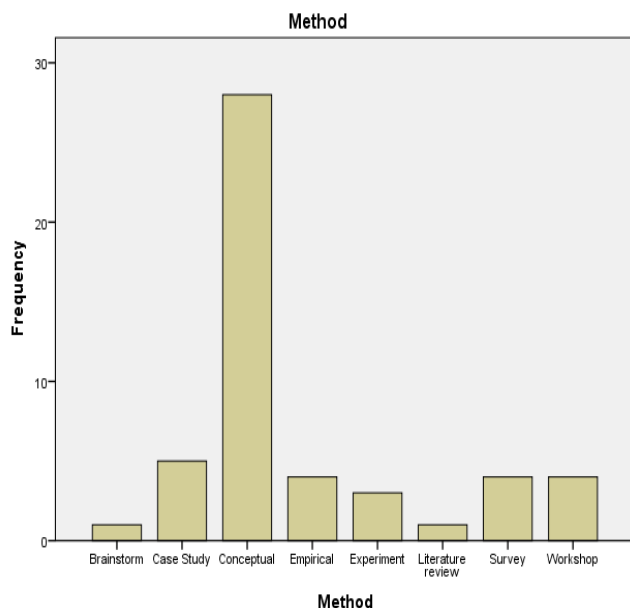
According to [13], [14], [15], [16], [17], [18], and [19], some of the effective tactics include wireframes, icon-based modelling, an ontology-based persona-driven method, Secure Tropos-SPL, gamification approach, and online serious games.

REST-bench, according to Paper [14], provides an assessment tool that demonstrates how software development projects are coordinated and identifies particular improvement opportunities; as a consequence, it recently introduced techniques in RE.

As stated in article [20], requirement visualisation is essential for efficient requirements specification in order to enhance user involvement and their perception of the activity's importance. Emotional and iconographic modelling falls within this group. As seen in [15] and [16], both simulations may offer a strong basis upon which to construct requirement analysis engineering.

Many different ontological techniques have been successfully applied in the field of requirements analysis [12].

Figure 4.2: Classification of research articles based on their research methodology



4.3 Classification based on journal of publication

Eight journals carry more than one article on Requirement Elicitation and required keywords. IEEE software consists of 8 journals, which is the maximum, and IEEE Transactions on Software Engineering consists of 7 articles on our area of study.

4.4 Classification based on the country:

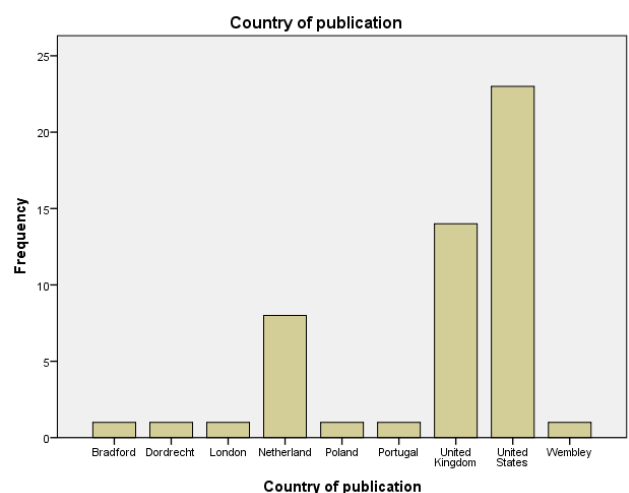
The graph below indicates the country for selecting a sample for the respective literature. The developed countries have conducted the highest number of studies, like the United States, which the United Kingdom follows.

In addition, articles are organized to determine the relationship between the Requirement Elicitation technique (Prototype, Use Case, Interviewing, RAD, JAD, Workshops, focus group, and brainstorming) and other analyst attributes.

As a consequence of a systematic review, eleven (11) publications were discovered in this study, demonstrating the significance of effective methodologies for the

requirements elicitation process. According to Shreta Sharma and S. K. Pandey [6], RE assists enterprises in creating high-quality computer systems given time and financial restrictions while accurately reflecting customer expectations. Production of a thorough, consistent set of system requirements spanning multiple system aspects, including defining business limitations, overall functionality requirements, and so-called non-functional specifications like safety and security, as stated in [2], is a key objective of problem definition financing. Therefore, it's crucial to use the best methods for eliciting requirements.

Figure 4.3: Country-wise publications related to RET



Efficient information gathering procedures, as described in [12], aid in the externalisation and visualization of knowledge. The primary advantage of our research study is that it examined a substantial number of publications from three widely used electronic databases that were published between 2014 and 2015 in various journals and conference proceedings.

The evaluation rigorously adhered to the selection standards to raise the standard of the search. Additionally, the literature study addressed nearly every area of the review questions. Nevertheless, this article's fault is that the search phrase is not as precise as it might be due to a lack of knowledge to make it clear and prudent.

4.5 Citation Analysis

[8] mentions in his article that Citations signify that an individual used another author's writing as a source (s). The citation analysis is looking through the references referenced in a population of publications to identify the most important pieces of research in the area. Google Scholar was used to determine the citation of an article. Researcher found that out of 57 articles, all the articles were cited by at least one researcher. Quality of the

research article can be determined by conducting citation analysis. The most cited article is of [9] which are 477. One of the reasons for more citation may be the year of publication is 1992. Next most cited article is authored by [10] with 430 citations. [11] Was cited 290 times [12] was cited 240 times and [13] was cited 212 times. [5] Was cited 210 times. These were the top 6 articles that were most cited in the researcher's area of study. The citation of the rest of the articles [6] mentions in his article that "many entities and processes involved in requirements analysis (RA) and knowledge acquisition (KA) are almost identical. In order to facilitate a merged awareness of both research streams, representative RA and KA techniques are compared. These techniques are grouped according to elicitation mode into 3 dimensions: 1. Communication obstacles, 2. a technique's locus of control, and 3. the nature of the understanding gained from using the technique."

V. DISCUSSION

It was evident that more articles (23) discussed interviewing, out of which nine articles concluded that interviews took longer duration compared to other techniques. Four articles mentioned that interviewing technique is suitable when there is less number of stakeholders. Eight papers discussed the prototype technique. Moreover, four papers indicated that prototypes take less time to conduct RE. Seven papers discussed the scenario technique. They indicated that the scenario is suitable when there are many stakeholders and less functionality. Some of the articles also have indicated that the scenario technique is suitable when there are several functionalities. Use cases take less time to collect the requirements. The workshop technique is suitable when there is large number of stakeholders, and the workshop technique is capable of eliciting large number of functionalities. Focus group is suitable in the situation when there is less number of stakeholders and focus group consumes less time duration for eliciting requirements.

Brainstorming technique is suitable when the analyst is less experienced, or novice. It is used in the condition when the number of stakeholders is less.

More number of studies is done on interview technique. Use case/ Scenario techniques are recent techniques and next highly discussed topic. But none of the articles have compared all the 8 RE techniques on the basis of the factors like time taken for elicitation, experience of the analyst, and number of stakeholders, and number of functionalities. A formal or informal method of gathering information from stakeholders is an interview.

It is carried out by posing planned and/or impromptu questions and recording the answers.

Although interviews are frequently performed one-on-one between the interviewer and the interviewee, they may sometimes involve a number of interviewers and/or interviewees. Any questions that come up during the discussion may be handled right away, and the requirements engineer may be able to unearth hidden needs by asking shrewd questions. [9], [10]. Mind mapping is employed to quickly create a large number of ideas from a group of stakeholders and to organise and rank those views [1].

By seeing people in their own environments carrying out their occupations or duties, observation is an elicitation approach that offers a direct way to learn how a process is performed or a product is utilised. This method is useful when domain experts are either unable to explain and signify their experience to the requirements engineer or are unwilling to spend the time necessary to convey their experience [1], [10]. Process analysis is applied to comprehend present processes and find areas where they might be improved.

Process modelling is a recognised method of illustrating how work is carried out. Written collections of questions known as questionnaires and surveys are used to swiftly gather data from a large number of respondents. Respondents to surveys are frequently distributed across a large geographic region and might represent a varied community. This method of elicitation has the advantage of being able to reach a broad audience for a relatively little investment [9], [13]. Based on the analysis of published literature, the gaps were identified by the researcher in the research methods, theoretical frameworks and study settings. Following were the few issues related to the literature that were observed by the researcher. According to citations, it seems that [12], [14] and [15] are the important articles. However, they are popular because of the fact that they were published long back.

Our study's SLR confirms [16] findings, which list mature techniques like use cases, repertory grids, user stories, mind mapping, interviews, workshops, focus groups, joint application development (JAD), quality function deployment, ethnography, scenarios, prototyping, protocol analysis, card sorting, ontologies, modelling, and goal-based approach. Investigation by [16] further categorised the ideal technique into interactive workshops, interviews, team collaboration, ethnography, issues list, models, questionnaires, knowledge discovery from legacy infrastructure, requirement specification categorization, dispute awareness and resolution, prototyping, and role play, while research by [15] recommended a framework to

assemble the a variety of methodologies into six categories: traditional, ground-breaking, innovative, creative, and experimental. As a result, the information gathering methods were divided into conventional, cognitive, group, and contextual techniques; the methodologies, into simulation, combinational, collaborative, empirical, and interpersonal approaches; and the tools, into basic, method, cognitive, platform, and collaborative tools. The strategies are divided into conventional, cognitive, contextual, and collaborative categories according to research by [17], [18], and [20].

Additionally, [8], [4], and [14] group the strategies according to the type of communication they facilitate. [12] Categorises them lastly into contemporary and traditional classifications, and [4] offer an additional categorization with basic and advanced categories.

We have categorised the gathered articles as follows based on the consensus of the prior study (i.e. [16]), and taking into consideration the Nuseibeh and Easterbrook classification owing to its extensive and logical coverage on elicitation procedures for assessment and comparison purposes [6].

- Traditional methods: As computer science has gained greater traction, these methods were the first utilised for requirements elicitation. This category contains a wide range of methods for gathering general data in order to establish and pinpoint the wants, requirements, and constraints of the many participants.

- Collaborative strategies: These strategies make use of the team structure to encourage and facilitate collaboration amongst participants. The techniques in this category also act as a manual for identifying key concepts and improving all-around comprehension of the programme, as well as for selecting and prioritising needs throughout the elicitation process. We discovered 13 studies in total for this area, with the breakdown being as follows: five for focus groups, three for workshops, and five for brainstorming.

- Prototyping strategies

A prototype is a condensed form of the programme (e.g. from sketches on pieces of paper to beta versions of software products). These are employed when there is a significant degree of uncertainty surrounding the specifications with the goal of acquiring a thorough understanding of the software's performance in actual usage through the collection of systematic information and the encouragement of external support.

Modelling approaches are used to guide the information gathering approach and to help explain the demands of the stakeholders, the setting, and the project. They give a specific model of the sort of information that will be

elicited. This category includes forecasting methodologies such as scenarios, goal- and objective-based methodologies (such as knowledge acquisition in computer controlled configuration , modelling business process, use cases, and other techniques (such as data flow diagrams, state machine diagrams, and unified modelling language (UML) diagrams). There were 29 studies altogether that we discovered, with the following breakdown: 10 for scenarios, 11 for goal-based methods, 2 for business processes, 3 for use cases, and 3 for other methodologies.

5.1 Lack of systematic theory development

Systematic theory development is lacking in Requirement Elicitation area. Very few papers have compared the RE technique. None of study have compared all the eight RE techniques. This may be due to two main reasons. First, Research on RE technique is a relatively smaller amount, and, second, researcher's major focus was on framing conceptual framework and developing new techniques of RE techniques or collaborating 2 or more RE technique to meet the situation requirement. There are 28 conceptual papers that were identified in the review. [15] Conducted appropriate Systematic research by comparing the RE techniques, this gives an opportunity to develop a systematic theory for choosing Requirement Elicitation technique. Hence there is a scope to conduct an empirical research in the area of RE techniques.

VI. IMPLICATIONS

Future research can be focused on developing industry-specific techniques eliciting the Requirements. More number of empirical studies can be conducted in this area. Regression models considering the cost of the project must be explored.

VII. CONCLUSION

Literature pertaining to Requirement Elicitation provides in depth contribution to our area of the research. Systematic Literature review was conducted by the researcher. Totally, 51 articles were referred in this article that was published in between 1992-2018, related to Requirement Elicitation. We found that there is an increase in the number of research articles in Requirement Elicitation, but the article's quality can be questioned because of the research methodology. Major focus of Requirement Elicitation research is on formulating the new RE technique and including collaborative technology in RE technique. It was observed that researchers were reluctant to adopt methods like empirical to study the Requirement Elicitation technique practices of firms. Based on the discussions done above it can be concluded that in future, the researcher should not write a conceptual paper.

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