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Analysis and Performance Evaluation of Requirement Elicitation Techniques

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***Abstract*—** The importance of requirements elicitation has been well recognized by the software development community. Clear and correct user requirement is critical to the success of software systems. There are numbers of requirements elicitation techniques available, which are used to understand and gather user requirements. In this paper, we have tried to analyze and evaluate the performance of different requirement elicitation techniques, which are under the categories of conversational, observational, analytic and synthetic methods of requirements elicitation. This study was performed in Ethiopia on analyst and requirement engineers working in various software development companies, staffs and senior students from University of Gondar who are involved in software development activities and bank employees who are involved in similar activities in their respective banks. In our study, we found that the requirement engineers prefer to use combination of different requirement elicitation methods. Interviews technique is the most preferred requirements elicitation technique in software development community followed by observation method.

***Keywords*—**Requirement elicitation, Conversational, Observational, Analytic, Synthetic

I. INTRODUCTION

Requirements elicitation is a process of searching, revealing, acquiring and detailing of requirements for computer based system [1]. It is a complex process involving many activities with a variety of available techniques, approaches, and tools for performing them [2]. During this activity, the client and developers define the purpose of the system to be developed. Requirements elicitation is the first and one of the most critical activity during software development process. Quality requirements are essential to the success of any software development project, regardless of whether it is based on agile or traditional methodologies [3]. If this activity is not performed in a well controlled manner and error remains in this phase, the final product may not satisfy the needs of the client and end users which will ultimately make the system unacceptable.

If proper focus is not given on the stages of the software development life cycle, the software life might be shorter [4]. Failure of software systems is common, and effective requirements elicitation is an important factor in avoiding system failure. The most efficient and well-engineered system must be useful to end users and that is contingent on the right specifications being obtained in the first instance [3]. Studies show that 70% of the system errors are due to the inadequate system specification and 30% errors are due to poor design issues [5]. Some other studies have exposed that problems associated with requirements engineering could cost 10-200 times more to rectify the program after its implementation, than if they were recognized during specifications [6, 7, 8]. Few other researchers have suggested that, the comprehensive amount of project budget due to requirements flaws is 25 to 40 % [9]. It is noteworthy that, requirements engineering is not only crucial, but will be disadvantageous, if the acceptable sources are not devoted early [10]. The purpose of this paper is to identify most effective and widely used requirement elicitation technique in the software organizations. This paper presents the empirical study on analyzing and comparing different methods for requirement gathering process.

The paper is organized as follows, Section I contains the introduction of requirements elicitation, Section II contains overview of different requirement elicitation techniques, Section III contains the research methodology which has been used in this research, in Section IV we have analyzed and presented the results graphically, and Section VI concludes research work with future directions.

II. REQUIREMENT ELICITATION TECHNIQUES

Requirements elicitation is a complex process involving many activities with a variety of available techniques, approaches for performing them [11]. Several researches and practices within requirements engineering have been largely directed towards improving the elicitation process through development of various techniques. There are hundreds of different techniques from a variety of sources that can and have been employed by requirement engineers for requirements elicitation. They are categorized as below:

- Conversational Methods
- Observational Methods
- Analytic Methods
- Synthetic Methods

A. Conversational Methods of Requirement Elicitation

The conversational methods of requirement elicitation provide a means of verbal communication between requirement engineers and client [10]. As conversation is a natural way to convey requirements and concepts, and ask and answer questions, it is efficient to build and comprehend the issues and to elicit generic product requirements [12]. The requirement elicitation methods under this category are Interviews, Workshops/ Focus Groups, and Brainstorming.

B. Observational Methods of Requirement Elicitatio

The observational method of requirement elicitation provides a means to develop a good understanding of the application domain by observing human activities [13]. Observing people performing their routine activity facilitates to gather information, which are difficult to explain in words. The requirement elicitation methods under this category are Social Analysis and Ethnographic Study, Observation, and Protocol Analysis.

C. Analytic Methods of Requirement Elicitation

Analytic methods of requirement elicitation provide ways to explore the existing documentation or knowledge and acquire requirements from a series of deductions [10]. The requirement elicitation methods under this category are Requirement reuse, Document analysis, Analysis Laddering, and Card Sorting.

D. Synthetic Methods of Requirement Elicitation

The synthetic methods incorporate various channels of communication, and offer models to illustrate the characteristics and relationship of system [13]. These techniques are generally integrated at other phases of the software development life cycle. The requirement elicitation methods under this category are Scenarios, Prototyping, Joint Application Development (JAD), and Contextual Inquiry.

III. RESEARCH METHODOLOGY

This research is based on the empirical study. This study was performed in Ethiopia on analyst and requirement engineers working in various software companies in Addis Ababa, staffs and senior students from University of Gondar who are involved in software development activities and bank employees who are involved in similar activities in their respective banks. A questionnaire was prepared related to existing requirement elicitation techniques and responses were collected. Respondents were contacted at their work places and were asked to select the most appropriate option representing their opinion. Responses for questionnaire were collected, tabulated and graphically represented for further interpretation and analysis.

The main parameters that were used for the Survey are as follows:

- Sample Size: The number of total respondents is an important factor to achieve a reliable result. A total of 157 responses were received from the requirement engineers who are working in Ethiopia.
- Reliability: Since this survey is about Requirements engineering elicitation, the respondents must be aware of the process and should have at least basic knowledge about the process. So the respondents were chosen from the software development, education sector, and banks.
- Designing of the questionnaire: The questionnaire was designed after a thorough study of the effective designing of a questionnaire. Most of the questions were multiple choices.
- Conducting the survey: The professionals were given the printed copy of the questionnaire. They were given enough time to fill and return it to the surveyor.
- Analysis of the results: The results collected from the respondents, were then tabulated. The percentage was then calculated based on various parameters. In order to provide the reader with a visual representation for easy understanding, the tabulated data was plotted in the Graph.

IV. ANALYSIS OF RESULTS

A. Respondents

A total of 157 respondents who are from software development organizations mostly from Addis Ababa, staffs and senior students from University of Gondar who are involved in software development activities, and bank employees who are involved in similar activities in their respective banks. Table 1 shows the number of respondents from different sectors of software developments:

Table 1. Respondents from Different Sectors of Software Development

Organisation Type	Number of Respondents	Percentage of Respondents (%)
Software Organisations	44	28.03
Educational Software Development	92	58.60
Bank Systems	21	13.37
Total	157	100

The above tabular data is represented graphically in the figure 1.

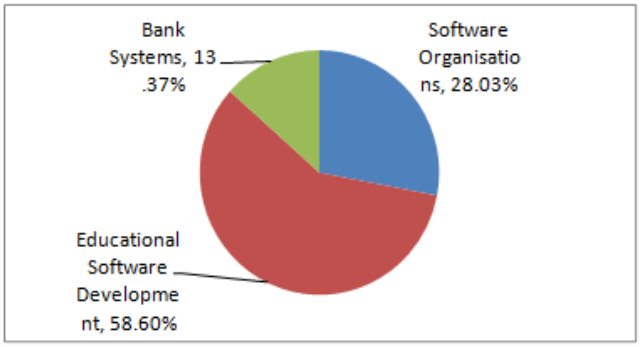

Figure 1. Percentage of respondents from different sectors of software development.

B. *Most Preferable Conversational Methods of Requirements Elicitation*

The respondents were asked to express their views about the most preferable conversational methods of requirements elicitation. Their response is represented graphically in figure 2. Interviews technique turned out to be most preferable conversational methods of requirements elicitation with 48.41%.

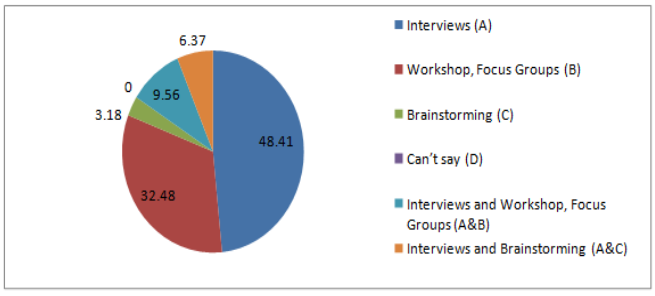

Figure 2. Conversational methods of requirements elicitation.

C. *Most Preferable Observational Methods of Requirements Elicitation*

In our study we found that the most preferable observational method of requirements elicitation is observation technique with 68.79%. The response from the respondents is graphically represented in Figure 3.

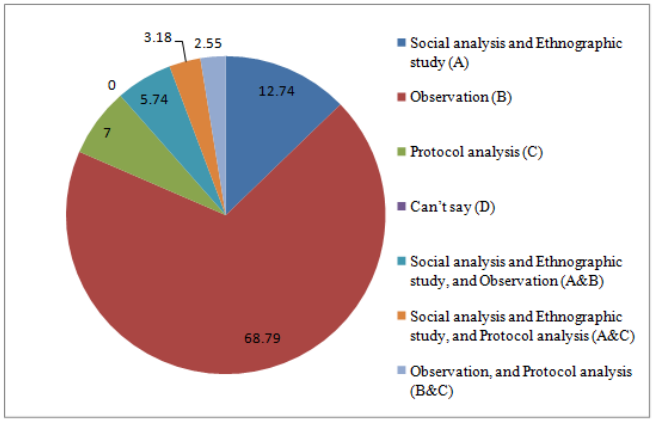

Figure 3. Observational methods of requirements elicitation.

D. *Most Preferable Analytic Methods of Requirements Elicitation*

Document analysis with 68.15%, turned out to be most preferable analytic methods of requirements elicitation in our research. The response from the respondents is graphically represented in Figure 4.

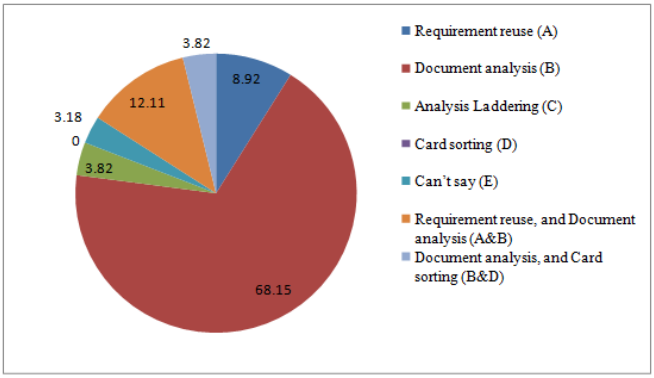

Figure 4. Analytic methods of requirements elicitation.

E. *Most Preferable Synthetic Methods of Requirements Elicitation*

Prototyping is considered most preferable synthetic methods of requirements elicitation followed by scenarios according to our study. The response from the respondents is graphically represented in Figure 5.

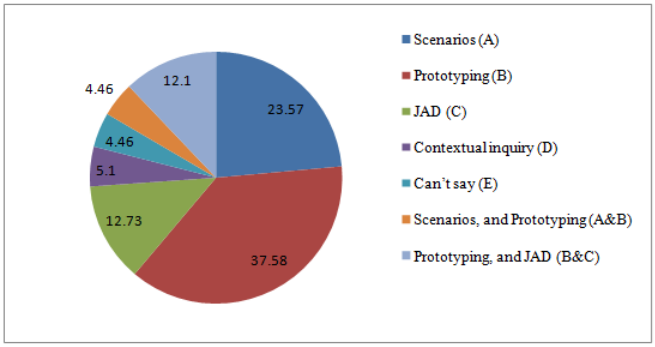

Figure 5. Synthetic methods of requirements elicitation.

F. Most Preferable Technique among Popular Techniques of Requirements Elicitation

In our research we wanted to the most preferable technique among popular techniques of requirements elicitation from the respondents. Interviews turned out to be most preferable technique with 24.20%. The response from the respondents is graphically represented in Figure 6.

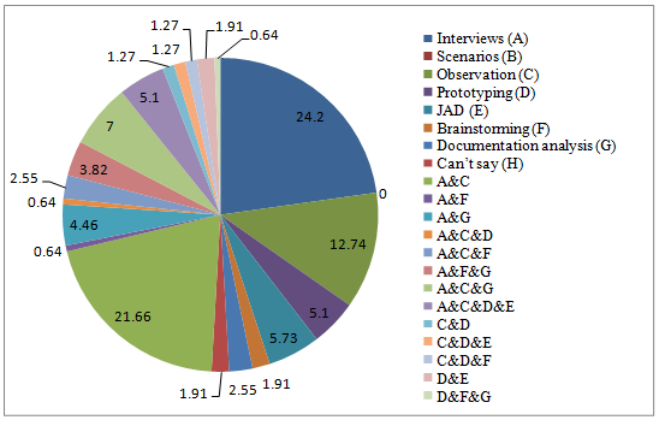

Figure 6. Most preferable requirements elicitation technique.

G. Factor most affect while choosing requirements elicitation technique

In our study we asked respondents to express their views about the factor most affect while choosing requirements elicitation technique. It is found that client's technical knowledge plays an important role while choosing requirements elicitation technique. The response from the respondents is graphically represented in Figure 7.

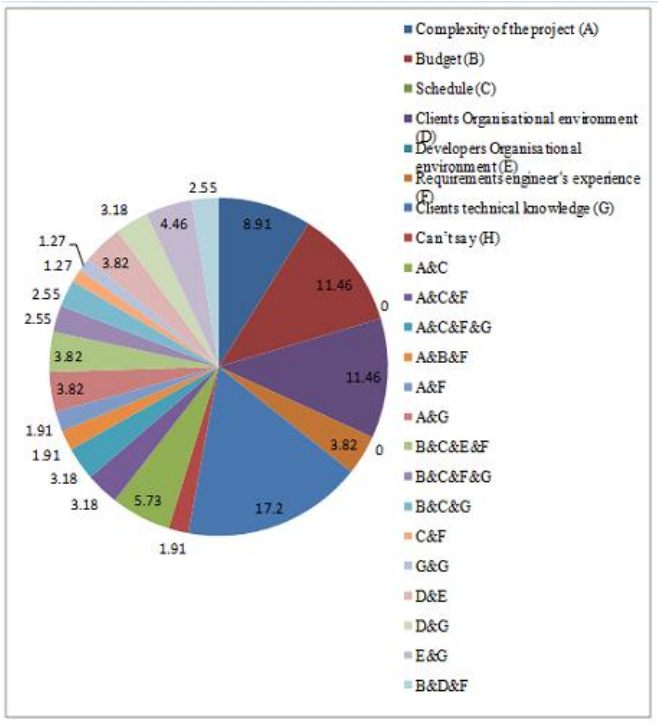

Figure 7. Factor most affect while choosing requirements elicitation technique.

H. Selecting right technique for the requirement elicitation is a key to the success of the project?

Does right technique selection for the requirement elicitation is a key to the success of the project. It is found that 87.90% respondents were agreed that selecting right technique for the requirement elicitation is a key to the success of the project. The response from the respondents is graphically represented in Figure 8.

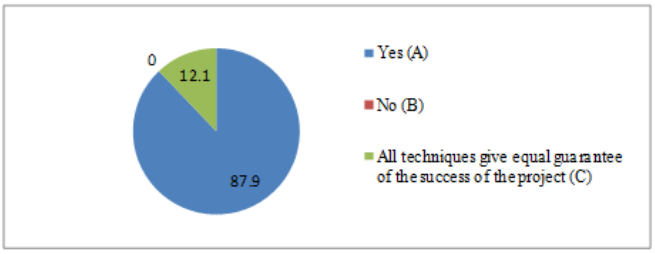

Figure 8. Right technique selection is a key to the success of the project.

I. Preferable Mode of Communication with the Client, if Client is not available for Face to Face Discussion

What is the most preferable mode of communication with the client, if client is not available for face to face discussion? Telephonic communication is found to be most preferable mode of communication with 46.49 % respondents preference followed by Email conversation. The response from the respondents is graphically represented in Figure 9.

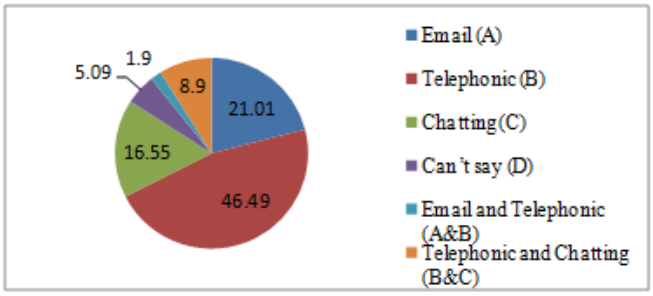

Figure 9. Preferable mode of communication with the client, if client is not physically present.

J. *Client's Lack of Technical Knowledge is an Obstacle in Gathering Correct Requirement*

In our research, we wanted to know from respondents that do they believe that client's lack of technical knowledge is an obstacle in gathering correct requirement. It is found that 73.89% respondents were agreed. The response from the respondents is graphically represented in Figure 10.

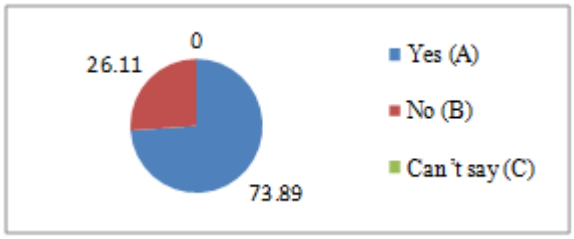

Figure 10. Client's lack of technical knowledge is an obstacle in gathering correct requirement.

K. *Unclear User Requirement may lead to the Project Failure*

According to our research 80.25% respondents were agreed that unclear user requirement may lead to the project failure. The response from the respondents is graphically represented in Figure 11.

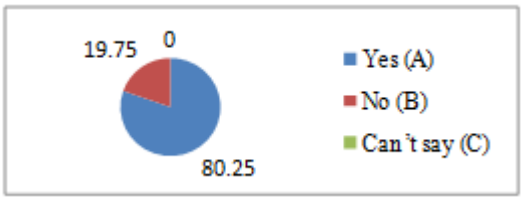

Figure 11. Unclear user requirement may lead to the project failure.

L. *Client Changes Requirement When Project is in the Advance Phase*

In our study we found that 43.31% respondents say that client doesn't change requirement after requirement elicitation is finished and the project is in the advance phase while 37.58 are not agreeing with it. The response from the respondents is graphically represented in Figure 12.

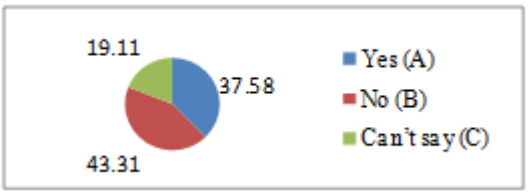

Figure 12. Client changes requirement when project is in the advance phase.

M. *Same Team of Developers should perform all the Software Development Activities for Clear Understanding of the Project*

In our study we found that 53.50% respondents didn't agree that same team of developers should perform all the software development activities during software development. The response from the respondents is graphically represented in Figure 13.

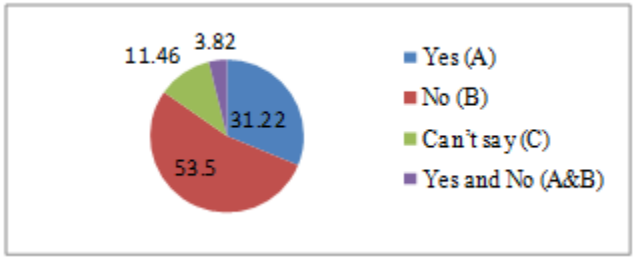

Figure 13. Same team of developers should perform all the software development activities for clear understanding of the project.

N. *Most Important Software Development Activity for the Success of the Project*

In our study we wanted to know which software development activity is the most important according to our respondents. Requirements engineering is considered most important software development activity according to 36.94% respondents while 35.03% believes that all software development activities are equally important for the success of the project. The response from the respondents is graphically represented in Figure 14.

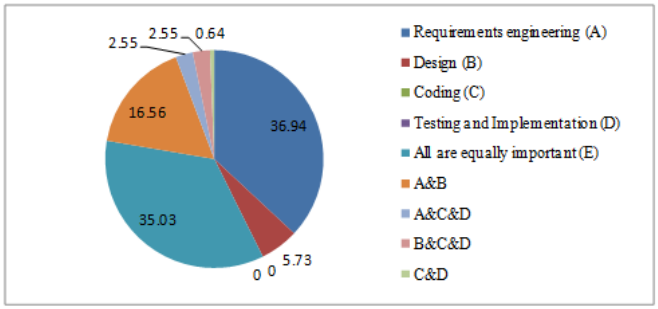

Figure 14. Most important software development activity for the success of the project.

V. CONCLUSION

Though there are various requirements elicitation techniques available, only some of the methods were found to be popular among software development community. Our study found that, interviews technique with 48.41%, observation technique with 68.79%, document analysis with 68.15%, and prototyping with 37.58 %, are the most preferable requirements elicitation techniques of conversational, observational, analytic, and synthetic methods respectively. Majority of respondents (87.90%) believe that, selecting right technique for the requirement elicitation is a key to the success of the project. It is also found that client's lack of technical knowledge, changing requirements in advance phase, and unclear user requirements are main obstacles during the development phase.

Requirement engineers believe that, requirements engineering is the most important software development activity and they prefer to use combination of different requirement elicitation methods. Interviews technique (24.20%) is most preferred in development community followed by observation (21.66%). A majority of development community prefer to use these two techniques in combination.

The paper also opens path for further study on the topic by considering various other conditions and parameters that might affect the requirements elicitation process.

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