Procedural Model of Requirements Elicitation Techniques

Hanan Al-Zawahreh
Master Student
Department of Software Engineering
Hashemite University
P.O. Box 330136 Zarqa (13115), Jordan
(00962) 788087687
hananh_a@hu.edu.jo

Khaled Almakadmeh
Assistant Professor
Department of Software Engineering
Hashemite University
P.O. Box 330136 Zarqa (13115), Jordan
(00962) 797676367
khaled.almakadmeh@hu.edu.jo

ABSTRACT

Software requirement elicitation is one of the most sensitive phases in software requirements knowledge area; it extracts useful requirement and help software engineers to select the right elicitation techniques. This paper presents a proposed elicitation model to facilitate the selection requirement elicitation techniques on the basis of the previous published work in academia, including the combination of situational characteristics, in addition technique characteristics, project characteristic and use guidelines to avoid misunderstanding of the requirements.

Categories and Subject Descriptors

D.2.1 [**Software Engineering**]: Requirements/Specifications – *Methodologies.*

General Terms

Measurement, Design, Standardization.

Keywords

Requirement Engineering, Requirements Elicitation Process, Elicitation Techniques, Elicitation Techniques Selection.

1. Introduction

Requirement in general can be used to solve the requirements problems and play a prime help for succession of the software engineering projects. Requirement engineering concerned with the process of defining, documenting and maintaining of the requirement. Moreover requirement engineering contains a set of activities such as: requirements inception or requirements elicitation, Requirements identification, Requirements analysis, Requirements specification, System modeling, Requirements validation and Requirements management.

Requirement elicitation is extract and determined the requirement from stakeholders, through the elicitation techniques. Also the requirements include both functional and non-functional

requirements. Thus the requirement elicitation is the essential part of requirement engineering to assure the success of the project with high quality. In requirement analysis, the stakeholder communicates and negotiates with each other to understand the requirement, while this negotiation, that a rise the conflict between stakeholder to define the more significant requirements. So a spiral model has been used to allow the renegotiation process

to solve this conflict and achieved the main goal. Requirement elicitation consider a first step to defined the problem and go to solve it, the analysts must be analysis the problem in deeply in order to defined the requirement needed and risk to achieved the success of project, and decreasing the time consumer .The elicitation technique classified as Traditional, Group Based, Scenario-Based and Contextual [1].

Elicitation techniques can be combined to obtain the high quality in elicitation process [2], moreover requirements elicitation is cooperative process involving expert's analysts, users and system stakeholders. The user can participate in elicitation process to supply the modification on his requirements.

Each type of elicitation technical have been issues , that lead to failure the project and inefficient result of the project, where in collaborative techniques stakeholders have different experience and background that causes difficult to communication with each other's and exchanging their opinion. Moreover, contextual techniques have implicit requirements which cannot be converted to verbal information, and the traditional techniques have suffered different answers to the same questions, this is due to the different understanding of stakeholders.

This paper is organized as follows: Section 2 presents related work; Section 3 presents requirements elicitation conflict; Section 4 presents requirement elicitation techniques with the definition and characteristics for all techniques. Section 5 presents the proposed model and the comparison between varieties of models of selection elicitation techniques. Conclusion and discussion are presented in section 6.

2. Related Work

The expert concerned with how to collect the experiences of the analysts with extensive experience in all the word at one place, in order to be available to use by the analysts that have less

experience to improve the ability to define the needed requirement of the user, where the analysts obtain the situational characteristic and elicitation techniques, then study the effect of such characteristic on the selection the appropriate techniques, it was through the expert opinion this opinion was gathered by generated interview between nine expert analysts, after that generate mapping between these characteristic with a suited techniques .Finally but these mapping in tool to available to all analysts [3].

The no engineering stakeholder could involvement in elicitation techniques process directly, the stakeholder could interact with the Requirement Increasing Format (ReqIF) tool through providing the problem on the online platform, and then could add new modification to enhance the quality of the desired requirements [4]. Also, user and stakeholder could participating in elicitation process through online collaboration and the usage of visualization techniques that have been achieved to increase their awareness in defined the requirement by used the tabular view and social visualization [5].

Involvement the user in requirement elicitation is important, so you can select the closer methodology from these methodologies: MUST Joint Application Design User-Led Requirements Construction and Soft Systems Methodology, which is based on understanding the context and the organization. It was aim to increase effective communication between stakeholders and users [17]. To obtain high quality of determined optimal requirement and selected the appropriate techniques, the stakeholder must write the needed customer requirement. In addition, that concerned with context types and type of system [6].

Misunderstanding of requirements, lack of experience of stakeholder and lack of communication between stakeholders, lead to losses in the project in addition the goal, have not been achieved [7].

The stakeholders used the graph to extract the requirement, and then drew relationship between the requirements as word graph and between customers as customer graph, for understanding the needed requirement; in addition that method was useful for used collected fragmented data and explored the hidden contexts [8]. The requirement elicitation techniques were effective when used in distributed setting, so used the survey and observation techniques to assess which techniques better used in distributed requirement than others. Thus, show the prototyping, interview, questionnaires and storyboards are poorly. Where the question and answer, use cases were the most effective than Brainstorming and requirements Management [9].

The requirement elicitation techniques have been combination with each other in complex project in order to a gain high quality and selection the right elicitation technique with right situation.

The combination of technical have been done by used the systematic techniques such as interviews, it was connected with potential customer to obtain the needed requirement, then analysis this requirement through brainstorming meeting by analyst [10]. Also, the guidelines are defined to facilitate the selection elicitation technique through analyzing the attribute then applied the mathematical formulation on the techniques, in order to obtain the quality of requirement elicitation [11]. Some of project that prefer deal with specific elicitation techniques, for example

RESORT project, which used interview, question and answer techniques to determine the needed requirements for each type of RESORT component [12]. The interview between the experts and stakeholders that have been analysis by the expert analyst to obtain the model has the ability to simulate the experts' interview, the interview that contain the blackboard mode and state transition model, and then defined the priority of each requirement [13].

In addition the interview technique is effective to collect and coordinates the requirement, where the analysts used four approaches factor-based, choice based, priority-based, and integration-based through to provide opinion to analyst that have been less experience [14]. Although the information that have been gathered from interview considered oral information, although the information that have been gathered from interview considered oral information but could transform to information visualization through qualitative interviewing. In addition, this tool have been allowed the user to participate and written his requirements [15]. While story telling is considered the efficient elicitation techniques to extract explicitly and implicitly knowledge in detailed more than brainstorming. Moreover, the communication between stakeholder in the storytelling is active than brainstorming [16]. To enhance the elicitation process the experts proposed new approach that contained many features, after the stakeholders collected the words, then representation of these words, after that mapping these words to generate requirement then applied the Quality Function Deployment to ensure that requirements meet the needed requirements. Finally, Researchers used Capability Maturity Model to avoid the risks [17].

3. Requirement Elicitation Conflict

The requirement elicitation process aim at defining the needed requirements with appropriate techniques based on the views of the user. Sometimes exist one or more problem; this is due to many reasons such as: varieties of purpose of domain and characteristics, stakeholders have different language. Moreover, the stakeholders from different domain where each type of stakeholders use the same sentence with different meaning .which that lead to miss understanding of requirement [1].

The lack of participation of user, lack of experience of the analyst, lack of understanding of elicitation techniques, the confused of views and requirement needed of user, all these problems leads to incorrect, incomplete, ambiguous of requirement elicitation process thus selection the wrong technique[4]. Why the analysts prefer the technique on the other?

- It was the most technique the analyst known.
- It was the analysts think this technique is most appropriate in all situations.
- It was effective in the previous process.

It can be enhancement these factor to help the analyst to select the best technique with determined situation through add some of situation and techniques characteristics, also study the project characteristics in addition used guidelines.

4. Requirement Elicitation Techniques

This section illustrates the requirements elicitation techniques. The requirements elicitation techniques can divide into four categories:

- Traditional Techniques: verbal communication between stakeholders and experts. Simple nature way to define the needed requirement such as an interview.
- Collaborative Techniques: this provides different way to connect the stakeholders with analysts to determine the desired requirements such as Focus Group.
- Cognitive Techniques: deal with documents to extraction knowledge and defined the requirement such as Document Analysis.
- Observational Techniques: strong understanding of domain problem through observes the human actions such as: Observation.

Table 1 illustrates the requirement elicitation techniques with their characteristics. Table 2 illustrates some of project characteristics, each project have some of characteristics that distinguished from one to anther based on goal of domain project.

Table 2. Project Characteristic

Project Characteristic	Definition
Project Complexity	The complex of project different from one to another based on structure of project, requirement that needed and functions.
Requirements Size	The size is important factor in selection technique,(large ,medium and small) .
Project Category	Projects have different Classification. Each type of project have the specific technique, for example the secure project need one technique, where this technique not suite to non-secure project.
Cost Available	Some of the projects have a budget that allows the use of any type of technique, where other projects committed to specific types of technique that the limited budget.

Table 3. Project Situational Characteristic

Situational Characteristic	Definition
Analyst	This has two type of analyst: experts and novice (have less experience) analysts.
Stakeholders	The stakeholder have different language , skills and different background of knowledge, this lead to conflict views ,so you must training to improve abilities and solved any miss understand .
Policy of the Organization	Which approach of requirement elicitation techniques that have been used?
Domain of the Project	Is public or private.

User	If the user have experts in domain or not. The user involvement in elicitation process is effective factor to success the selection requirements elicitation techniques.

Table 3 illustrates some of situational characteristics of software under development process, which is defined from analysts to facilitate selection techniques.

5. Model of the Improved Elicitation Techniques

This section presents the proposed procedure for selecting elicitation techniques for achieving a high quality of requirements for software design; the requirement elicitation process beginning of the analyst analysis the problem domain to determine the requirements through defined the various stages of activities. Then study and analysis the source of domain such as: goal of software, domain knowledge, business rule and the organization environment. Thus, the analyst determines the requirements at each stage are better than the previous stage, with appropriate technique through selection requirement technique process in elicitation requirement where participant contain (stakeholders, analysts and users). To select the appropriate technique through fivefold:

- Using the requirements that were extraction from the user.
- Determined the project characteristics in table 2.
- Determined the situational characteristics in table 3.
- Determined available techniques with specific characteristics in table 1.
- Using of guidelines.

The needed requirements are identified and classified. After that, ready to input in the matching process to helping the selection appropriate technique, where defined the properties of elicitation technique in order to match between the best elicitation technical with the needed requirement in specific situation, thus the result was collection of techniques based on situational characteristic ,that have been defined through the software domain [18]. In addition, the situational characteristic includes a set of characteristics: if stakeholders have experience or not, with the social science, and the domain of the project if private or general, they choose techniques influenced by the policy of the organization. So developer's effects on selection techniques through the level of knowledge they have, then select one elicitation technique from collection the elicitation technique where each type of the technique have many strengths and weakness. In addition, there is no one technique used in all situations. Each technique has characteristics suited with specific situation as explain in table 1.
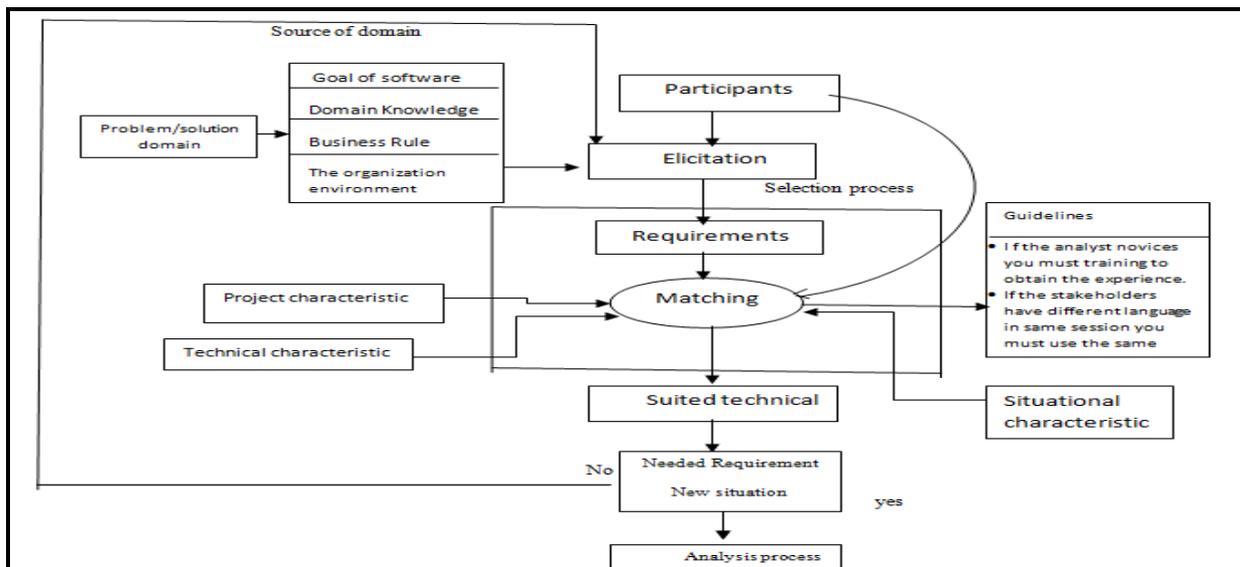
Figure 1. Model of Improved Elicitation Techniques

Also we used some of the guidelines to avoid problems that could occur in selection of techniques. Such guidelines are aimed to help the analyst on the elicitation technique process and using such guidelines requires the identification of the level of expertise of the analyst him/herself. Further, using such guidelines might require some training to improve the analyst technical knowledge. Moreover, discussion carried out between the analysts needs to include common terminology in order to reduce misunderstanding of requirements. Also, the project characteristics influenced in selection process as explain in table 2. After that, determined the personal selector to perform the appropriate technique based on qualified. Finally, the result is new situation and new state of requirement, if some of requirement not obtain you must return to the elicitation process to redefine the needed requirement. This model succeeded in the ability to choose the appropriate technique based on situational characteristics, project characteristics and techniques characteristics.

6. Conclusion

The requirement elicitation can help the analysts who have less experience to increase experience through discussion with expert's analysts to obtain the needed requirement. In addition, the requirement elicitation technique can be used efficiently in distribution sitting in some projects. The elicitation selection process is a sensitive process so that have been attention from many researchers with variety model where some model concern with mathematical way and other concern to characteristic all these models have the same aim is selected the suited technique.

This paper presents three types of characteristics: project characteristics, situational and technical characteristics. Moreover, we can use some of guidelines on analysts and stakeholders to assure the pass of the selection process. In addition, this paper presents table explain the comparison between five previous models to help this proposed model for select the technique. Also, we proposed a new model to select the suited techniques with specific requirements. Based on combination of situational characteristics, technical and project characteristics that communication with each

other to support the selection elicitation process, where show the importance of requirement elicitation process for success the project thus obtain a high quality software project.

References

[1] Bourque, P., & Fairley, R. E. (2014). *Guide to the Software Engineering Body of Knowledge (SWEBOK (R)): Version 3.0*. IEEE Computer Society Press.

[2] Ahmad, S. (2008, March). Negotiation in the requirements elicitation and analysis process In *Software Engineering, 2008. ASWEC 2008. 19th Australian Conference on* (pp. 683-689). IEEE.

[3] Kausar, S., Tariq, S., Riaz, S., & Khanum, A. (2010, October). Guidelines for the selection of elicitation techniques. In *Emerging Technologies(ICET), 2010 6th International Conference on* (pp. 265-269). IEEE.

[4] Hickey, A. M., & Davis, A. M. (2003, September). Elicitation technique selection: how do experts do it?. In *Requirements Engineering Conference, 2003. Proceedings. 11th IEEE International* (pp. 169-178). IEEE..

[5] Yozgyur, K. (2014, June). A proposal for a requirements elicitation tool to increase stakeholder involvement. In *Software Engineering and Service Science (ICSESS), 2014 5th IEEE International Conference on* (pp. 145-148). IEEE.

[6] Lloyd, W. J., Rosson, M. B., & Arthur, J. D. (2002). Effectiveness of elicitation techniques in distributed requirements engineering. In *Requirements Engineering, 2002. Proceedings. IEEE Joint International Conference on* (pp. 311-318). IEEE

[7] Tiwari, S., Rathore, S. S., & Gupta, A. (2012, September). Selecting requirement elicitation techniques for software projects. In *Software Engineering (CONSEG), 2012 CSI Sixth International Conference on* (pp. 1-10). IEEE.

[8] Mishra, D., Mishra, A., & Yazici, A. (2008, August). Successful requirement elicitation by combining requirement engineering techniques. In *Applications of Digital Information and Web Technologies, 2008. ICADIWT 2008. First International Conference on the* (pp. 258-263). IEEE.

[9] Duarte, D., Farinha, C., da Silva, M. M., & da Silva, A. R. (2012, June). Collaborative Requirements Elicitation with Visualization Techniques. In*Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE), 2012 IEEE 21st International Workshop on* (pp. 343-348). IEEE.

[10] Sharma, S., & Pandey, S. K. (2014, March). Requirements elicitation: Issues and challenges. In *Computing for Sustainable*

Global Development (INDIACom) 2014 International Conference on (pp. 151-155). IEEE

[11] Nakatani, T., Hori, S., Ubayashi, N., Katamine, K., & Hashimoto, M. (2008, September). A case study: Requirements elicitation processes throughout a project. In *International Requirements Engineering, 2008. RE'08. 16th IEEE*(pp. 241-246). IEEE

[12] Kato, J., Komiya, S., Saeki, M., Ohnishi, A., Nagata, M., Yamamoto, S., & Horai, H(2001, December). A model for navigating interview processes in requirements elicitation. In *Software Engineering Conference, 2001. APSEC 2001. Eighth Asia-Pacific* (pp. 141-148). IEEE.

[13] Chua, B. B., Bernardo, D. V., & Verner, J. (2010, August). Understanding the Use of Elicitation Approaches for Effective Requirements Gathering. In*Proceedings of the 2010 Fifth International Conference on Software Engineering Advances* (pp. 325-330). IEEE Computer Society.

[14] Ahmed, S., & Kanwal, H. T. (2014, December). Visualization based tools for software requirement elicitation. In *Open Source Systems and Technologies (ICOSST), 2014 International Conference on* (pp. 156-159). IEEE.

[15] Knauss, A. (2012, September). On the usage of context for requirements elicitation: End-user involvement in IT ecosystems In *Requirements Engineering Conference (RE), 2012 20th IEEE International* (pp. 345-348). IEEE.

[16] Boulila, N., Hoffmann, A., & Herrmann, A. (2011, August). Using Storytelling to record requirements: Elements for an effective requirements elicitation approach In *Multimedia and Enjoyable Requirements Engineering-Beyond Mere Descriptions and with More Fun and Games (MERE), 2011 Fourth International Workshop on* (pp. 9-16). IEEE.

[17] Macredie, R. D., & Coughlan, J. A. (2002). Effective communication in requirements elicitation: A comparison of methodologies School of Information Systems, Computing and Mathematics.

[18] Hickey, A. M., & Davis, A. M. (2007). An ontological approach to requirements elicitation technique selection. In Ontologies (pp. 403-431). Springer US.

Table 1: Requirement Elicitation Techniques

Categories	Technical	Description	Strengths	Weaknesses
Traditional Techniques	Questionnaire	Used in domain that has large number of people .and useful for answering the specific questions.have two type of question: open ended question, close ended question.	• Collect large amount of information from large number of people in short time. • large number of people involved	• This technique no attention of changes of emotions, behavior and feelings of user. • Concern of specific information without explanation
	Interview	Communication between stakeholder and analysts, to gather requirements. have two type of interviews : the closed interview and open interview .	• Good of complex topic. • Can deep understanding of views in interview. • Can make effective discussion and high response rate.	Consume of time. • Small number of people involved. • In consistent between interviews may effect on data.
Collaborative Techniques	Brainstorming	Allow environment for discussion. This technique has two phases: collect the idea and analysis, then evaluation these ideas.	• Low cost. • The participant in this technique are no need have high qualified. • Brainstorming does not would like a lot of resources. • This is simple technique and easy to understand. • Can generate new idea and answer of many questions.	• Some individuals afraid to speak with leadership. • If the group is not organize then take a long time . • No good for the large number of participant. • Sometimes the details on thing doesn't use.
	Focus Group	This technique can help the user to define the needed and enhancement their expectation.	• Discussion of group can obtain the best solution. • This group can exist the weakness in primary stage.	• Consume of time and may without conclusion . • Lead to misunderstand between group and argument.
	Joint Application Development (JAD)	Similar of brainstorming but more than structured and more intensive. Where get all participants (experts, stakeholders) at the same place and time.	• The participant can involve effectively in requirement process. • The most technique understands the goals. • Accurate technique • Use of visual aids.	• More expensive. • Requires training and experience of all participants in session.
	Prototyping	This useful to validate and understand the requirement. This has two type of prototype: throw-away and Evolutionary prototypes.	• Obtain valuable feedback from customer. • Can verifying the complexity of the system. • Can discover the problem in design. • Save the time and cost of development time.	• This technique consumes a lot of resources. • Objective is ambiguity. • May result insufficient analysis. • The real performance is very difficult than expectation.
	Workshop	Use the different type of session to collect the needed requirement from stakeholders, this good in complex project.	• Exchanging knowledge between participants. • Obtain new business opportunities and valuable feedback. • Useful in large system.	• Consume of a lot of time of preparation. • Need to travel to other country.
Cognitive Techniques	Document Analysis	This concern the document of the domain problem, analyze such document to extract requirement.	• Interchange between ideas. • Determine domain of focus	• Not all needs that have been discussed from user are realistic.

	Card Sorting	Communication between stakeholders & analyst Determined a set of concept then generate relations between these concepts.	• Simple. • Easy to automation. • Can classification knowledge	• No performance knowledge. • Relation may be not optimal
	Laddering	Is similar structure of interview but in amide range and divide into three phases: create, review and motivation.	• Use in collect the tacit requirements. • Representation knowledge based on standers.	• Assumes hierarchically arranged knowledge.
Observational Techniques	Observation	This takes actual view of what the user need in your project. Moreover can help to understand the problem domain. Observe a user with system in either indirect or direct.	• Divers of stakeholder. • Provide details information about the system.	• The requirements is update continuously thus needs to revision. • Time consuming. • Hard analysis the result of this technique.
	Social analysis	Depth communication between stakeholders and experts with different skills. To understanding policy of organization.	• Can discovering new products	• Time-consuming. • Difficult to generalizes the result in other products.