



A Systematic Approach for Requirements Elicitation Techniques Selection: A Review

¹Masooma Yousuf*, ²M. Asger, ³Mohammad Ubaidullah Bokhari

¹Department of Computer Science, Baba Ghulam Shah Badshah University, Rajouri, J&K, India

²School of Mathematical Science and Engineering, Baba Ghulam Shah Badshah University, Rajouri, J&K, India

³Department of Computer Science, Aligarh Muslim University, Aligarh, India

Abstract— *Software requirements elicitation is the initial and error prone activity in the software development cycle. Due to the increasing complexity and size of software projects, requirements elicitation is becoming even more challenging than it is. Although many techniques are prescribed by researchers but the key problem in requirements elicitation is the selection of the most effective technique. Requirements engineering being the recent field in software engineering as compared to the other fields, therefore, not adequate research has been carried out in evaluating efficiency and effectiveness of software requirements elicitation techniques. However, till now no research could present the universal acceptable results. As no single technique can fulfil all the needs of requirements elicitation activity; techniques must be selected according to the given conditions. In this paper, we present a decision support strategy for selecting the appropriate requirements elicitation technique based on the several distinguished factors that affect the selection of right techniques. Selection of elicitation techniques based on the distinguished factors mentioned in this paper can considerably improve the effectiveness of elicitation activity.*

Keywords— *Software Requirements, Requirements Elicitation, Elicitation Technique Selection, Stakeholders, Elicitation Techniques*

I. INTRODUCTION

Requirements elicitation is all about learning and understanding the needs of users and project sponsors with the ultimate aim of communicating these needs to the system developers [1]. It is considered as the most time consuming and effortful activity. Elicitation of requirements is all about gathering information from the users as to how the system should be, what functions it should perform including its non-functional requirements like performance, throughput, reliability, efficiency, etc. There are many ways of getting as much information as possible from the users and other stakeholders. Even the collected information which act as requirements in the system can be compared with requirements of other users for negotiation and conflict resolution. A report from [2] claims that requirements elicitation is concerned with the source of software requirements and how the software engineer can gather them. Many ways of collecting information from users are implementation of the techniques like interviews, questionnaires, brainstorming, etc. The techniques are applied towards the different users to get proper set of requirements in order to get high quality end product which fulfils the intended needs of users. If the requirements are not collected properly, the missing requirements in the initial phase are passed to the next phases of development, causing errors, which in turn create problems in the developed system and increase the overall cost of the system development and maintenance. Although not all the elicitation techniques are feasible for all projects; they too have their advantages and disadvantages during their actual implementation, therefore we need to select the most appropriate one. There are no proper guidelines or well-established rules for selecting elicitation techniques for different projects. The knowledge of selecting elicitation techniques comes from empirical studies that rationalize their advantages and factors affecting their applicability in particular conditions. Although project failures cannot be controlled [3], but it is relatively expected that if the elicitation process is improved by the industry it will have remarkable effect on the success rates of the industry [4]. Currently, the problem is to make appropriate selection of elicitation techniques so as to make the elicitation process effective and efficient. Once this problem is solved it will help analysts select the appropriate technique for every project.

II. ELICITATION TECHNIQUES AND THEIR USAGE

The requirements elicitation techniques simplify the task of developers in identifying user requirements; at this stage, developers become aware of the requirements of stakeholders, in addition to the actual users of the system [5, 6]. There are many requirements elicitation techniques prescribed by researchers as well as implemented by practitioners to collect requirements. Elicitation techniques are the different ways of gathering information from users regarding their needs and expectations from the developing system. These techniques help in uncovering the requirements, gathering, analysing and validating them. Each technique has the capability of collecting one type of requirements and are mostly useful in one area for requirements collection. Many times different techniques can be combined together to get a useful methodology for implementation in a full-fledged process of elicitation. Requirements techniques must be such that they gather maximum and relevant requirements with significant use of resources (time, budget and efforts). Some techniques

are easy to implement while others needs experience for effective implementation. In some projects, more than one technique may be used to gather the proper requirements set. The features which a technique possesses help in dictating how it should be implemented but are not enough to determine its adequacy. More the elicitation techniques are used the greater insight is gained regarding their usage, characteristics, drawbacks and applicability conditions.

Focusing on elicitation technique selection, there is no best technique yet as not adequate data is available for making the decisions regarding effectiveness of techniques.

Qualities of good elicitation technique are:

- Capability of finding most and high valued requirements.
- Capability of finding tacit requirements.
- Accomplishes its goal with least use of resources i.e. time and budget.
- Non-redundant

III. CHARACTERISTICS OF GOOD REQUIREMENTS ELICITATION TECHNIQUES

Which of the elicitation techniques are best? Each techniques are best suited for uncovering one type of requirements but may not be good for other types of requirements. For example, One-to-One interviewing is useful for gathering personal requirements and observational technique is used when users cannot explain what they do, how they work; at that time system analysts have to observe their work and environment; and is helpful in gathering information on current processes. Prototyping technique is used to gather initial requirements that are used to build an initial version of the solution through a prototype. Requirements elicitation techniques must ensure maximum requirements gathering with least use of resources. The best suited technique is the one that lets you to accomplish the goal in your current situation. Some techniques are efficient in finding relevant requirements and some are easier to implement than others. Some techniques are more applicable to certain situations and project types others are applicable to all. Each elicitation technique has its own criteria for selecting requirements i.e. what type of requirements it will uncover, what setting it will work properly in, what will be the outcome of the technique, etc. Each technique requires efforts before implementing and after implementation for requirements gathering. Requirements gathering process is often time consuming process because as it is the process of collecting detailed data on the operation of a system [7, 8].

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IV. PROBLEMS IN MAKING ELICITATION TECHNIQUES SELECTION

The aim of the analyst should be to uncover maximum but proper set of requirements within budget and time constraints with manageable efforts and from relevant stakeholders. When selecting the elicitation technique, practitioners are eager to know which technique is helpful in collecting requirements that are relevant to the project. In most cases, elicitation technique is selected not because of its qualities or strengths but because of its familiarity or past records. This one-sided decision can influence the elicitation results, degrading the quality of requirements which will ultimately have wrong effects on the developing system. The problems faced in selection of elicitation techniques are:

- Wide variety of elicitation techniques available.
- Many of the prescribed practices, methods, techniques and standards are not thoroughly evaluated [9, 10].
- There is an inadequate knowledge about which techniques are effective, and which factors influence their adoption.
- Not proper information regarding what elicitation techniques are available and which of them do the practitioners implement most.
- Less practical data available as the practitioners don't tend to share after practicing the techniques.

The above mentioned problems make effective selection of elicitation techniques difficult

V. FACTORS FOR SELECTING ELICITATION TECHNIQUES

With so many elicitation techniques available, how analysts can decide which ones to use? How can the most appropriate technique be chosen? Each and every situation where requirements have to be collected is different and therefore, must be treated that way. Lot of research has been done and papers written that give description regarding the available elicitation techniques, but little research is done focusing on helping the analysts in decision support for elicitation technique selection [11]. There are no proper tools or methodologies which can help in determining which elicitation technique is effective in which situation. Even in some cases, there is lack of knowledge of which techniques are available for requirements elicitation, their characteristics, etc. While some analysts think that one technique is suitable for all environments and for all project types, which is not possible, since one technique cannot be suitable for all projects and environments [12] [13]. Analysts usually select a technique for gathering requirements for one of the four reasons: 1) It is the only technique that analysts have knowledge about, 2) It's their favourite techniques of all times, 3) The analyst is following some methodology which recommends the use of the particular technique at that time, 4) The

analysts has intuition about the technique that it will be suitable in this condition. There are large number of elicitation techniques available and therefore, it is a challenge for analysts to select an appropriate technique. The lack of knowledge and understanding about elicitation techniques results in inappropriate technique selection which in turn leads to the failure of the project. So, there are different factors which should be taken into account while deciding which elicitation technique to choose. They include but are not limited to: The type of system, the type of requirements, stakeholders involved resources available, available expertise and skills, experience with the technique, how it is done (settings). Specifically, every situation demands an elicitation technique that is best suited for that situation as shown in Fig. 1.

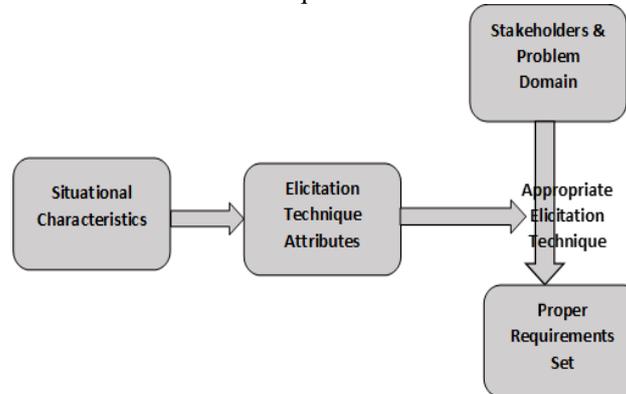


Fig. 1 Elicitation Technique Selection Based on Situational Characteristics and Elicitation Technique Attributes [14].

Factors influencing the criteria which technique to use are:

A. Type of the System

The type of the system being developed influences the decision of selecting the technique. For example, in developing a new novel system prototyping technique would be useful and for general purpose system questionnaire technique will be beneficial. The size of the project also plays an important role in selecting a technique. Some technique work with small projects some with large and complex ones. And the phase of the project is also considered while selection of techniques like, is it the early project phase or the later one. For example, observational techniques and analytical techniques are applicable in the early phases of RE process.

B. Type of the requirements

The type of requirements being collected influence the selection of technique. For example, for collecting implicit and functional requirements ethnography technique is used and for gathering additional information regarding scope, social context; unstructured interview technique is used.

C. Requirements sources

There are three sources from which the requirements can be gathered viz. Stakeholders, Available documents and Existing systems. The ideas of stakeholders are important for defining the requirements of the system. To ensure high quality requirements, relevant stakeholders need to be identified. Therefore, it is important to systematically select appropriate stakeholders for the project considering the defined quality criteria [15]. Documents can be manuals, forms or legal and standard documents. Since it is a time-consuming process therefore proper documents need to be selected that are directly related to the project. Documents provide knowledge which cannot be directly obtained from the stakeholders. Existing systems can be predecessors or similar systems already working in an organization. They can act as a baseline for improvement in the future projects to be developed.

Depending upon the sources of the requirements available, a suitable technique is selected.

D. Maturity of the technique

Technique to be implemented has to be mature i.e. must have organized and properly defined steps and well documented as well and has been used in industry. The ability of the technique to help analysts easily acquire and transfer knowledge from users is also the important criteria for technique selection.

E. Coverage of all aspects of RE process

Technique used in one phase of RE might also be used in some other phase as well. Sometimes technique is selected such that it adequately covers all the phases of RE process. For example, Exploratory and Evolutionary prototypes are applied in Elicitation, Analysis and Negotiation, Verification and Validation phases; Card sorting is used in Prioritization phase.

F. Available expertise and experience

Experience of analysts with the technique and their knowledge of it in eliciting requirements will be beneficial in selecting the technique. Practitioners scoring the technique for its attributes influence technique selection to a larger extent, as their knowledge is mostly influenced by the experience with the technique.

G. Stakeholders involved

This is also the important aspect in selecting the technique as stakeholder identification and involvement is must. Requirements analysis is considered as a social activity, if the techniques and methods doesn't involve appropriate persons or groups needed in this activity (most of them do fail!), it reduce the chances of collecting all the required information [16]. The experience and domain knowledge of stakeholders is very important. For less experienced users and more experienced users separate techniques are used; those having less domain knowledge and full domain knowledge separate techniques are used.

H. Scope of techniques

The scope of the technique i.e. the RE subject it deals with or to what extent it will be relevant in RE process also influences its selection. For example, object oriented analysis is used for Object oriented requirements modelling and Entity relationship diagram (ERD) is used for documentation, analysis and negotiation.

I. Level of certainty

One of the important factors influencing technique selection is the acquaintance of the organization with the application domain. The acquainted domain implies that the problem situation is mature and its knowledge is already with the organization, engineers and the stakeholders. With the already defined problems, their scope and objectives are already characterized; eliciting requirements is easy. While as with the new novel project or application domain there is high level of uncertainty. The organization, engineer and users are not well acquainted with the domain. There are chances of problems which engineers have never faced before. Before starting elicitation of requirements, engineers have to acquaint themselves properly with the domain knowledge. Therefore, depending upon the certainty or uncertainty of application domain; a technique can be selected. For example, Prototyping technique can be used when new project is developed.

J. Evaluation criteria

What is the criteria for technique selection? The most effective technique needs to be selected or the most efficient one? Effectiveness means maximum number of requirements collected. Efficiency means collecting requirements with usage of minimum resources (time, budget, technology or human resources).

K. Time and Budget

How much time is available for collecting requirements and what are the budget constraints on the project, also affect the technique selection. Requirements elicitation is time consuming activity and so is the elicitation technique selection. When more time and budget is available, number of techniques can be implemented and also those ones which require more money. However when the time and budget is limited, the technique collecting important requirements within the time and budget limits are selected.

VI. CONCLUSIONS AND FUTURE SCOPE

Requirements elicitation techniques are very important and without them the elicitation process would never be complete. The important features of any elicitation technique define how to apply it but they doesn't ascertain its adequacy. Therefore, to select the most appropriate and adequate technique some factors need to be considered. We need to select the elicitation techniques in a well-defined manner not considering only the single aspect or factor. However, there is no single technique that can solve all the problems of requirements elicitation. As one technique is effective for one type of requirements and can help in collecting all relevant requirements of that type only. And other types of requirements will be missed. Using variety of techniques will ensure gathering maximum number of requirements resulting in effective requirements elicitation. The above mentioned factors must be taken into account while selecting the requirements elicitation techniques to ascertain that the appropriate technique is chosen. Appropriate technique selection improves the production of information collected during elicitation process. The future work includes that the factors mentioned can be further studied to check if i) any of the factor is missing or ii) any defined factor is not important.

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