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Systematizing requirements elicitation technique selection

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ABSTRACT

Context: This research deals with requirements elicitation technique selection for software product requirements and the overselection of open interviews.
Objectives: This paper proposes and validates a framework to help requirements engineers select the most adequate elicitation techniques at any time.
Method: We have explored both the existing underlying theory and the results of empirical research to build the framework. Based on this, we have deduced and put together justified proposals about the framework components. We have also had to add information not found in theoretical or empirical sources. In these cases, we drew on our own experience and expertise.
Results: A new validated approach for requirements technique selection. This new approach selects techniques other than open interview, offers a wider range of possible techniques and captures more requirements information.
Conclusions: The framework is easily extensible and changeable. Whenever any theoretical or empirical evidence for an attribute, technique or adequacy value is unearthed, the information can be easily added to the framework.

1. Introduction

The requirements engineering (RE) process is composed of [1]: requirements elicitation, analysis, specification, validation and management. Requirements elicitation covers the capture and discovery of stakeholder needs. Its aim is to identify information determining what features the software system should have. This activity is carried out recurrently throughout the requirements stage. It often takes place iteratively and is interlinked with other activities in this stage. Each of these iterations for capturing key information about requirements is called an elicitation session. Each session requires preparation, execution and later analysis. Requirements engineers have to select which elicitation technique to use in each session. According to Zowghi and Coulin [2], the preparation of an elicitation session entails: (i) understanding the application domain by exploring the policy, organizational and social aspects of the current environment, as well as system and development constraints; (ii) identifying requirement sources, that is, users, experts and any relevant project, process and system, as well as existing documentation like manuals, forms, reports and earlier requirement specifications; (iii) analyzing stakeholders and identifying key representative users; (iv) selecting techniques, approaches and tools for use in the requirements process; and (v) eliciting requirements from stakeholders and other sources. Our research focuses on the task of selecting techniques for eliciting requirements (iv).

Software engineers tend to choose a technique to apply on one of the following grounds [22]: it is the only technique they are acquainted with; it is their favorite technique for all situations; they are using a methodology that prescribes a particular technique; or they guess that the technique is effective under the existing circumstances. This subjective decision can bias the elicitation results, degrade the quality of the output requirements, and, ultimately, have an impact on the quality of the final software product [9].

In practice, when analysts set out to determine a software system's requirements, they very often use only one technique, interviews, to capture information, even though they are probably acquainted with several other methods [3]. This could be because they are unaware of the benefits of each technique, there is no methodological guidance for the elicitation process or it is standard procedure: in many cases, an elicitation method or technique is chosen not for its features or strengths, but simply on the grounds of history or familiarity [4].

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According to Beyer and Holtzblatt [38], there is evidence, however, that traditional interviews are inadequate for the development of systems today. They propose techniques that reflect the typical master-apprentice relationship in which the stakeholder is a master of his job but does not necessarily have teaching skills to communicate actions to the developer. In addition, watching and experiencing stakeholders doing their job reveals issues, details, structure and work strategies that are difficult to capture clearly using interviews. Other authors, such as Maiden and Rugg, indicate that probably more than one elicitation technique may be necessary to get the full range of requirements for most complex software systems [16]. In short, it must be recognized that there are contextual conditions that hinder the use of interviews to elicit requirements, such as stakeholder inaccessibility, schedule coordination problems, problem domain complexity, stakeholder profile diversity, disagreement on the problem to be solved, deficient communication skills or cultural differences between requirements engineers and stakeholders.

Some reviews account for tens of elicitation techniques [5]. Many of these techniques have been imported from fields like cognitive psychology, anthropology, sociology and linguistics [6], and have been successfully used in knowledge engineering [7] and, lately, software engineering. Most requirements engineers are nonetheless unfamiliar with this range of techniques and miss the chance of optimizing requirements elicitation. This can be considered as another side of the well-known breach between theory and practice [8].

The differences between elicitation techniques are characteristically very large, the inference being that some are likely to perform better in some situations than in others. An elicitation technique's intrinsic features dictate how it should be applied, but is not enough to ascertain its adequacy. Methodological support to help requirements engineers to select the most adequate technique for the conditions that they face during elicitation could turn out to be very useful.

This research tackles the problem of selecting elicitation techniques based on the idiosyncrasy of each technique and the particularities of the development context. An appropriate choice of technique optimizes the productivity of the information captured in the elicitation sessions. This makes it possible to generate a more correct and complete specification which then results in a quality final product through a process with fewer holdups [9].

We aim to set up a framework that in practice helps requirements engineers to choose a suitable technique to elicit the key information at any time during development project requirements elicitation.

Section 2 discusses work related to the problem. Section 3 shows an overview of the proposed framework. Section 4 determines and defines the relevant contextual attributes for elicitation and their values, which is the initial information required to analyze technique fitness. Section 5 establishes the values of elicitation technique fitness for each key contextual attributes value. Section 6 presents the procedure for selecting the best techniques for a particular project. Section 7 shows an example in which the framework is applied. Section 8 presents the evaluation of the proposed framework through two experiments. Finally, Section 9 discusses the results and presents the final conclusions.

2. Related work

The requirements research field has expanded over recent decades. Even so, there is little research addressing how to support analysts in decision making on the choice of elicitation techniques, methods or tools for capturing information for specifying requirements.

Several papers describe elicitation techniques and provide some instructions on their use [5,10,11,6]. There are also some empirical studies comparing elicitation techniques. The shortage of experiments and the non-uniformity of the experimental conditions, variables and techniques that they study make it difficult to infer the application conditions for elicitation techniques [12]. Some research on elicitation techniques, mainly empirical, comes from the knowledge engineering area. Although these studies were carried out before 2000, their results continue to be valid.

After reviewing about three hundred articles and thirty books related to requirements engineering, we found that the first studies designed to prescribe techniques based on contextual attributes were conducted only ten years ago. This dearth of studies is a sign of how little research has focused on the selection of elicitation techniques. Elicitation technique selection is the central goal of only ten papers. Table 1 summarizes these studies. It uses a set of criteria for evaluating and comparing the related work. These criteria are:

- Discipline in which the proposal is applicable: proposals have been made in knowledge engineering and software engineering (some comparative studies of techniques have been conducted in the fields of economics, marketing, psychology). Proposal objectives are discipline dependent. Thus, the goal in knowledge engineering is to elicit knowledge from experts. The goal in software engineering is to capture relevant information for requirements specification. This area is more important for our purposes, because our proposal aims to support novice requirements engineers.
- Scope that the proposal aims to cover: proposals may be designed to help select techniques for broader processes like the software development process or the requirements process or specifically for requirements elicitation. The techniques may differ depending on the scope of use. For our study, the elicitation techniques have the distinctive trait of being user interaction intensive. On this ground, we are interested in the techniques used in the requirements elicitation activity.
- Type of information on which the proposal is based: proposals can be based on the expert opinions of their authors and/or on empirical studies. We believe that this type of research to support technique selection should be based primarily on empirical evidence as its recommendations are more reliable. The proposals should evolve towards this goal.
- Number of elicitation techniques covered: requirements engineers reckon with more and more alternatives for capturing requirements information, close to fifty at present. However, the proposals should consider, at least initially, a sizeable number of the most popular techniques.
- Types of elicitation process contextual factors accounted for: the contextual attributes of the elicitation activity have been grouped under five factors that influence technique effectiveness (elicitor, informant, problem domain, solution domain, and elicitation process). Proposals should, at least initially, consider all these contextual factors.
- Specification of the contextual attribute values: the possible values of the contextual attributes at any time during a project may or may not be available in the proposals. This is important as the workability of the method depends on the possibility of quickly and easily determining such values.
- Evolvability of the proposal: proposals may or may not offer facilities for updating the method. However, we consider that the determination of other influential attributes, the addition of other techniques or the incorporation of evidence on their effectiveness is essential for the validity and use of the proposal over time.