

Towards Customer-Based Requirements Engineering Practices

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Abstract—Factors related to the requirements engineering process and customers have been repeatedly reported among those that most strongly influence the success of a software project. However, requirements engineering research has so far barely studied practice from a customer-based perspective. Furthermore, rigorous evidence about customers’ perspectives regarding requirements engineering approaches is scarce, and links between customer-based requirements engineering research and the industrial practices are necessary. This paper argues that new research is necessary to tackle the above weaknesses. Our position is that: requirements specification approaches must be validated from a customer-based perspective; the influence of customers’ characteristics on the requirements engineering process must be studied in more depth; and potential customer-based improvements in practice must be assessed. We also present situations in which the results from these activities would help practitioners, propose a research agenda to execute these activities, and discuss challenges that might hinder their execution.

Keywords—requirements engineering; empirical software engineering; customer; practice; industry.

I. INTRODUCTION

Existing literature on software project success (e.g., [2][13]) indicates that factors related to the requirements engineering (RE) process (requirements elicitation, analysis, specification, validation, negotiation, and management) are among the most important ones, and most of them are related to customers (i.e., organizations and people at which a system is targeted, including end-users). For example, customer involvement, good communication with customers, and adequate analysis of customers and their needs have been repeatedly reported as major success factors. Customers must participate in the RE process, and RE practices should be adapted to customers’ characteristics.

Despite the importance of customers and the need of adapting RE practices to project characteristics [4], RE research has so far barely studied how customer-based factors affect the RE process. Consequently, little knowledge exists about what RE practices are better suited for involving and communicating with customers, better meeting their needs and wishes, and thus increasing a project’s probability of success. This situation is exacerbated by the lack of rigorous evidence about the validation of RE approaches, and of links between customer-based RE research and the industrial practice.

This position paper argues that new research is necessary to deal with these problems, and such efforts must aim to

rigorously analyse RE practices from a customer-based perspective. The ultimate goal of the research is to propose improvements in the state of the practice, based on a thorough investigation of factors that have not been adequately studied in the existing literature.

To this end, the paper proposes a research agenda targeted at (1) studying the state of the art and the state of the practice concerning customer-based factors that influence the RE process, (2) devising solutions to better deal with customers’ characteristics and perspectives in the RE process, and (3) assessing the impact of such solutions in industry. These activities must be based on empirical research methods, and driven by principles targeted at facilitating technology transfer. Otherwise, it would not be possible to provide evidence of customer-based RE practices and of how industry can actually benefit from it.

We expect both research and practice to benefit from the research agenda, which would provide new knowledge about customers’ characteristics in RE and solutions to better account for these characteristics. On the research side, the work can be useful for identifying factors that should be considered when designing RE approaches, and those that may require further study. On the practice side, the work will help better address customers’ needs during the RE process, thus making system development and the resulting systems more effective, efficient, and competitive.

The rest of the paper is organized as follows. Section II describes the background of the paper. Section III presents our proposed research agenda. Section IV discusses challenges that must be tackled to realise the research agenda. Finally, Section V presents our conclusions.

II. BACKGROUND

This section presents in more detail the motivation of the research agenda proposed, and examples of real situations in industry where the results would be valuable.

A. Motivation

Although RE is a relatively young area, many advances have been made during the last two decades, thanks to the efforts of many influential researchers and the creation of a strong research community. However, RE is still an immature area if compared to other software engineering areas in terms of, for instance, rigorousness, use of empirical methods, and focus on industry needs. In addition, and mainly as a consequence of its youth, many essential aspects of RE have been barely studied. As a result, new research in selected, crucial RE aspects remains a priority.

The main problems and challenges identified in relation to customer-based RE practices are the following ones.

Evidence-based, rigorous RE research. Recent studies (e.g., [3]) have shown that RE approaches are not usually empirically evaluated. Furthermore, according to the recommendations of the empirical software engineering community [9], most of the evaluations are not performed rigorously enough. It therefore remains hard to generalise the results of the evaluations or to analyse the actual usefulness of an RE approach in industry.

Industry-driven RE research. Gaining insights into industrial RE is recognised as one of the main needs for RE research because of the gap that exists between academia and practice [12]. Otherwise, it is difficult for research to fulfil real industry needs. Evaluation of RE approaches in actual industrial contexts and use of real stakeholders and projects as subjects have been recommended (e.g., [15]).

Customer-based evaluation of RE practices. Customers are most often disregarded in the evaluation of RE research [3]. For example, we are not aware of any experiment concerning the use of models that has used customers as subjects. Therefore, it is almost impossible to really know how these approaches can, for instance, facilitate user involvement or communication with customers. The few existing studies whose subjects are real customers (e.g., [5]) lack rigorousness (e.g., details about the subjects).

Evidence on how customers' socio-technical characteristics influence RE practices. Some works have studied customers' perspectives in RE (e.g., [6]), customer-based factors for selection of RE approaches (e.g., [10]), RE in global software development (e.g., [4]), or requirements elicitation from a customer-based perspective (e.g., [7]). However, we are not aware of any work that has studied in enough depth how customers' socio-technical characteristics (e.g., education, experience, nationality, and business sector) can influence the RE process and thus how industry should adapt its practices according to these characteristics (e.g., when operating in a new sector). New knowledge and more guidance for practitioners are necessary.

B. Situations in Industry

Based on our experience in industry, two types of projects are analysed for presenting situations in which better customer-based RE practices would be useful: contract-based and market-driven projects.

In contract-based projects, interaction with customers in the RE process can take different forms. For example, a client can ask for a specific product or service, or can contact a company due to the interest in some product or service. In both cases, the client is involved in the RE process, or at least more than in market-driven projects (as shown below).

Customers with specific needs usually provide some initial description of their requirements, and can be more reluctant to participate and collaborate in the RE process. This increases and sometimes can even hinder system analysts' work. They can have difficulties to organize meetings with the client, and thus must try to (1) be as efficient as possible in these meetings and (2) use the most

adequate and effective approaches to, for instance, elicit and specify requirements according to client's characteristics.

For these two cases, several sub-cases can be identified according to customers' characteristics. For example, it is common nowadays for software development companies to search for clients in countries different than where their headquarters are. When dealing with non-domestic clients, existing RE practices may no longer be effective and efficient, and might increase companies' costs (e.g., due to having to make unplanned trips). This also applies to, for instance, clients in new business sectors (e.g., clients in the finance sector are different than those in the construction sector), or clients with different education (e.g., people with a technical education might more easily understand models).

Customers' characteristics might even influence aspects of requirements negotiation in contract-driven project (i.e., negotiation strategies might have to be adapted).

In market-driven projects, companies do not usually directly interact with customers, but other mechanisms for eliciting requirements are used. In particular, marketing departments can play a major role in the RE process.

Another example is online, web-based products, in which customers can provide feedback about the product (e.g., about problems they have experienced or improvement suggestions) by means of forms. Specification and analysis of this feedback can be difficult if proper means are not used to facilitate customers' communication and involvement. For example, forms must be adequately structured and should be adapted to customers' socio-technical characteristics.

In line with the description of contract-based projects, it is common for a product that has been successful in one country to be introduced in another. These products are usually standard or based on a product line. When introducing a product in a new country, most of the product's functionality will remain unchanged, however, the product needs to be adapted to the specific characteristics of the people who live in that country. As a result, requirements analysis and management change. For example, requirements' priorities can vary. This also occurs when adapting a product to a new business sector or targeting it at people with different experience or age.

In the situations presented above, questions that can easily arise in a software development company are (1) which approaches for requirements specification are better suited for interacting with customers? (2) how should the company adapt its RE practices to customers' socio-technical characteristics? and (3) how can the company's RE practices be improved from a customer-based perspective?

III. RESEARCH AGENDA

Tackling the challenges presented in Section II.A would strongly impact both academia and industry. The results would provide novel knowledge and solutions, both in their form (e.g., customer-based) and in the way of creating them (e.g., rigorous empirical research).

The research agenda proposed in this paper for tackling the challenges is introduced in the following subsections. We first introduce three core research questions. Next, we outline a research process to answer the questions.

A. Research Questions

The initial research questions identified towards better, customer-based RE practices are as follows.

RQ1. Among the existing approaches for requirements specification, which ones are better suited from a customer-based perspective?

A requirements specification is the main artefact resulting from the RE process. It is used as basis for requirements analysis, negotiation, management, and validation, and it is used also to communicate with customers. On the basis of the model proposed in [11], the efficiency, effectiveness, ease of use, and usefulness of different specification approaches should be evaluated.

Previous research (e.g., [5][13]) suggests that some approaches are better suited to communicating with customers. For example, task descriptions seem to be easier to understand to customers than use cases. However, there are cases in which we do not know if the use of an approach or another would be better suited. For example, we do not know if text-based scenario specification is better than model-based specification (e.g., with sequence diagrams).

Answering RQ1 would help practitioners to better know which approaches to use in order to improve communication with customers and facilitate customer involvement.

RQ2. How can customers' socio-technical characteristics influence RE practices?

First, the customers' socio-technical characteristics that can influence RE practices should be investigated. Next, how these characteristics actually influence the RE process should be studied and analysed in depth. Aspects that could be studied are: (1) How do development companies adapt their RE practices to customers? (2) What are the differences between contract-driven and market-driven projects?

The current lack of results and knowledge regarding the above questions hinders the formulation of clear hypotheses. Therefore, and as we discuss below, we believe that the use of grounded theory [14] would be advisable for data analysis.

Answering RQ2 would help practitioners to better know how to manage customers in new business contexts.

RQ3. How can RE practices be improved from a customer-based perspective?

Once answers to RQ1 and RQ2 are found, how the findings can be translated into better RE practices should be investigated. That is, solutions in the form of new tool

support and new methodological guidance (e.g., for requirements specification) should be developed. The solutions would aim to provide better suited RE approaches and new ways to manage and analyse customers.

Answering RQ3 would help practitioners to know how and when they should apply the solutions developed.

B. Research Process

Figure 1 shows an overview of the research process proposed. It is based on and adapts the technology transfer model proposed in [8].

This paper represents the identification of the problem. For its solution, the state of the art and the state of the practice should first be studied. On the basis of the findings from these two activities, candidate solutions for the problem would be formulated and developed. Finally, the candidate solutions would be evaluated by means of in-lab validation (in academic, controlled environments), static validation (by getting feedback from people from industry, both practitioners and customers), and dynamic validation (by applying the solutions with data from real projects and/or in real projects). The candidate solutions may be refined and improved as a result of new findings from evaluation.

The research methods to use would be [3][14][16]:

- Systematic Literature Reviews, in order to evaluate and interpret all available research in a trustworthy, rigorous, and auditable way (addressing RQ1-2).
- Surveys, in order to analyse perspectives and past experiences of customers and of practitioners regarding customer-based RE practices (RQ1-2-3).
- Experiments, in order to analyse the differences in the results of some task (e.g., use of an RE approach) on the basis of the variation of some factor (RQ1-2-3).
- Case Studies, in order to analyse RE practices in real, industry projects on which researchers would not work (they would only study them) (RQ1-2-3).
- Action Research, in order to analyse customer-based RE practices in industry projects on which researchers would work (RQ3).
- Grounded Theory, in order to analyse RE phenomena for which little knowledge exists by means of an inductive process: (1) observation, (2) pattern identification, (3) tentative hypotheses formulation, and (4) theory creation (RQ1-2).

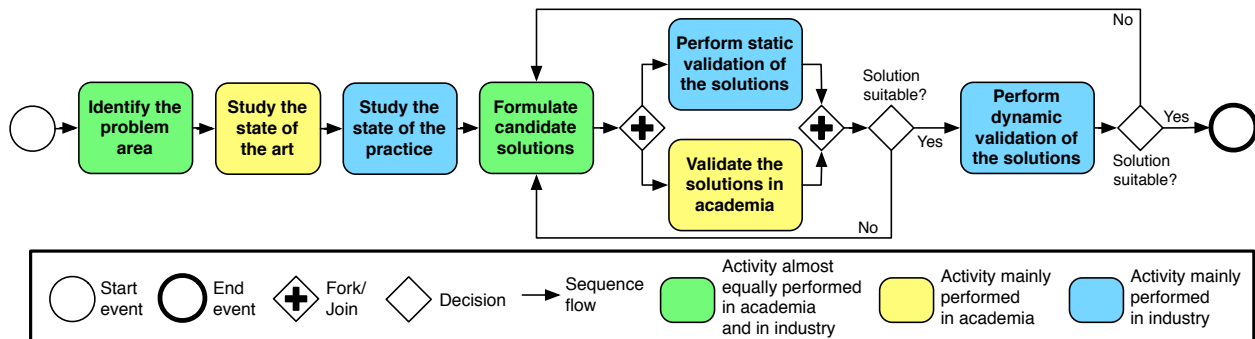


Figure 1. Research process overview

IV. CHALLENGES

This section discusses the main challenges that we have identified to realise the research agenda proposed in the previous section. The challenges have been divided into two categories: customer-related and practitioners-related.

A. Customer-Related Challenges

We have identified four primary challenges related to customers.

C1) Use of customers as subjects. One of the main characteristics of the research agenda is the need of using real customers as subjects in empirical studies. However, reaching them might be difficult for researchers.

C2) Lack of knowledge of RE practices. Another issue is that, when validating RE approaches with customers, they might not be aware of such approaches. Therefore, some training would be necessary. This would increase the time that the customers would have to spend for validating the approaches, and could discourage some potential subjects.

C3) Design of studies that fit subjects with different background. People with heterogeneous backgrounds should participate in the empirical studies, thus this aspect would have to be carefully addressed when designing the studies.

C4) Need of collaboration from several countries. We think that nationality is a customers' characteristics that might strongly influence the RE process. Reaching people from different countries can pose some problems if on-site collaborators are not found.

B. Practitioners-Related Challenges

We have found four primary challenges related to practitioners.

P1) Access to sensitive information. The research agenda implies accessing and analysing information about practice. This information can be sensitive (e.g., it might be considered strategic and of competitive value). Therefore, practitioners might be reluctant to provide the information.

P2) Successful academia-industry collaboration. This aspect can be one of the most challenging aspects of the research agenda proposed. For its resolution, existing guidelines and strategies [1][17] should be followed, such as contacting companies with which collaborations have been performed in past or finding a champion in the companies.

P3) Dynamic validation. Once solutions and potential improvements have been implemented, practitioners should use them in order to assess their real impact on practice. Finding practitioners that accept to use a new technology in real projects can be difficult.

P4) Reluctance to report on past problems. Last but not least, and on the basis of our own past experience, practitioners and companies can be reluctant to report on past unsuccessful or failed projects. We consider that information about these projects is essential in order to understand current practice and design suitable solutions.

V. CONCLUSIONS

Customer-based RE practices can be a prerequisite for project success. Consequently, software development

companies should adapt their practices to customers and new research efforts addressing these issues are necessary.

This position paper has presented a research agenda in order to analyse and improve RE practices from a customer based-perspective. The agenda is based on three research questions, which aim to study, from a customer-based perspective, (1) which approaches for requirements specification are better-suited, (2) how companies should adapt their RE practices, and (3) how RE practices can be improved. For answering the research questions, a research process has also been proposed.

In addition, the paper has presented situations in contract-based and market-driven projects in which the results would help practitioners. Finally, the paper has discussed eight foreseen challenges to realise the research agenda. Such challenges are related to customers and to practitioners, whose involvement and collaboration would be critical.

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