

A Framework to Resolve Requirements Engineering Issues in Software Development Outsourcing

Javed Iqbal

Dept. of Software Engineering
University of Malaya
Kuala Lumpur, Malaysia
javediqbal6000@siswa.um.edu.my

Rodina Ahmed

Dept. of Software Engineering
University of Malaya
Kuala Lumpur, Malaysia
rodina@um.edu.my

Sabrina Marczak

Computer Science School
PUCRS
Porto Alegre, Brazil
sabrina.marczak@pucrs.br

Abstract—The outsourcing of software development processes has become a common practice in the IT market due to its reported benefits in terms of cost reduction, process improvement, and optimal resource usage. However, a considerable proportion of outsourcing projects fail to materialize the anticipated results. The failure reasons are often traced back to Requirements Engineering (RE) processes. This establishes the importance of RE for software development outsourcing. We aim to help reducing RE issues in software development outsourcing by proposing a literature and empirically-based framework that maps RE issues to relevant best practices. We intend to perform a literature review, employ questionnaire-based surveys, and conduct semi-structured interviews with practitioners to identify RE issues and best practices to resolve these issues. In this paper we present our research plan to achieve our goal and briefly present our preliminary findings.

Index Terms—Requirements engineering, software development outsourcing, RE issues, RE practices, framework, empirical work.

I. INTRODUCTION

Software Development Outsourcing (SDO) is defined as software organizations' leveraging resources in terms of performing software development activities from another team or organization located at some other location [1]. It can be characterized by four main different scenarios as detailed in [20]: a) Vendor serving at client's location, b) On shoring or Domestic Outsourcing, c) Offshoring, and d) Global Software Development. With the advent of globalization in the past two decades, the trend of SDO has increased considerably. International IT Outsourcing revenue has reached \$288 billion in 2013 [2] and is expected to reach \$3.8 trillion in 2014 [3]. Requirements Engineering (RE) is a core discipline in software development and it is equally important for SDO as requirements misinterpretation and misunderstanding that can lead to project failures are exacerbated in distributed environments [4][5]. Other reasons of project failure that are related to or impact RE activities are lack of communication, misalignment of strategies, disagreement of tool selection, lack of client contribution, and lack of well-defined RE practices [5]. Therefore, to acquire the anticipated benefits of SDO, RE practices and processes must be identified and put in place in a timely manner [6]. Although there are studies on improving

RE practices on Global Software Development [17] [18], no study focuses on SDO as a whole. In this paper we present the proposal of a study that aims to define a framework which provides RE practices that can be employed to resolve RE issues faced by SDO teams while performing RE activities.

II. RELATED WORK

Requirements engineering processes have been studied in literature for SDO from several aspects. Xiong and Wu [7] propose a method to control requirements change in SDO through cross-cultural communication. Mao et al. [8] found that the quality of requirements affects vendors' trust, and cultural blending was suggested to understand vendor's requirements. Nguyen and colleagues [9] found that managing expectations of clients' requirements is an important issue in maintaining client-vendor trust for successful SDO projects. Moreover, SDO teams reported various issues to manage requirements while being geographically apart and having difference in the teams' social norms [10]. Since we know the importance of having defined RE practices for SDO to solve RE issues and no study has systematically identified and categorized these issues and practices for the 4 mentioned SDO scenarios, we decided to take up this issue. We aim to contribute by providing a literature-based and empirically-informed framework that can be used to counter RE issues faced by IT outsourcing practitioners with their relevant practices.

III. RESEARCH OBJECTIVES AND QUESTIONS

This research work is intended to develop a framework in order to resolve issues related to RE processes in SDO. To achieve our goal, we have defined the following four research objectives and a set of associated research questions to guide our study as follows:

Objective 1: To identify RE issues for SDO from literature and relevant practices to handle those issues.

To attend this objective, we first aim to identify which are the RE issues for SDO pointed out by literature. Therefore, we pose the following research question:

RQ1: What are the issues related to RE process for SDO reported in the literature?

After identifying the RE issues for SDO from the literature, we aim to identify which are the RE practices that can be used

to resolve these issues. Somerville and Sawyer [16] have proposed RE practices for resolving issues of traditional RE process. We want to empirically investigate how significant these RE practices are to resolve SDO-related RE issues. Our research question to address this matter is as follows:

RQ2: Which of the RE practices, proposed by Sommerville and Sawyer [16] in literature are considered significant for SDO by practitioners?

After extracting the SDO RE issues and relevant RE practices from literature, we might come across several issues for which the relevant practices are not present in literature. If this is the case, we aim to empirically identify practices that SDO practitioners recommend to address these issues. We pose then our third research question:

RQ3: What are the significant RE practices to resolve RE issues for SDO, given in literature, that:

- i) Are reported in the literature, other than recommended by Sommerville and Sawyer [16]?
- ii) IT outsourcing practitioners follow to handle these issues?

However, it is equally important to investigate SDO teams' take on RE issues and practices. Therefore, we aim to find out the RE issues they encounter and the practices they use to resolve these issues. So we establish a second research objective to our study as follows:

Objective 2: To identify RE issues faced by SDO practitioners and relevant practices to handle these issues.

To address this objective, first we aim to identify the issues SDO teams face while working on outsourcing projects as defined in our following research question:

RQ4: What are the SDO RE issues faced by SDO practitioners?

Next, we aim to identify the RE practices adopted by SDO teams to resolve the RE issues they face, as defined below:

RQ5: What are significant RE practices adopted by SDO practitioners to handle the RE issues they face?

By having identified RE issues and respective practices to handle them, we can now build framework. Thus we pose our next objective:

Objective 3: To propose the framework for resolving the SDO RE Process issues.

To achieve this goal we intend to rationalize and structure the results obtained by answering research questions 1 to 5. So our next research question is:

RQ6: How the framework, to resolve RE issues for SDO, will be formulated?

Next we define our last objective, to evaluate the framework:

Objective 4: To evaluate the proposed framework.

We want to evaluate the framework through experts' panel to make it effective for the SDO industry practitioners. This intention guides us to the last research question of the study.

RQ7: How useful is the framework for SDO practitioners?

IV. RESEARCH METHODOLOGY

To fulfill research objectives and answer research questions we have defined a mixed-method approach comprising of questionnaire-based surveys and semi-structured interviews. We intend to use Two-Panel Delphi technique, which aims for

consensus on a certain matter [15], to formulate the framework through literature review, the questionnaire-based surveys and the interviews. To employ Delphi, we will consult two groups of practitioners through online questionnaires and use a multi-round methodology to build consensus. We aim to fulfill our research goals through a step-wise approach as shown in Fig. 1.

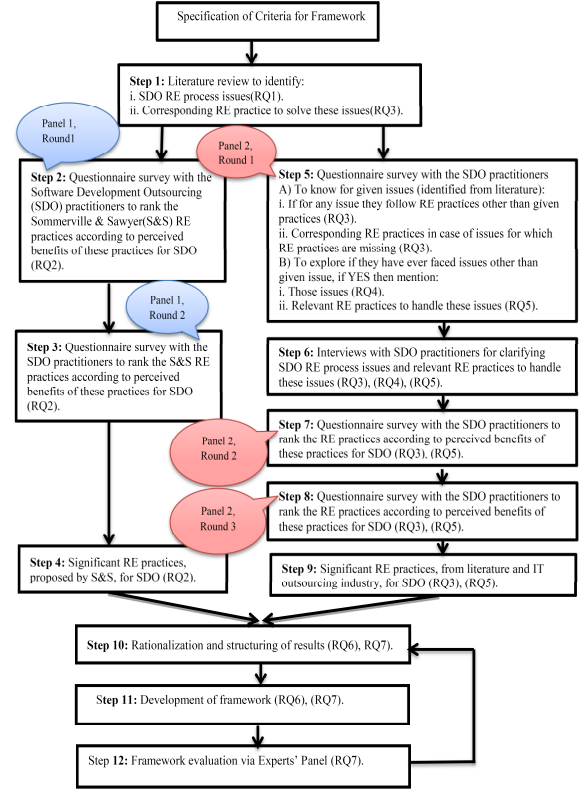


Fig. 1. Steps to develop the proposed framework.

RQ1 is about the identification of RE issues for SDO from literature. We find the RE issues for SDO given in literature through Step 1(i).

Our next target is to investigate which of the Sommerville and Sawyer's RE practices [16] are significant to resolve RE issues of SDO (RQ2). The Sommerville and Sawyer's significant RE practices for SDO are identified in Steps 2, 3 and 4. Step 2 shows Delphi technique' round 1 with panel 1 and step 3 indicates Delphi technique' round 2 with panel 1. In Step 4 we will extract which of the Sommerville and Sawyer's RE practices [16] are significant for SDO. Ranks, to judge significance, of RE practices according to their perceived benefits for SDO RE process, as defined in [18] [19], are: (1) *High Perceived Benefits*, an RE practice belongs to this category if it is always used; (2) *Medium Perceived Benefits*, this category is for a widely used practice; (3) *Low Perceived Benefits*, this category is for a practice used in specific projects only; and (4) *Zero Perceived Benefits*, this category is for a practice never or seldom used.

An RE practice is regarded as 'significant' for SDO RE process if at least 50% of the respondents choose 'high' and 'medium' perceived benefits categories for that RE practice as

defined by [18][19]. The purpose of finding ‘significance’ of the practices is actually application of the criterion to select only those RE practices which are useful and really used by practitioners in outsourcing industry.

Significant RE practices to solve SDO RE issues identified from literature (RQ3) are identified in Step 1 (ii), Step 5A(i) and 5A(ii), and Steps 6, 7, 8, and 9. The RE issues to be found in Step 1(i) can be divided into two categories. First category consists of the issues for which we can find relevant practices from literature and second category is of those issues for which we cannot find practices from the literature. Step 1(ii) helps us to find RE practices to handle the issues that belong to first category. For the first category of issues, we want to know further that if SDO practitioners are following practices other than we found from literature. This is Step 5A(i). The purpose of this step is to find more or better practices for such issues. For the second category of issues, we want to inquire from the SDO practitioners which practices they are following to handle these issues. This is Step 5A(ii). Step 6 is intended to clarify the investigations through semi-structured interviews and Steps 7, 8 and 9 help to find significant practices like Steps 2, 3 and 4.

SDO RE issues faced by IT outsourcing practitioners (RQ4) are explored through Step 5B(i) and Step 6. In Step 5B(i) we find the RE issues faced by SDO practitioners and Step 6 helps to clarify findings about these issues through the interviews with practitioners.

The significant RE practices adopted by IT outsourcing practitioners to resolve the SDO RE issues they face (RQ5) are discovered in Step 5B(ii) and Steps 6, 7, 8 and 9. More specifically, in Step 5B(ii) we explore the practices to handle the issues that are faced by SDO practitioners and again Step 6 helps to clarify any ambiguities. Steps 7, 8 and 9 are used to determine the significant practices like Steps 2, 3, and 4.

The framework will be formulated (RQ6) in Steps 10 and 11 that are based on the rationalization and structuring of the results found in the previous steps.

The framework will be evaluated for its applicability and usability (RQ7) for industry practitioners through Steps 12, 10 and 11 iteratively. We aim to follow the evaluation strategy proposed in [13] [14] to determine the usability and utility of our proposed framework for industry practitioners. We initially define a set of strategies to evaluate our framework, for instance, we intend to follow data triangulation approach to minimize the risk of missing data and achieving reliable results. We will seek experts’ opinion on our framework constructs to gather critical feedback from the experts for improvement.

V. PRELIMINARY FINDINGS

Work on Step 1 is still in progress. So far, we have deployed RQ2 to partially achieve Objective 1 of the study. We have employed questionnaire based surveys among the SDO practitioners to identify the RE practices that are significant for SDO, out of traditional RE practices proposed by Somerville and Sawyer [16].

The participants have at least 5 years’ experience in SDO, and are senior managers, managers and developers. This

classification has been used previously [11] [12]. Developers are designers, testers and analysts etc. Managers are team leaders and project managers whereas Senior Managers’ group consists of professionals from higher management like directors. Through e-mail invitations and face-to-face meetings, we have attained the responses by 108 respondents.

Sommerville and Sawyer have recommended 49 RE practices for Elicitation, Analysis, Negotiation, Description, Modeling, Validation and Management activities of the RE process [16]. The results show that out of 49 practices, 43 fulfilled the significance criterion (Section IV) and, therefore, are considered significant practices for SDO [20]. Only six traditional RE practices are considered insignificant to resolve RE issues for SDO. Table I shows the results. The preliminary results reveal that most of the RE practices proposed by Somerville and Sawyer [16] are feasible for SDO.

TABLE I. SIGNIFICANT & INSIGNIFICANT RE PRACTICES

RE Key Area	Total No. of RE Practices	No. of Significant Practices	No. of Insignificant Practices
Elicitation	13	11	2
Analysis & Negotiation	08	07	1
Description	05	05	0
Modeling	06	05	1
Validation	08	07	1
Management	09	08	1

VI. ANTICIPATED CHALLENGES AND LIMITATIONS

We have used questionnaires and interviews as basic methods of data collection. The risk of missing data or incomplete information is minimized by making use of follow-up interviews and reducing the number of open-ended questions in the questionnaires. The use of Two-Panel Delphi technique is time consuming and demands a lot of effort. This reduces the number of participants due to lack of interest, time and missing current contacts of the respondents. We have tried to minimize this by: (i) selecting reasonably big data sample at first place so as to mitigate the risk of less number of participants in the second round (108 practitioners), (ii) inviting participants who showed interest to help in this study, and (iii) keeping record of the current contact information of the respondents.

VII. CONCLUSION

SDO is the need of today’s fast growing yet geographically dispersed software industry. RE being an important part of software development activities cannot be ignored in SDO as well. However, there is a gap of knowledge found in literature with regard to RE practices identification for resolving RE issues for SDO as a whole. Therefore, we aim to formulate a framework to resolve the RE process issues for SDO as presented in this paper. We are working on Step 1, have implemented Steps 2, 3 and 4 as the preliminary findings presented in Section V. We are currently preparing for the execution of Steps 5 and 6 to identify the RE issues and relevant practices from SDO practitioners’ perspective. Next is

the ranking of identified practices. Finally, we will formulate the framework as per the identified RE issues and practices.

A. Expected Contributions and Implications

This study has several expected contributions namely: (i) identification of RE issues for SDO from literature and industry; (ii) identification of RE practices for SDO (a) as proposed by Sommerville and Sawyer and (b) as proposed in other literature; and (c) used by SDO industry practitioners; and (iii) Mapping of RE issues and relevant practices in order to resolve the issues of RE process for SDO.

The results of this research will provide a roadmap to the practitioners to resolve the RE issues for SDO and researchers to conduct further studies following the framework and supporting the findings with more empirical results.

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