

A Framework to Improve the Requirements Engineering Process for Software Development Outsourcing

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Abstract— The number of IT projects outsourced for software development is increasing day by day as outsourcing is anticipated to provide substantial benefits and the organizations which outsource the projects have certain constraints. But unfortunately, a considerable number of the projects which are outsourced for development are failed in realizing the estimated results. The failure reasons are often entrenched in Requirements Engineering (RE) process. Despite this, appropriate research efforts are not made to evade these unexpected consequences of software development outsourcing. The objective of this research is to propose a framework in order to improve the RE process for outsourced software development projects. This framework is based upon empirical studies with pertinent national and multinational organizations and RE practices introduced by Sommerville and Sawyer. We have used a survey research method for the data collection and preliminary results confirm that majority of the RE practices recommended by Sommerville and Sawyer are significant for the RE concerned with outsourced software development.

Keywords—software development outsourcing; IT outsourcing; on shoring; domestic outsourcing; near shoring; offshoring; distributed software development; global software development.

I. INTRODUCTION AND RELATED WORK

In IT outsourcing, an organization procures the services of IT from external resources in order to perform software development and related activities [1]. Outsourcing causes have two classes. i): Outsourcing benefits such as reduction in cost, accessibility to high-quality capabilities, process usefulness, outsourcing of non-core organizational activities and releasing internal resources. ii): Organizational constraints such as problems with the management of IT functions, shortage of resources and required skills [2] [3]. There are four different scenarios of IT outsourcing:

- a) When a contractor provides services at the location of the outsourcing organization.
- b) In the case of On Shoring Outsourcing or Domestic Outsourcing, services are not provided at the outsourcing location but the contractor operates from the same country.
- c) Contractor provides services from another country:

If services are provided from the same region/nearby country, it is called Near Shoring. If a vendor supplies services from a far off country, it is called Off Shoring.

- d) When multiple contractors/vendors are involved: When stakeholders are geographically dispersed, we call it Distributed Software Development or DSD. When distances among the stakeholders become global, it is called Global Software Development or GSD [1].

In Software Development Outsourcing (SDO) the vendor performs some or all of the software development activities for the client. The idea of SDO is becoming popular rapidly [4] [5]. It creates a state which is a win-win situation for both the developed and developing countries [6]. However, many risks are involved in the process of outsourcing [7]. But risks related to software requirements are the main reason for the failure of outsourced projects [8] [9]. This is not surprising as RE is the most important phase of the software development life cycle [10] that affects the other software development activities significantly [11].

For outsourced projects where the clients and vendors are located at different places [12], the requirements problems are expected to increase many times. Lack of communication or improper communication, different working hours, rare head to head meetings, language issues and dissimilar working practices are some of reasons for requirements problems' augmentation in the case of outsourcing [13]. That is why 40 percent of off-shore projects do not achieve expected benefits [14], and half of the companies trying GSD are failed to attain anticipated results [15]. According to Herbsleb [16], elicitation and communication of the software requirements is one of the four challenges of globally distributed software development projects.

Perera describes that poor RE in case of outsourcing results in extra effort and cost [6]. Based upon the industrial experiences, Lormans, Dijik and Deursen et al. present a report in order to manage the evolving requirements [34]. By using a Fuzzy Analytic Hierarchy Process (AHP), Salarian and Rashidi identify requirements related risks and prioritize these risks [35]. Bhat, Gupta and Murthy suggest practices to deal with the

RE challenges created as a result of offshoring outsourcing [10]. Damian and Zowghi describe the RE issues encountered during software development at the multiple sites. They have divided the related problems into four categories which are cultural diversity, inadequate communication, knowledge management and time difference [12]. Similarly, they narrate the effects on the requirements management if stakeholders are geographically distributed [36]. Niazi, El-Attar and Usman et al. have identified the high perceived value RE practices for GSD [37]. Damian, Eberlein and Shaw et al. emphasize upon the necessity of human facilitator to improve the distributed RE process [38]. To handle the problems which are generated as a result of the geographical distribution of the outsourcing stakeholders, Sayao, Filho and Prado present the idea of using software agents[39]. To deal with global RE challenges, Damian advises to acquire the relevant knowledge, share it and build the relationships among the stakeholders [40].

A number of frameworks and models have been suggested 36Pandey, Suman and Ramani have proposed a RE process model for producing and managing quality requirements [26]. Islam and Houbm have presented Goal-driven Software Development Risk Management Model for assessment and management of the risks during the initial phases of offshored software development [27]. Serebrenik, Mishra, Delissen et al. advocate the LaQuSo Software Product Certification Model (LSPCM) to verify the requirements for offshoring. They also apply LSPCM in case of the three offshored projects and analyze the requirement to prove the model validity [28]. Zowghi underlines the need of a special RE process for GSD [29]. Aranda, Vizcaino and Piattini propose a framework that suggests the tactics for improving the process of requirements elicitation in case of GSD projects [30]. Khan, Basri and Dominic introduce a Requirements Change Management (RCM) framework to manage the changing requirements in GSD [31]. Niazi, El-Attar and Usman et al. suggest a framework GlobReq, to improve the RE process for GSD [15]. Hussain and Clear present a model to manage the change of global requirements efficiently [32]. Gumm suggests a model that introduces the idea of ‘organizational interfaces’. The RE activities are analyzed in connection with the ‘organizational interfaces’ [33].

These models and frameworks lack a holistic perspective to deal with the RE issues associated with various scenarios of SDO and do not cover all the aspects of RE process. The proposed PhD work is aimed at bridging this gap.

II. RESEARCH OBJECTIVES AND QUESTIONS

The primary objective of this research is developing a framework to improve the RE Process for the SDO. ‘Improvement’ means ‘a change in something that makes it better or something that is better than it was before’ [42].

For this purpose the relevant research questions are:

RQ1. Which of the Sommerville and Sawyer(S&S)’s RE practices are significant for SDO?

We investigate the significance of S&S’s RE practices through the questionnaire survey with SDO professionals.

RQ2. Which additional RE practices are significant for SDO?

We address this question through literature review, questionnaire surveys and experts’ interviews by identifying:

- i. RE practices suitable for SDO.
- ii. Issues related to the RE process for SDO and then by finding RE practices to cope these issues.

RQ3. How framework will be developed to improve the RE process for SDO?

The RE framework will be based upon S&S’s RE practices and empirical studies with SDO organizations. Detailed empirical data will be collected to develop framework in order to handle RE process issues related to communication, knowledge management, cultural variances and time differences.

RQ4. How framework will be evaluated?

We intend to evaluate the proposed framework via experts’ panel.

Fig. 1 shows overall flow of work.

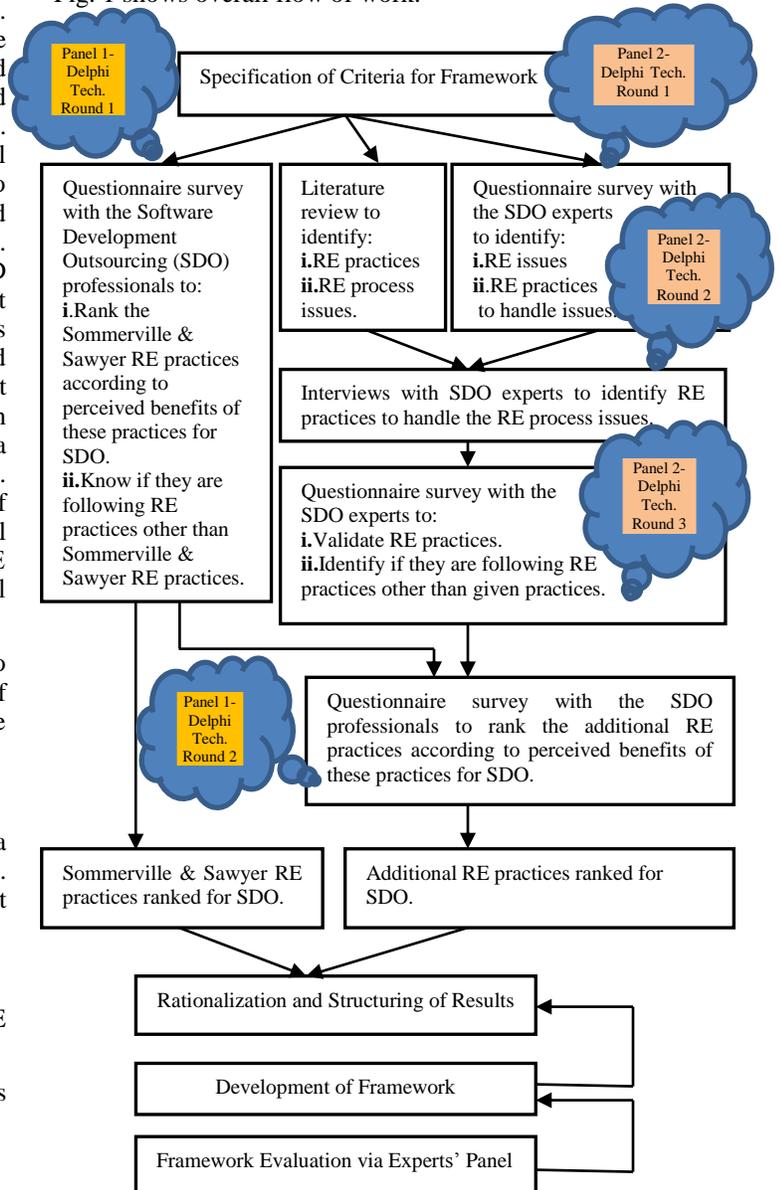


Fig. 1. Steps to develop RE Framework

III. RESEARCH METHODOLOGY

A survey research method has been utilized to attain the data regarding significant RE practices. The survey is based upon S&S's 49 RE practices [17] for six key areas of the RE process which are elicitation of requirements, analyzing and negotiating requirements, requirements description, modeling requirements, validating requirements and managing requirements. The survey research method is looked upon as an appropriate way for the collection of qualitative or quantitative data [18]. Usually, a combination of various techniques for data collection such as interview and questionnaire or any of these techniques is used in a survey research method [19]. Through a questionnaire, we have solicited the practitioners to rank the S&S's RE practices according to the perceived benefits of these RE practices for SDO. The different ranks or categories of perceived benefits are [15] [22]:

- *High Perceived Benefits* (H_i): An RE practice has 'high perceived benefits' if it is mandatory and always used.
- *Medium Perceived Benefits* (M_i): An RE practice has 'medium perceived benefits' if it is not mandatory but widely used.
- *Low Perceived Benefits* (L_i): An RE practice has 'low perceived benefits' if it is used only for some particular projects.
- *Zero Perceived Benefits* (Z_i): An RE practice has 'zero perceived benefits' if it is never or rarely used.

We have selected 108(T) questionnaires for the data analysis.

A. Criteria for the Selection of Significant RE Practices for Software Development Outsourcing

If, according to the responses of at least 50% of respondents, the perceived benefits of a RE practice fall in the 'high perceived benefits' and the 'medium perceived benefits' categories then that RE practice is considered to be 'significant'. A similar method, using the criterion of considering the opinion of 50% or more respondents for decision making, has already been employed effectively in preceding studies [20][21][22].

By 'significant' we mean 'important to be worthy of attention' or 'important enough to have an effect' [41] [42]. To identify the significant RE practices for SDO, we have taken into account the 'high perceived benefits' category and also the 'medium perceived benefits' category [15]. The rationale for this decision is that a RE practice having 'high perceived benefits' is always followed i.e., it is mandatory. Hence such RE practice must have significance for SDO. Likewise a RE practice with 'medium perceived benefits' is widely followed although it is not mandatory. Thus the RE practices providing medium benefits are frequently followed, therefore, such practices cannot be ignored and must also be considered significant for SDO. For each RE practice, the Prominence Level (PL) represents the percentage of responses in 'high perceived benefits' and 'medium perceived benefits' categories and is calculated as given in (1):

$$PL = [(H_i + M_i) / T] \times 100. \quad (1)$$

IV. INITIAL FINDINGS

We have found that out of 49 RE practices, 43 practices are significant and 6 are insignificant for SDO. Table I shows area wise number of significant and insignificant RE practices.

TABLE I. AREA WISE NO. OF SIGNIFICANT AND INSIGNIFICANT RE PRACTICES

RE Key Area	Total no. of RE Practices	No. of Significant RE Practices	No. of Insignificant RE 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

Table II presents area wise 6 insignificant RE practices.

TABLE II. AREA WISE INSIGNIFICANT RE PRACTICES

RE Key Area	Insignificant RE Practice(s)
Elicitation	i. Sensitivity to organizational and political considerations.
	ii. Collect requirements from multiple viewpoints.
Analysis and Negotiation	iii. Using interaction matrices for finding requirements conflicts and overlaps.
Modeling	iv. Develop complementary system models.
Validation	v. Proposing requirements test cases.
Management	vi. Recording of the rejected requirements.

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