

Practices for Effective Software Project Management in Global Software Development: A Systematic Literature Review

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ABSTRACT

Effective software project management plays an important role during requirements collection and implementation for any software system. In Global Software Development (GSD), its significance increase more as stakeholders are far away across the globe. In GSD, challenges such as language differences and time zone differences cause significant barrier during requirements collection and thus need of effective project management increase more and more to handle challenges of GSD. This study address possible solutions and practices for effective global software project management. Through Systematic Literature Review (SLR), 25 practices are identified. These practices will help software vendors to better manage software projects in GSD.

Keywords

Practices, Effective software project management, Global Software Development, Systematic Literature Review.

1. INTRODUCTION

Requirement Engineering (RE) deals with all aspects of software requirements from requirements collection to requirements implementation in systematic way [1][2]. RE consist of different phases. In requirement elicitation phase, requirements for software system are collected from clients by applying various elicitation techniques such as background study, interview, questionnaire, apprenticing [3][4]. In GSD, where clients and vendors are far away and there exist geographical distance thus proper requirements collection and management become more difficult. According to [5], due to barriers such as geographical distance, time zone differences and language differences, effective requirements collection and implementation in GSD become more and more difficult which can affect the quality of software systems and project completion time and cost [6]. In GSD, where there exist critical challenges during requirements elicitation, proper requirements management and implementation become a big challenge. In GSD, there is essential to implement practices needed for successful management of software project. The purpose of this research is to identify all possible practices for effective global project management. No SLR has been yet conducted to identify best practices for global project management. This current work will fill this research gap. Implementing all possible best practices will help software vendors to better implement RE in GSD.

2. BACKGROUND STUDY

Systematic literature review is conducted by [7], where effective communication is identified as most critical success factor during successful requirements implementation in GSD. With effective communication channels, proper elicitation of requirements in GSD can be assured.

Language is very essential in requirement collection as it disturbs transfer of knowledge and proper communication that depends entirely on appropriate usage of language [8]. In GSD this factor is a big challenge because mostly the clients and vendors face difficulties to fully cope the terminologies of other languages [9][10]. In GSD, timely communication is another big challenge because there exist difference of time zones among countries and sometimes this variation in time zones can increases that makes it difficult to communicate synchronously such as video or audio calls etc [7]. Time zone variance is a challenge for both vendors and clients in GSD and thus it requires appropriate solutions and practices [11][12].

Elicitation problems occur due to lack of proper communication and for which model is suggested in one of the studies [13]. The first phase in this model is to arrange interviews with several software industries and compare the consequences with outcomes as identified by research group. Theoretical modeling of requirements uncertainty and elicitation dimensions is the next step and the last phase of the model is the validation of model from different software organizations.

Communicating knowledge and information's in GSD is challenging and a big challenge [14]. Poor SRS shows that the knowledge managing was not properly conducted [15].

Proper discussion and negotiation on requirements in GSD is an crucial challenge to be overcome and but due to the stated challenges such as time differences, language barriers and culture differences it is quite difficult to have proper negotiations on requirements [16][17]. Trust should be established in GSD because without trust no team is possible and without team no collaboration is possible and without collaboration and trust a success is achieved only by luck [17].

Different implementation models are suggested for efficient requirements implementation in the context of GSD.

Requirement Implementation Model (RIM)[18], Requirement Elicitation Model (REM) [19] and Requirement Management Model (RMM)[20] are presented in different studies. The proposed models are based on empirical studies that will consist of all possible challenges and success factors during requirements implementation, elicitation and management in context of GSD.

3. RESEARCH METHOD

SLR is conducted to achieve goals and objectives of the research. In our previous studies we used the same research method to achieve other goals [21][22]. In this research study, we are repeating the same steps as we did in our previous research works. The step by step approach of conducting SLR is shown in Fig 1.

a. Research Question Identification

The first step of doing SLR is finalizing research questions. Based on particular research question, data are retrieved from different research studies. The following research question (RQ1) for this study.

RQ1: What are possible solutions and practices for implementation of effective project management in global software development?

b. Literature Search Strategy

Literature Search strategy is made that consist of the following;

- **Range of search (time and space)**

There is no bound on search time and space. Publications related to our defined RQ1 will be included for the next step.

- **Electronic data sources used**

We will used Science Direct, Springer link, ACM portal, IEEE Xplore.

- **Strings for the search**

The following search string is finalized for this research work. ((“Requirement Engineering” OR “Requirement Implementation” OR “Requirement Elicitation”) AND (“Global Software development” OR “Distributed Software Development”)).

c. Literature Selection Criteria

During literature selection criteria, not all but some publications that are most relevant to research question are selected for final data retrieval. Studies that are not written in English language will be excluded from final list of papers. Inclusion and exclusion criteria for this research study is based on RQ1. Papers that address practices for effective communication in GSD will be only included.

d. Data extraction

This is last phase where practices for effective communication during requirements implementation in context of GSD will be retrieved from final selected list of publications.

Based on inclusion and exclusion criteria, Table 1 shows number of primary and final selected papers from different digital resources.

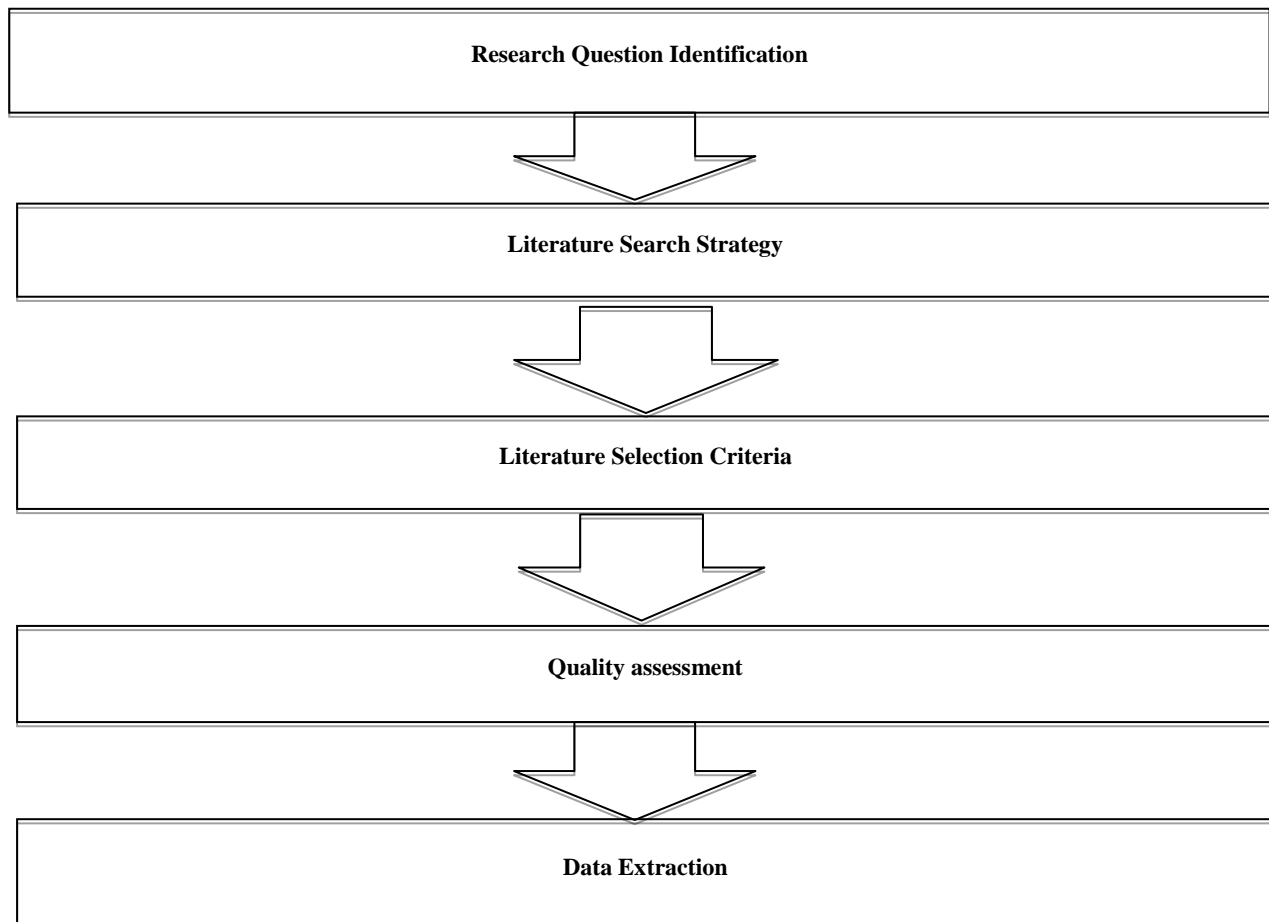


Fig 1: Development Process for the SLR Protocol

Table 1: Number of publications selected for data extraction

Publisher Site	Total Results found	Primary selection	Final Selected Papers (Appendix)
IEEEExplore	360	85	14
Science Direct	300	85	4
ACM	280	40	3
Others	430	105	7
SpringerLink	140	20	2
TOTAL	1510	335	30

4. REULTS AND DISCUSSION

After conducting SLR, following 25 practices for implementation of effective software project management

during requirements implementation in GSD as shown in Table 2 are identified.

Table 2: Practices for effective project management in GSD

S/No	Practices for effective project management in GSD	No of Practices via SLR (N=30)
1	Global project management tools should be used	5
2	Clear definition of roles and responsibilities and make team wisely	6
3	Strong leadership and skills at the project management	4
4	Bring collaboration in the team	2
5	Professionally train all project managers	2
6	Apply best practices from the CMMI	2
7	Information about best elicitation techniques used in market	1
8	Obtaining information about the organizational environment	1
9	Knowledge of requirements documentation basics	1
10	Knowledge on definition of requirements is must for the team	1
11	Management support for people in GSD is necessary	1
12	Regular personal meetings	1
13	Work with multiple partners. Distribute critical knowledge	1
14	Have periodic workshops with teams.	1
15	Formalization of documentation	1
16	Develop a trust relationship in the team	3
17	peer-to-peer links at all management	1
18	Innovative processes and technologies	5
19	Use agile practices	3
20	Creating a communication coordinator role to reduce misinterpretations	1
21	Use a human facilitator in integrated rich communication media during decision making	1
22	Implement and systematically follow quality gates at work product level	2
23	Maintain an organization risk repository.	1
24	organizations need to allow enough time to make the change	1
25	Rigorously highlight insufficient quality	1

Modern global project management tools should be used for effective implementation of software requirements. Modern GSD tools facilitate both synchronous and asynchronous ways of communication among clients and vendors. In GSD, clear roles and responsibilities should be assigned to each member of the team. As compare to local development, in GSD, role of strong and effective leadership become more important. Strong leadership can enable team members to effectively manage requirements. Bring collaboration and coordination in team makes it easier to share knowledge in GSD which will assist successful requirements implementation. Professional training of team members for GSD is a success factor for global project management. Vendors of GSD need to apply best practices from CMMI. As in GSD, traditional ways of elicitation techniques such as background study is not possible so vendors need to implement collaborative ways of elicitation techniques and for this purpose they need to know from surrounding organizations about use of new ways of elicitation techniques in GSD. Knowledge on requirements and its way of implementation is necessary to understand before implementation. Knowledge comes with experience and for this purpose, it is necessary to access experience persons inside or outside organizations. Support of management to bring best practices in GSD is very important. Meetings of members on regular basis is very important in GSD. Through regular meetings, any knowledge and information's that can favor successful requirements implementation can be shared among team members. It is the responsibility of project managers to arrange workshops on regular basis for their team members on how to handle software projects in GSD. Through workshops and discussion, any conflicts on requirements can be resolved efficiently. Formalization of documents is important in GSD which

makes it easier to track any information on requirements from clients. Trust building is considered to be very important success factor among team members and with clients of GSD. It is the responsibility of project managers to bring trust with clients. Peer to peer links among team members bring more collaboration and coordination and thus favor knowledge sharing and helps in conflict resolution among team members in GSD. Use of innovative technologies such as semantic web technology and use of ontologies for requirements representation and management in GSD are suggested by many authors for effective requirements collection and management. Use of modern software process models such as agile helps to better implement requirements in GSD and for this purpose more and more work is already done. As in GSD, their exist difference in languages and terminologies among vendors and clients, so defining role of communication coordinator that facilitate effective communication in GSD is very helpful and thus proper negotiations on requirements become easy. As culture problem is also considered as critical challenge in GSD, thus defining coordinator role makes it easier to reduce culture gap among stakeholders. Similarly during meetings of management, human facilitator role for effective rich communication become more helpful. Making risk repository in GSD that contain possible risks that can occur in GSD and factors that are important to tackle these risks should be defined so that possibility of any potential risks can be resolved on time. Requirements change management in GSD is more difficult as compare to local development, thus proper time should be given before doing some changes in requirements. Fig 2 shows critical practices that have more frequency of occurrence from literature. Other practices that have low frequency are also important.

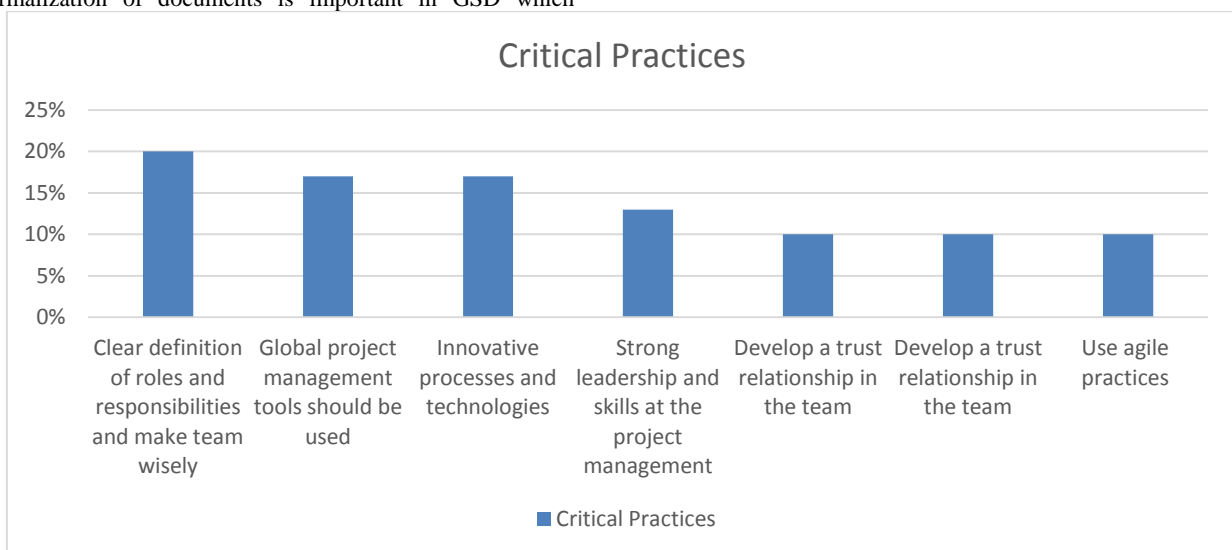


Fig 2: Critical Practices identified with SLR

5. CONCLUSION AND FUTURE WORK

As a result of SLR, 25 practices are identified for implementation of effective software project management in GSD. In these practices, Global project management tools should be used, innovative processes and technologies, clear definition of roles and responsibilities and make team wisely, strong leadership and skills at the project management, develop a trust relationship in the team and use agile practices are maximum identified practices from literature. Implementing these practices will assist software vendors of GSD to efficiently manage software projects. Effective

management practices will result in delivery of quality product which is very difficult in GSD. In future, the aim is to validate these practices through industrial surveys and explore some new practices that are not previously identified from literature.

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