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Inter-organizational learning and knowledge sharing management model (ILKSM) in Global software development

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Abstract
Inter-organizational learning and knowledge sharing management play 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 where critical challenges such as language differences, geographical distance, culture differences and time zone differences exist, thus need of inter-organizational learning and knowledge sharing become more increase. This study aims to propose Inter-organizational learning and Knowledge Sharing Management Model (ILKSM) in Global Software Development to assist vendors to learn and share knowledge of successful implementation of software engineering.

Keywords: Practices, coordination and collaboration, global software development, systematic literature review

Introduction

In GSD, where clients and vendors are far away and there exist geographical distance thus proper requirements collection and implementation become more difficult. Requirement Engineering (RE) deals with all aspects of software requirements from requirements collection to requirements implementation in systematic and discipline 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]. 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. In GSD, where there exist critical challenges during requirements elicitation, need of need of inter-organizational learning and knowledge sharing become increase more and more. In several studies, authors have focused on benefits of inter-organizational learning and knowledge sharing in GSD for successful implementation of requirements and delivery of quality software projects. In one of study, SLR is being conducted to identify all success factors during requirements implementation in GSD where inter-organizational learning and knowledge sharing is identified as critical success factor [6]. With inter-organizational learning and knowledge sharing, effect of the stated challenges can be reduced. Through this way, successful implementation of requirements can be assured.

Background Study

Culture differences, language barrier and time zone differences exist in GSD which makes it difficult for both vendors and clients to communicate properly. Systematic literature review is conducted by [6], 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. There are two types of communication i.e. synchronous communication and asynchronous communication. With synchronous ways of communication such as email and fax, clients and vendors can properly discuss requirements especially in case where there exist time differences and language barrier. With synchronous ways of communication such as video links, vendors and clients can directly negotiate requirements face to face.

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Language is very essential in requirement collection as it disturbs transfer of knowledge and proper communication that depends entirely on appropriate usage of language [5, 7]. In GSD this factor is a big challenge because mostly the clients and vendors face difficulties to fully cope the terminologies of other languages and thus proper requirements collection become difficult. Time zone variance is a challenge for both vendors and clients in GSD and thus it requires appropriate solutions and practices [8, 9]. Problems during elicitation of requirements occur due to lack of proper communication and for which model is suggested in one of the studies [10]. The first step in this model is to arrange interviews from 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 step is the validation of model from different software organizations. Communicating knowledge and information's in GSD is required so that effect of the stated challenges in GSD can be reduced [11]. Poor SRS shows that the knowledge managing was improper. 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 [12, 13]. Proper negotiation is needed for inter-organization learning and knowledge management. 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 [13].

Different implementation models are proposed for efficient requirements implementation in the context of GSD. Requirement Implementation Model (RIM) [14], Requirement Elicitation Model (REM) [15] and Requirement Management Model (RMM) [16] are presented in different studies. The proposed models are based on empirical studies that will consist of all possible challenges and success factors with practices and solutions during requirements implementation, elicitation and management in context of GSD.

Aim and Objective
The main objective is to design Inter-organizational learning and Knowledge Sharing Management Model (ILKSM) in Global Software Development to assist vendors to learn and share knowledge of successful implementation of software requirements successfully.
Through empirical studies, best practices needed for inter-organizational learning and knowledge sharing management will be identified. With implementing these practices, successful implementation of software requirements can be assured.

Research Method
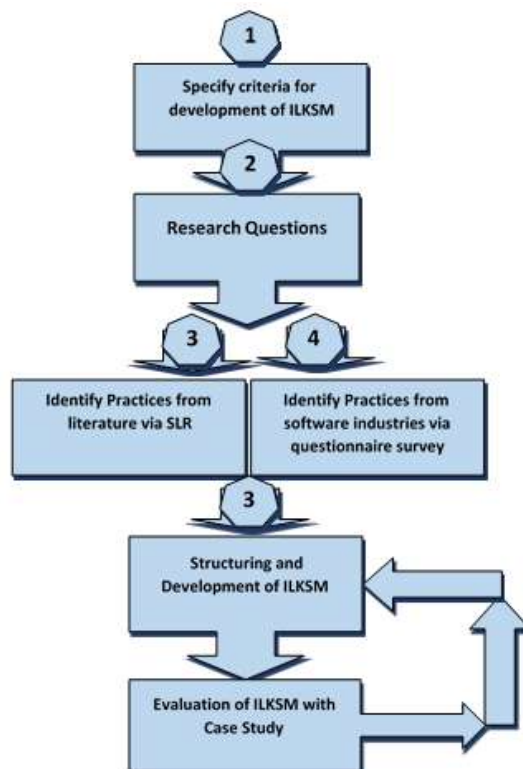Design of model ILKSM consist of three phases as shown in Figure 1 below.

Fig 1: Design phases of LLKSM

Specify criteria for development of ILKSM
The first phase in DHM development is specification of ILKSM development criteria. Literature review is conducted and different models are analyzed. Guidance for specifying criteria will be taken from different models of previous studies.

Research Questions
Data collection for the development of ILKSM is based on the following research questions.
RQ1: What are critical success factors and best practices needed as identified from literature for assuring successful inter-organizational learning and knowledge sharing

management in global software development?

RQ2: What are critical success factors and best practices needed as identified in real software industrial practice for assuring successful inter-organizational learning and knowledge sharing management in global software development?

Data Collection with SLR

Data collection through SLR is based on RQ1. SLR is different from ordinary literature review and is formally planned and for this purpose SLR protocol is designed. SLR protocol consist of three phases. First phase is planning in which SLR protocol is designed based on research questions. Second phase is execution phase where planned protocol is executed using different digital libraries and research publications are retrieved. Third phase is reporting phase where collected data from literature are documented properly in specific format. Planning of SLR protocol consist of the following five steps as shown in Figure 1.

Fig 2: Design phases of LLKSM

Searching Criteria

a)   Time period: It define which papers to be retrieved based on year of publication. In our research, there is no bound on year in which paper is published. All papers related to research questions will be extracted from literature.

b)   Digital resources: Digital libraries selected for retrieval of papers are; 1) IEEE, 2) Elseiver, 3) ACM, 4) Springer Link.

c)   Searching String: All retrieval of papers are based on searching string. All publications related to global software development will be retrieved.

Publication selection criteria

Publication selection criteria is defined to include certain papers and exclude others. Papers that are not written in English language will be excluded. Similarly papers that are written in context of inter-organization learning and knowledge sharing management but doesn't discuss practices to implement inter-organizational learning and knowledge sharing management will be excluded from final list of papers.

a)   Questionnaire survey

Questionnaire study is type of empirical research where maximum feedback is taken from people in short time. Pre-defined questions will be finalized based on data collected with SLR. There will be seven options given to industrial practitioners i.e. strongly agree, agree, slightly agree, not sure, not agree, strongly disagree. Industrial practitioners can write new practices that are not identified with SLR in form attached.

Structuring and Development of ILKSM

Based on review of different models, results of data collected with SLR and questionnaire survey, ILKSM will be structured. ILKSM will consists of five levels. Organizations will fall in one of the category based on level they achieve. Organizations that implement particular practice will be given score against that practice. Organization exceed particular range of score will be categorized in particular level of ILKSM.

The below mentioned two measures will be considered for the development and valuation of ILKSM.

A. **Developer's satisfaction:** The ultimate goal is to provide ILKSM to industrial practitioners so that best practices needed for inter-organizational learning and knowledge sharing management can be assured properly. Developers can take guidance from ILKSM.

B. **Usability:** This measures of ILKSM focus on usability i.e. he or she can comfortably use this model with much easiness. The designed model must be flexible and easy for understanding as organizations hesitate to accept models of complex nature and standards which require resources, training and efforts.

Evaluation of ILKSM

For evaluation of proposed model, minimum five cases studies will be conducted using different organizations. Feedback or changes suggested as result of case study will be adjusted in structuring and development phase. After evaluation of ILKSM, design of ILKSM will be finalized and distributed to software industries for implementation.

Preliminary Results

As result of execution of SLR protocol, 30 publications from different digital libraries are retrieved as shown in Table below.

Table 1: Final selected papers from different digital resources

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

After conducting SLR, following 13 practices inter-organizational learning and knowledge sharing management

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

Table 2: Practices for inter-organizational learning and knowledge sharing management

S/No	Practices/Solutions	% of Practices via SLR (N=30)
1	Effective and proper communication is needed	10
2	Proper negotiations are needed	7
3	face-to-face project kickoff meetings	2
4	Demand improvements in RE processes and tools in order to achieve better management of requirements knowledge	2
5	Frequent meetings improve awareness among distributed site	6
6	Clear organizational structure	6
7	experienced team members should be accessible	5
8	Who to talk to? Finding the right people	3
9	Common language to be used with-in the organization	2
10	Modern Technologies and tools should be implemented	5
11	Centralized communication structure can help new teams to remain aware	3
12	Practices along with knowledge is must	2
13	Code repositories, forums, or wikis can provide a common space for consistent management of knowledge	1

Effective communication is cited as most critical factor with percentage occurrence of 34%. With effective communication channels and mechanisms, knowledge can easily be shared and managed [17]. Proper negotiation and discussion on issues regarding implementation of software requirements can resolve it [18]. Inter-organizational learning can only be possible if knowledge on requirements and issues is properly discussed. Frequently meetings of requirement analysts and developers makes it possible to discuss properly [19]. Role of organizational structure and implementation of modern tools and technologies inside software industries makes it easier to provide environment of learning and knowledge sharing [19-21]. If anything goes wrong, it is necessary to access experienced team members inside organization. Collaboration of unexperienced and experienced people in organization is necessary and for this purpose, role of management is important. If anything goes wrong regarding implementation of software requirements, experienced team members should be accessible. Inside organization, centralized communication system will increase collaboration among people and thus help in getting more and more learning and knowledge sharing [22]. Figure 2 shows critical practices that are maximum identified practices from literature.
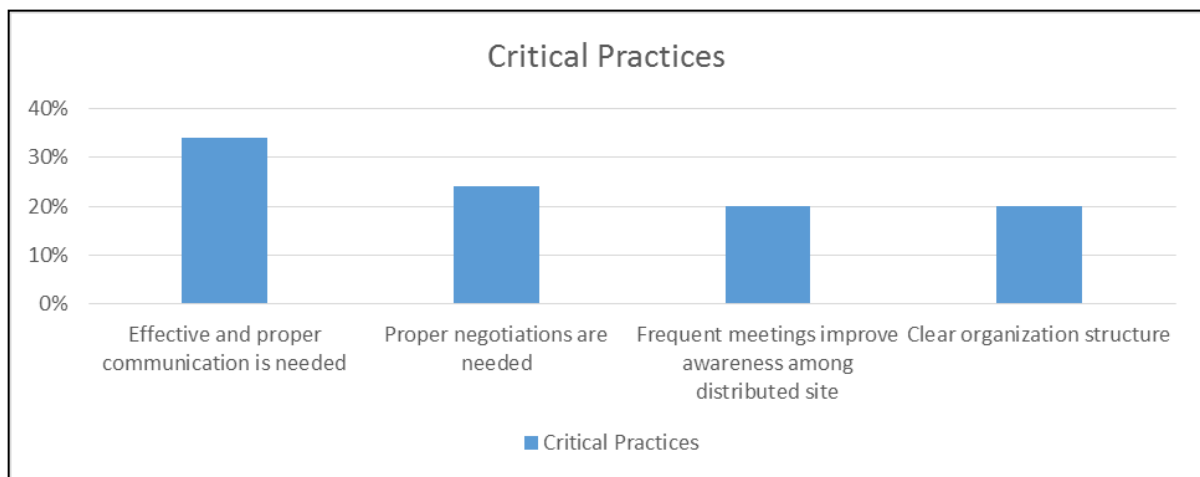

Fig 3: Critical practices identified with SLR

Conclusion and Future Work
As a result of SLR, 13 practices are identified for inter-organizational learning and knowledge sharing management in GSD. Effective and proper communication is identified as most critical success factor. With effective communication channels inside organization, inter-organization learning and management become easy. Similarly proper negotiations and discussion, knowledge about requirements in GSD can easily be transferred. Modern tools and technologies are suggested in several studies for effective requirement engineering process in GSD, so implementing these tools not only reduce the effect of challenges in GSD but knowledge can be easily shared and managed inside organization. In future, we aim to validate these practices from software industry and to identify some more practices that are not previously identified from literature. This research study will help software vendors to have full list of possible best practices needed for inter-organizational learning and knowledge sharing management while developing software in GSD. The ultimate future goal is to design and implement inter-organizational learning and knowledge sharing management model (ILKSM). This current research work is first phase to achieve our aims and goals.

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