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An empirical Study Investigation of Task Allocation Process Barriers in the Context of Offshore Software Development Outsourcing: An Organization Size Based Analysis

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Abstract: Planning and managing the task allocation process in offshore software development outsourcing environment plays an important role in order to develop the good quality software with in time and budget. In this study we investigate the berries that negatively affect the task allocation process in geographically distributed development environment. A literature review and questionnaire survey approach was adopted in order to investigate the barriers of task allocation process. The investigated barriers were further classified into four core categories i.e. team, coordination, project administration and technology. A total of 14 barriers were identified from the literature and validated with organizational experts by using questionnaire survey. The findings revolved that all the survey respondents are agree with the findings of literature review. We further analyze the investigated barriers based on organizations size, to check the significant difference between the barriers with respect to organization size (small, medium and large). Moreover the categorization of the investigated barriers indicate that the project administration is the most significant category of investigated barriers of task allocation process. The findings of this study may helpful for researcher and practitioners to consider the most significant barriers of task allocation process in the context of offshore software development outsourcing environment.

Keywords: Task allocation process, Offshore software development, Empirical investigation, Categorization of barriers

1. INTRODUCTION

Most of the software organization located in develop countries are motivated to transformed their development activities across the globe. The purpose of adoption of offshore development paradigm is producing the good quality software with low cost and time [1]. In offshore software development paradigm the development activities are carried out across the geographically distributed sites. There are several benefits and limitation faced by software firms while adoption offshore software development environment. Akbar et al. [2, 22] indicated that the software development cost is one third less in developing counters than developed countries [23]. Hence due to the good economic gains, the software organizations are excited to carry their development activities across the globe. Furthermore, Binder et al. [3] reported that the development time is reduced by managing the development activities round the clock to gain the 24/7 working hours. Moreover, the adoption of offshore development outsourcing is helpful for employing the expert's human's resources and advanced technological tools [4]. Besides the benefits of offshore software development outsourcing faced several additional problems that were not occurred in collocated software development environment, such as communication, coordination and control problems due to the language and cultural barriers across the geographically distributed development sites [4, 5]. The physical distance among the distributed development teams causes the lack of face to face meeting. Furthermore, Khan et al. [6] indicated that the lack of face to face meeting causes the lack of trust among the

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distributed teams. The overseas development teams also faced the problems of less development visibility of the developed product.

The software project management play an important role in order to perform the development activities effectively and efficiently. Kern and Willcocks [7] highlighted that for producing the quality product the management of development activities are significant. The effective project management is helpful for practitioner to take right decision at right time. Khan et al. [8] and Akbar et al. [9] also highlighted the importance of project management in the software development. It is quite true that the management of software development activities are complicated in and it became more complex while adoption in offshore software development outsourcing environment. However, the software project management is challenging in geographically distributed development environment. Khan et al. [10] conducted a systematic mapping study and highlighted that the poor project management can cause the budget and time overrun. However to develop the software in time and budget, the effective management of software development activities are significant [8, 10, 24]. Through literature we noted that the task allocation mechanism is very important and challenging in the context of offshore software development outsourcing environment. According to Deshpand et al. [11] the proper task allocation plays an important role for managing the carried the software development activities effectively end smoothly. We considering the definition provided by Jalote and Jain's [12] "A task is the smallest unit of work with a well-defined functionality and external interface with other tasks". In example a task is refer to a piece of code, enlisting requirements or designing, testing etc. in the software development life cycle. The task allocation is an important project management activity which is helpful for caring the development activities effectively and efficiently [13, 25-28]. However, the proper task allocation is considered as the complex activity of software project management in local or in house development and it became more complication in the context of offshore software development outsourcing environment. Niazi [13] et al. indicated that the offshore software organization failed to produce software in-time and budget due to poor task allocation mechanism in geographically distributed development environment.

A. *Study objective and research questions*

Despite the significance of task allocation mechanisms offshore software development outsourcing environment, limited consideration is given to address the problem geographically distributed sites. The ultimate aim of this study is to develop a comprehensive readiness model for task allocation process in the context of offshore software development environment. In this research work we conduct and empirical study in order to identify the barriers faced by offshore software development organizations. The investigated barriers are helpful for researcher and practitioner to plane their task allocation strategies for effectively performed the development activities in geographically distributed environment. In order to address the objective of this study we develop the following research questions:

RQ1: What barriers are reported in the literature that negatively affect the task allocation process in offshore software development outsourcing?

RQ2: What are the barriers faced by practitioner in task allocation process in the context of offshore software development outsourcing environment.

RQ3: how are the investigated barriers are analyzed based on organization size?

RQ4: How we develop a taxonomy of the investigated barriers?

B. *Study structure*

Rest of the study is structured as: Section 2 define the used research methodology, section 3 consists of findings of literature study, and investigation of empirical study is discussed in section 4. The robust framework is presented in section 5. Summary of the study findings is briefly discussed in section 6. Future work of the study is indicated in section 7 and the conclusions are described in section 8.

2. RESEARCH METHODOLOGY

In order to address the research aim of this study we adopted two different methodologies (i) literature review (ii) empirical study (questionnaire survey). The detail description of the used methodologies are discussed in the subsequent section and the important phases are presented in Figure 1.

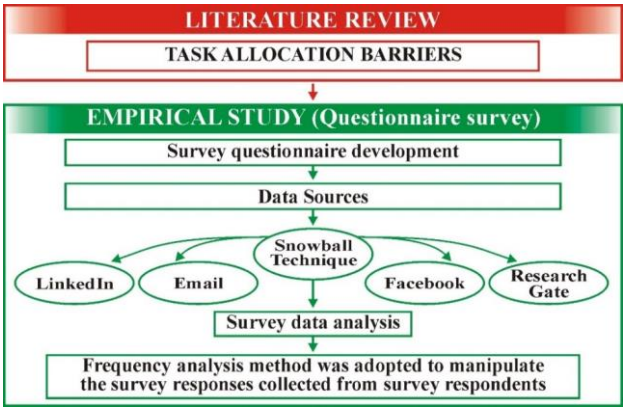

Figure 1. Phase of proposed research methodologies

In order to validate the findings of literature review, we conduct a questionnaire survey with real world practitioners. The following steps are adopted in order to conduct the survey.

A. *Questionnaire development*

In order to get the responses of the practitioners we develop a questionnaire survey. The queries of the

questionnaire were based on the identified barriers. The questionnaire survey approach is very effective to get the data from the target population. We used a 5 point options which include: “strongly agree”, “agree”, “neutral”, “disagree”, and “strongly disagree” [6]. All respondents were guaranteed that the gather data would remain private. The survey questioner was further piloted with co-authors of this study [4, 29]. The purpose of piloting study is to clarify the view of survey instrument. It is assured that the info was used only for research purposes and will not be revealed to someone under any conditions. A sample of the final survey questionnaire is presented in Appendix-A.

B. Data sources

The basic aim of this survey was to explore the barrier of task allocation process. It is important to collect the data from the real word practitioners. The participants were invited through snowball technique. The participants were invited through Social Medias, Facebook and LinkedIn [4]. The data was collected from Jun 2018 to October 2018. A total of 40 responses were received. The demographic data of the respondent is given in Appendix-B.

C. Data analysis

Frequency analysis method was used in order to analyze the collected data. Frequency analysis approach is useful to analyze the analytical data [4, 6, 34].

3. LITERATURE STUDY

In offshore software development environment the development activities are carried out at different geographically distributed sites. Globalization in the software industry has resulted in new challenges in the management of GSD projects [14, 30-32]. Reported problems encountered in managing GSD projects include challenges associated with inter-site communication [11], coordination [8], knowledge sharing [7] and issues related to inter-personal relationships in global teams [1]. The literature, in some cases, also discusses the practices that help overcome such challenges [13].

Khan et al. [15] indicted the due to the lack of frequent communication and coordination in the distributed teams, the task allocation activities are badly affected. Lacity and Rottman [16] highlighted the significant of communication and coordination problem faced by offshore software development teams. Lack of trust building is also one of the key barrier faced by geographically distributed teams. Keil et al. [17] emphasized that the lack of coordination among offshore teams causes the lack of trust among practitioners. Similarly Khan et al. [18] highlighted that time zone difference among the distributed team causes the critical berries in task allocation process in geographically distributed practitioners. He indicated the due to the time-zone different the overseas sites con not communication with each other frequently. Language barrier is also report an important challenge in task allocation process in the context of geographically distributed development. Several other barriers are identified form the literature as listed in the Table I.

TABLE I. STUDY QUALITY ASSESSMENT CRITERIA

S. No	Identified barriers	References
B1	lack of frequent communication	[1], [3], [4]
B2	Lack of coordination	[3], [4], [5], [6]
B3	Lack of trust	[2], [7]
B4	Time zone differences	[3], [9]
B5	Language barrier	[7], [15]
B6	Cultural differences	[13], [15]
B7	Site technical complexities	[3], [5]
B8	Different local government rules and regulation	[4], [6]
B9	Requirements instability	[10], [[14]]
B10	Lack of Knowledge management	[4], [16]
B11	Delay in responses	[9], [12]
B12	Lack of technological tools	[8], [11]
B13	Internal political factor	[5]
B14	Lack of skilled resources	[2], [9], [11]

4. FINDINGS OF THE EMPIRICAL STUDY

The findings of the survey was categorized into positive (agree + strongly agree), negative (disagree + strongly disagree), and neutral. The analyzed results are presented in Table II.

The results demonstrated in Table II, highlights that all the respondents are agree with the findings of literature review. All the reported barriers scored greater than 70% in the favor literature review findings.

An interesting observation is that the all the respondents are agree with the B1 (lack of frequent communication, 100%) and B2 (Lack of coordination, 100%). This render that in software development practices the B1 and B2 are more significant for effective task management activities in the context of offshore software development environment. Khan et al. [6] conducted an empirical study and heighted that in geographically distributed development environment frequent communication is indispensable for the managing the development activities effectively and efficiently. Furthermore Shafiq et al. [4] underlined that the lack of frequent communication among the overseas teams causes the confusion and misunderstanding among the development teams. Similarly, Khan et al. [10] conducted an empirical study and reported that lack of coordination among the overseas teams causes the cause the lack of trust among the distributed teams. Mahmood et al. [19] indicated that due to the geographical distance among the global practitioners cause the lack of coordination. Khan et al. [6] also highlighted the importance of face to face meetings among distributed teams.

TABLE II. OBSERVATIONS OF SURVEY RESPONDENTS

S. No	Identified barriers	Survey responses (N=40)							
		S.A	A	%	S.D	D	%	N	%
B1	lack of frequent communication	12	28	100	0	0	-	0	-
B2	Lack of coordination	16	24	100	0	0	-	0	-
B3	Lack of trust	9	21	75	1	4	13	5	13
B4	Time zone differences	8	21	73	2	3	13	6	15
B5	Language barrier	10	18	70	3	3	15	6	15
B6	Cultural differences	9	20	73	1	6	18	4	10
B7	Site technical complexities	11	24	88	0	3	8	2	5
B8	Different local government rules and regulation	6	22	70	2	4	15	6	15
B9	Requirements instability	9	23	80	1	3	10	4	10
B10	Lack of Knowledge management	8	21	73	0	5	13	6	15
B11	Delay in responses	15	17	80	0	4	10	4	10
B12	Lack of technological tools	12	18	75	2	3	13	5	13
B13	Internal political factor	6	19	63	3	4	18	8	20
B14	Lack of skilled resources	13	20	83	1	3	10	3	8

We further noted that SF7 (Site technical complexities, 88%) was the second most significant barriers for task allocation process in the context of offshore software development outsourcing environment. Narendra et al. [20] indicated that technical complexities in geographical distributed sites causes the barriers in task allocation process in the context of offshore software development outsourcing environment. Khan et al. [10] also highlighted the importance of task allocation system in the context of offshore software development outsourcing. Moreover, B14 (Lack of skilled resources, 83%) was reported as a significant barrier in the context of offshore software development outsourcing environment.

In the negative category B6 (Cultural differences, 18%) and B13 (Internal political factor, 18%) was reported as the most significant barriers in the negative category in the context of offshore software development environment. B5 (Language barrier, 15%) and B8 (different local government rules and regulation, 15%) was the second highest reported barriers in the context of offshore software development outsourcing environment.

Moreover, we noted that B13 (Internal political factor, 20%) was the highest cited reported barriers in task allocation process in the context of offshore software development outsourcing environment. B4 (Time zone differences, 15%), B5 (Language barrier, 15%), B8 (Language barrier, 15%) and B10 (Lack of Knowledge management, 15%) were the second most significant barriers in task allocation process in the context of offshore software development environment.

A. Organization size based analysis

The investigated barriers were further analyzed based on the context of organization size. The basic aim of this analysis is to check the importance of the investigated factors with respect to organization size. We have performed Chi-square test to check the significant difference between the investigated factors. However, to notify the significant difference between the investigated factors, we have develop the following hypothesis:

H0 (Null hypothesis): Is there any difference between the identified factors with respect to organization size.

H1 (Alternate hypothesis): there is no significant difference between the identified factors with respect to organizations size.

The detail analysis and the frequency of occurrence of each factor in all organizations category are presented in Table III.

According to the results indicated in Table III, there is no significant difference between the investigated factors with respect to organization size. As all the factor have significant value $p > 0.05$. Though, Null hypothesis is accepted. This readers that the investigated factors have equal importance for all size of organizations.

Moreover, we noted that in small scale organizations B1 (lack of frequent communication, 85%), B9 (Requirements instability) and B12 (Lack of technological tools) are most highly cited factors for task allocation process.

According to the results presented in Table III, B3 (Lack of trust, 80%), B8 (Different local government rules and regulation, 80%) and B13 (Internal political factor, 80%) are declared as the most important factor for task allocation process.

TABLE III. ORGANIZATION SIZE BASED ANALYSIS

S.No.	Barriers	Small (N=13)		Medium (N=10)		Large (N=17)		Chi-square Test "α = 0.05"		
		F	%	F	%	F	%	X^2	df	P
B1	lack of frequent communication	11	85	6	60	11	65	0.473	1	0.491
B2	Lack of coordination	9	69	7	70	12	71	0.105	1	0.746
B3	Lack of trust	7	54	8	80	10	59	1.320	1	0.251
B4	Time zone differences	10	77	7	70	13	76	1.236	1	0.266
B5	Language barrier	10	77	6	60	12	71	2.139	1	0.144
B6	Cultural differences	6	46	6	60	5	29	0.660	1	0.416
B7	Site technical complexities	7	54	5	50	6	35	1.491	1	0.222
B8	Different local government rules and regulation	8	62	8	80	14	82	1.211	1	0.271
B9	Requirements instability	11	85	7	70	15	88	1.012	1	0.314
B10	Lack of Knowledge management	10	77	7	70	7	41	2.795	1	0.095
B11	Delay in responses	9	69	6	60	11	65	0.067	1	0.795
B12	Lack of technological tools	11	85	5	50	12	71	5.369	1	0.057
B13	Internal political factor	7	54	8	80	12	71	0.297	1	0.586
B14	Lack of skilled resources	8	62	7	70	9	53	0.002	1	0.966

In large organizations category, B9 (Requirements instability, 88%) is declared as the most significant factor for task allocation process.

In addition, we have map the investigated factors by following the framework developed by Akbar et al. [33, 35]. This mapping process is conducted based on the frequency analysis. For example B1 (lack of frequent communication) was reported 85% in small organizations, 60% in medium organization and 65% in large organization category. As the frequency is higher in small organizations category, so the B1 is assigned to the small organizations (Figure 2). By following the same criteria, we have map the investigated factors into three different organization category. The mapping result is presented in Figure 2.

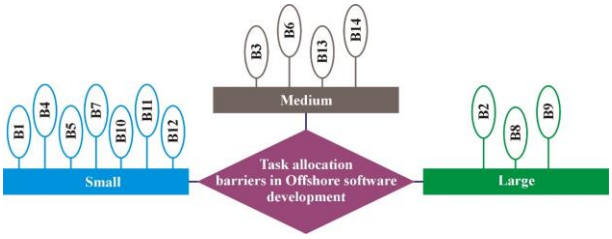

Figure 2. mapping of investigated factors with respect to organization size

5. ROBUST FRAMEWORK

The reported task allocation barriers were categorized into core four categories i.e. Software methodology, coordination, project administration and technologies. Khan et al. [18] and Shameem et al.[21] indicted the every barriers have variances in impact with respect to the nature of designation or nature of assigned work. The purpose of this categorization is to investigate the most significant barriers category of task allocation system. In categorization process all the listed authors of this paper are informally involved. The categorization is made according to the understanding of mapping team and the impact of barriers on task allocation process in the context of offshore software development outsourcing. The results of categorization process indicates the project management category is the most significant category of task allocation barriers (Figure-3). This categorization is helpful for researcher and practitioners to consider the most significant barriers category with respect to their interest.

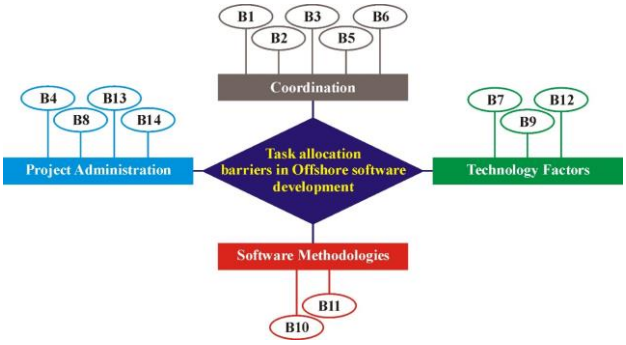

Figure 3. Taxonomy of the reported barriers

6. SUMMARY OF STUDY FINDINGS

The ultimate aim of this research work is to develop a readiness model for task allocation process in the domain of offshore software development outsourcing. The current study was conducted to address the one part of the proposed readiness mode with is barriers of task allocation process. The barriers of task allocation process are identified from the existing literature and analyze them with respect to organization size (small, medium and large). The detail summary of the research question is presented in Table IV.

TABLE IV. SUMMARY OF THE FINDINGS

Research questions	Findings
RQ1: What barriers are reported in the literature that negatively affect the task allocation process in offshore software development outsourcing?	lack of frequent communication (B1) Lack of coordination (B2) Lack of trust (B3) Time zone differences (B4) Language barrier (B5) Cultural differences (B6) Site technical complexities (B7) Different local government rules and regulation (B8) Requirements instability (B9) Lack of Knowledge management (B10) Delay in responses (B11) Lack of technological tools (B12) Internal political factor (B13) Lack of skilled resources (B14)
RQ2: What are the barriers faced by practitioner in task allocation process in the context of offshore software development outsourcing environment.	According to the results of empirical study, all the barriers investigated through literature study are important to address for the successful task allocation process in offshore software development environment.
RQ3: How are the investigated barriers are analyzed based on organization size?	According to the results, there is no significant difference between the investigate factors with respect to organization size. All the barriers are important for small, medium and large scale organizations.
RQ4: How we develop a robust framework of the investigated barriers?	The identified barriers are categorized into four key categories of software process improvement. The results presented that coordination is the key category of the investigated barriers. This renders that the coordination category is most significant category of investigated berries of task allocation process.

7. FUTURE WORK

The ultimate aim of this research work is to develop a readiness model for task allocation process for offshore software development organizations. The current study just contribute to the development of only one factor of the proposed readiness model i.e. barriers of task allocation process in offshore software development environment. The association of all the components of the proposed readiness model is given in Figure 4. In future, we plan to conduct systematic literature review study in order to investigate the additional barriers of software task allocation process in the context of offshore software development outsourcing environment. Furthermore we conduct empirical study to validate and explore the barriers are success factors of task allocation process in the context of offshore software development outsourcing environment.

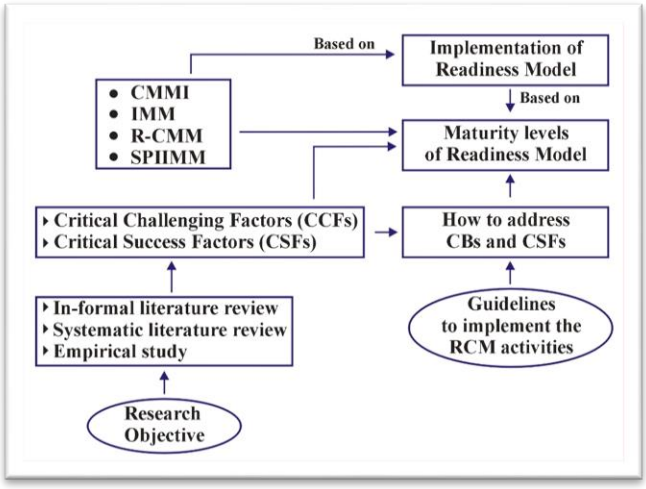

Figure 4. Structure of proposed task allocation readiness model

8. CONCLUSION

The offshore software development outsourcing is most widely used development phenomena in software development organizations. Due to the huge economic gains the software firms are adopting offshore software development increasingly, but several barriers are associated with it and task allocation process are one of them. In this study we identify the barriers of offshore software development outsourcing environment through literature review and further validated with real world practitioner. The findings revolved that a total of 14 barriers of task allocation process were investigated from literature and validated with real-world practitioner by using questionnaire survey. According to the results all the survey respondents are agree with the findings of literature review. An important observation is that the lack of frequent communication and Lack of coordination both are reported by all the participants are the critical barrier for task allocation process in the context of offshore software development outsourcing. We have further performed organization size based analysis to the significance of the investigated factors with respect to organization size. The results demonstrated that most of the identified factors are related to small scale organizations category. In addition, the investigate task allocation barriers were categorized into four core categories of project management. The categorization results indicated that project administration is the most significant category of investigated barriers. We are confident that the investigated task allocation barriers are helpful for practitioner to develop their strategies to manage the task allocation process in geographically distributed software development environment.

APPENDICES

Please visit the following links to explore the Appendices:

Appendix A: http://tinyurl.com/y4hgdfe2

Appendix B: http://tinyurl.com/y3gtsawr

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