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Research Article

Critical Barriers in Project Management Faced by Offshore Software Multi-Sourcing Vendors: A Detailed Study

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Abstract: Multi-sourcing is a modern business strategy in Global Software Development (GSD), adopted by many organizations in developed areas for producing fast and improved quality software products with minimum developmental cost by contracting the project with copious vendor organizations at low prices countries. The objective of this research work is to find out all possible critical barriers (CBs) in software project management faced by multi-sourcing vendor organizations. This will assist in planning for mitigation and avoidance of these risks/barriers for successfully achieving project goals in earlier planning phase. Systematic Literature Review (SLR) was used for identification of these critical barriers that can be faced by vendor organizations at various stages of SDLC for multi-sourced software projects development. Our research reveals that most of the challenges are relevant to planning phase of SDLC.

Keywords: Global software development, multi-sourcing, software project management, vendors, SLR, offshore software development outsourcing, barriers

1. INTRODUCTION

Global software development (GSD) is a phenomenon of development of software by teams dispersed throughout the different geographical locations, also called development sites. This approach has been adopted by many software development organizations for the last two decades in order to increase their business incomes. In GSD, the software projects are distributed and developed in different firms normally located in different countries of the world. Basic purpose of this strategy is to develop software 24/7 hours which reduce the product availability time to market. In GSD, offshore software development outsourcing (OSDO) or software outsourcing, is the modern approach to software development in which software products development projects are contracted to firms from low cost countries for developing high quality software products and decreasing the developmental costs and time [1, 2].

The knowledge behind GSD paradigm is that software engineers from geographical locations around the globe, with different languages, cultures and temporal backgrounds, collaborate and work together for development of software projects, communally; it is termed as "global distance" [32, 33, 34, 35, 36]. In GSD environment, geographical remoteness creates physical separation between software engineers/team members and team management [3]; temporal distance minimizes the opportunities of direct contacts and communication and cooperation between team members [31], and cultural differences undesirably affect the understanding and appreciation of the work progress of the team members and remote colleagues [9, 36]. The difference in native languages, also called "linguistic distance", creates multiple critical

barriers to communication [8, 33, 35].

Global software development has been found fruitful by many organizations, because through GSD the vendor organization can take benefits in terms of cost and time by accessing global multi-skilled workforce, antagonism, easy access to global markets and end users/consumers [3]. Global software development is a broad category providing a platform to different dynamic development environments in different formats like outsourcing, freelancing, partnership, crowd sourcing, etc. [4]. Here, the discussion will be limited to outsourcing paradigm of GSD, which is the most popular and rapidly growing feature of GSD. Most software development organizations around the world are adapting outsourcing and moving towards GSD model due to its various benefits.

Outsourcing is a contractual association between vendor and client organization based upon written agreement. This strategy has been adopted and implemented by many software development firms throughout the world gives new prophecy to business process that play key role in making business decision [5]. Based upon nature of geographical separation, outsourcing relationship can be further divided into three major types such as include onshore outsourcing, nearshore outsourcing and offshore outsourcing [6]. The offshore outsourcing can be further divided into uni-sourcing (one-one relationship between client and vendor) and multi-sourcing (one to many or many-to-many relationship(s) between clients and vendors). In each type of outsourcing, an agreement is made between vendor and client located apart from one another in different countries.

The management of software projects in case of outsourcing is more complicated than software projects executed and developed indoor because parties involved in outsourcing belong to different cultures, time zones and languages etc. Another type of outsourcing called Multi-sourcing or multi-vendor sourcing or multiple outsourcing in which one client or vendor organization is associated with multiple clients or vendors located in different locations/sites. There is one-to-many relationship in this type of outsourcing. The client organization is dependent on more than one vendors as well as there is high dependency between involved vendors. The

project management in this type become toughest than outsourcing because of additional work done for controlling communication and coordination between parties, product integration from involved parties etc.

Cohen [7] has defined the multi-sourcing relationship as "the organizing and establishing of IT infrastructure and business services in regimented way for achieving targeted project and business goals successfully by contracting the project with optimum external and internal service supplier".

The main reason behind increasing trend of multi-sourcing strategy is that each firm tries their best to reduce product development cost, time and increase the efficiency, flexibility and quality of product in fast changing global market [9]. Multi-souring strategy is fruitful in many aspects and lead to incredible benefits as discussed [26], but on the other hand, it challenge the existing administrative competencies and approved operational models of the organization [7, 27].

Challenging the managerial capabilities of an organization is the key limitation of multi-sourcing paradigm in IT projects; otherwise it is the most suitable strategy for successful completion of software projects with reduced risks [28].

1.1 Why Study SPM in the Context of Multi-Sourcing?

The main idea behind this study is to facilitate and empower vendor organizations to successfully execute multisource software development projects effectively and efficiently by following a set of processes and procedures (a model). This study will assist the vendor organization in decision making either to outsource the project by considering different constraints and critical barriers/challenges that can be faced in multi-sourcing environment or not.

To manage and handle multiple suppliers in parallel from different backgrounds like different cultures, languages and time zones is not an easy task and require strong internal management at vendor organization. Project management in software multi-sourcing should be based upon

strong procedures, processes and models, so that vendor organization can take positive and bold decisions for improving their business [9]. Ebert [10] and Prikladnicki [39] have argued that proper risk management and risk handling are most critical challenges, which project managers are facing in GSD software projects. These risks become more critical in multi-sourced software projects.

2. BACKGROUND

Software project management is a process of planning, monitoring, controlling, budgeting, scheduling, project resource allocation/de-allocation, communication, collaboration, documentation and change and risks management. Good project management contributes significantly in success of any project/program. In case of software projects, the project management have a vital role in successful completion of development activities. The software project failure comes in different forms like budget limit exceed than allocate one, project not completed in the given time frame or not functioning according to SRS, etc.

According to the CHAOS report only 37% of all software and Information Technology (IT) projects are successfully completed and succeeded in the sense that they were delivered within given constraints of time frame, within calculated budget, with all the required specification, features and functions. The research conducted by IBM showed that 54% of software projects failures were due to poor management of software projects.

Lago et al. [2] argues that one of the main reasons behind software project failure is the lack of project management knowledge of project managers as they do not know how to deal with uncertainties occurs during the project execution. Current research and literature [43] has acknowledged different reasons due to which software and IT projects failed, like unclear requirement specifications, weak project escalation, lack of risk management knowledge, high user expectations, inadequate software development or project management model and processes, or no record track knowledge of previous failed or succeeded projects.

A report in IT Weekly magazine reveals that Eighty percent of software organizations who have outsourced and contracted there software projects to vendors in offshore development environment faced many critical problems because both vendors and client's inexperience, unawareness with outsourcing and poor software projects management in GSD [37]. One of the main problem is that most of the client organisations make global contracts with their vendors before proper judgment of their potentials and efficiencies required for successful project management in GSD [38].

Multi-sourcing in offshore software development outsourcing (OSDO) has many benefits; but there are several critical challenges faced by vendor organizations. According to the literature, these are as under:

➢ In OSDO relationships, Khan et al. [11], pointed out number of critical challenges like lack of communication and coordination between vendors organizations, lack of project management, delayed responses etc. which can leads the project toward failure if proper attention is not given for mitigating these challenges in start of project execution.

➢ In OSDO, the rich Communication and strong coordination are the two key factors and plays vital role in success of software outsourcing projects. These are badly affected by geographical separation between vendors, time zone, cultural differences and language differences [12].

➢ In a study, Verner et al. [13] pointed out different barriers faced in OSDO like selection of appropriate vendors, project management, selection of appropriate development process and design, requirement engineering, architectural design, software integration and component management, training, coordination/collaboration and communication and planning for risks control.

➢ Due to geographical dispersion among vendors/stakeholders in the GSD, some of the challenges like complexity in communication and collaboration process, language, culture and time difference, knowledge sharing and management are automatically created [14].

Geographical separation is the biggest challenge in GSD because some projects activities like coding and testing are carried out by one sub-vendor located at one geographical location while other activities like planning, requirement specification and analysis, integration, implantation and testing are carried out at some other place. The basic of strong and effective software project management in GSD is coordination and control. But geographical separation and long distances introduce complications which directly influences the command, control and coordination through its effect on communication and cooperation [29, 30].

Many researchers and author pointed out difference risk factors and barriers in context of outsourcing. All these factors and barriers also faced by vendor's organizations working on multi-sourcing in OSDO. The most critical barriers in multi-sourcing environment are high dependency among stakeholders, lack of collaboration and coordination and delayed responses. These make the software project management for vendor organization working in multi-sourcing environment tougher and needs additional work done.

Different process models and procedure have been developed and defined for successful completion of software projects within given constraints of time budget, time, quality standard etc [1, 19-25].

3. RESEARCH QUESTIONS

Following research questions were formulated keeping in view the project management challenges in context of multi sourcing in OSDO relationships from vendor's perspective:

RQ1: What are critical challenges, as identified in literature, in software project management in the context of software multi-sourcing?

RQ2: What are critical challenges, as identified in real World, in software project management in the context of software multi-sourcing?

RQ3: What are the real-world practices for software project management in the context of software multi-sourcing?

4. RESEARCH METHODOLOGY

To achieve our expected goals and objectives as outcome from this research accurately, we have adopted systematic literature reviews (SLR), questionnaire survey and case study techniques to gain maximum from existing literature and for validation of these results. This research approach has been adopted by other researchers also [15, 16]. A SLR is a new approach in software research field for identification, evaluation and interpretation of all relevant research for a Specific research query/ question, or topic area, or phenomenon of Interest [18]. In first steps, to identify software project management critical barriers/challenges faced by vendors in OSDO multi-sourcing relationships, the existing literature has been reviewed through SLR. In addition to barriers, some practices/solutions for addressing these challenges have been noted. In 2nd step, an empirical study will be conducted in industry working on OSDO multi-sourcing approach for validation of the identified challenges of the SLRs. In this step, experts will point out more challenges or practices in addition to the identified ones. In third step the practices will be identified using SLR and empirical study for the purpose to avoid/mitigate the identified challenges. In step fourth the various levels will be defined on the basis of the identified critical challenges and practices. Finally, the developed model of PMMSM will be validated through case studies and changes will be made if required. The detail of search strategy is given in our developed protocol which is in pipeline for publishing.

5. DATA SYNTHESIS

In this phase, the barriers were extracted from 45 research papers and have been categorized in 23 different groups with specific name, their frequency and percentage. The percentage will help in decision making regarding criticality of a barrier. This categorization was done by author and co-author as shown in Table 1.

We have extracted different challenges from different research papers and articles through SLR. 'Lack of Communication and Collaboration between Stakeholders' is most critical challenge identified in our study i.e. 96% as shown in Table

Table 1. List of Identified Barriers through SLR.

S. No.	Barrier Class	Frequency Out of 45	Percentage
01	Lack of Communication and Collaboration between Stakeholders	43	96%
02	Difference in Language, Culture, Time and Geographical Distance	38	84%
03	Complex Relationship Between Vendors	16	36%
04	Lack of Experience in Multi-sourcing Projects	20	44%
05	Lack of Technical Skills	28	62%
06	Delayed Feedback	08	18%
07	Volatile Customers Requirements	16	36%
08	Poor planning and estimation	19	42%
09	Ambiguous software design	14	31%
10	Issues in software coding and testing	13	29%
11	Lack of Trust	29	64%
12	Software Integration Problems	02	4%
13	Lack of Client and Top Management Involvement	16	36%
14	Security and Privacy Issues	10	22%
15	Weak monitoring and Control	23	51%
16	Lack of Standard PM Practices and Processes in Multi-sourcing	19	42%
17	Organizational Politics	22	49%
18	Complexity in Multi-sourcing contracting	08	16%
19	Lack of Training	22	49%
20	Change in Roles and Responsibilities	08	18%
21	Lack of Team Spirit	06	13%
22	Hidden Costs	14	31%
23	Lack of Knowledge Sharing	20	44%

1. It means that vendor organizations have to do more work for improvement of communication and collaboration between involved stakeholders (sub-vendors, clients etc.) when managing software multi-sourced project in OSDO. The 2nd most critical barrier is 'Difference in Language, Culture, Time and Geographical Distance' with frequency 84%. Geographical separation of stakeholders means that different team members may be involved and working on same project e.g. some teams and team members are from USA, some from Asia and some from Europe etc. Geographical separation provide base for language, time and cultural differences. Now, it becomes very difficult to manage the involved teams and members together at the same time due to time differences. This time difference directly effects the quality of collaboration, communication and coordination in offshore multi-sourcing. The difference in cultural means difference in societies, religious factors and rules, public and custom holidays, values, languages, procedures, and thoughts [44]. Khan S.U and Azeem [44] have also discussed in their research that culture difference is most critical challenge for vendors working in OSDO relationship. Difference in language mean that as people involved in OSDO relationship belongs to different regions and speak different native languages, which leads to problems like unknown expressions, gestures, ideas and directions. Some authors [e.g., 45] argued that language and cultural differences can contribute a lot in lacking the communication, coordination and collaboration processes between clients and vendors in OSDO relationships. 'Lack of Technical Skills' (62%) is another barrier faced by vendor organizations. By this we mean the shortage of technological experiences, absence of matured processes, procedures and outdated technologies possess by a vendor organization working in OSDO. Technology difference between vendors and clients can create serious problems.

'Lack of trust' is another critical barrier faced by vendor organizations in management
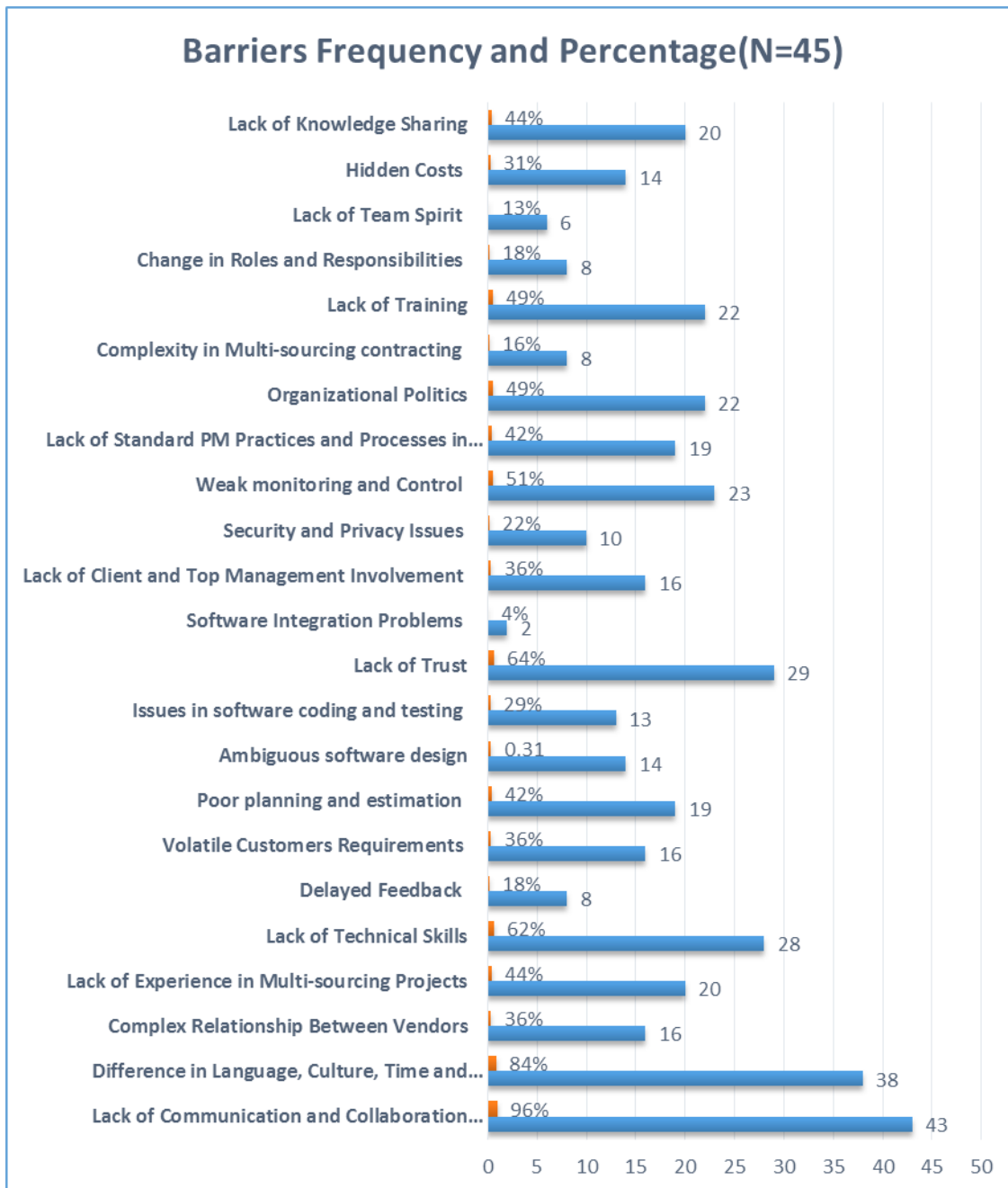
Fig. 1. List of Barriers Identified Through SLR.

of software multi-sourced projects. N. B. Moe and D. Smite [46] in their research identify some of the important factors that creates lack of trust in teams and a there members in GSD. These are lack of face-to-face communication, cultural and social mismatch, language difference, poor conflict handling, absence of cognitive-based trust, unnecessary observations, inconsistency in development processes and procedures. In case of trust absence, the employees waste much of their energy in self-protecting, individual goals become more important as compare to group goals and doubt negative feedback from management.

'Lack of experience in multi-sourcing projects' is another critical barrier. According to this, the vendor organizations, before going to contract multi-sourced software projects in GSD, should measure and examine their capabilities for managing and executing such projects i.e. technical and managerial capabilities of their managers,

potentiality of their employees, technologies, processes and resources currently in use, effective risks management etc. The lack of experience for handling such projects become difficult and may lead to failure.

'Poor planning and estimations (42%)' are other barriers that need special attention before execution of project because if proper planning, scheduling, resource allocation and budgeting are not performed, the project will be definitely delayed or will exceed allocated budget. Other barriers like 'weak monitoring and Control (51%)', 'Organizational Politics (49%)', 'Lack of Training (49%)', 'Lack of Knowledge Sharing (44%)' should be kept in mind by vendor organization in managing multi-sourced projects in GSD.

Fig. 1 shows detailed distribution of barriers with frequency and percentage identified through SLR.

6. RESULTS

In this section, detailed discussion and analysis will be done of each barrier from different angles. We have used SPSS for finding out facts and figures. The identified barriers that have frequency >= 30% will be considered critical barriers. According to this criterion there are 16 critical barriers out of 23 identified barriers as shown in Table 1.

6.1 Database Wise Detail of Research Papers and Their Percentage

Detail of the research papers selected through SLR across the various search engines and data bases
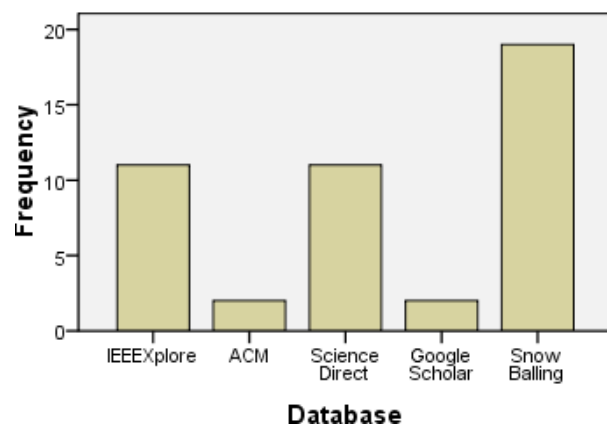
Table 2. List of selected papers across various search engines and libraries (directories).

Data Base	Frequency	Percentage
IEEE Explore	11	24.4
ACM	2	4.4
Science Direct	11	24.4
Google Scholar	2	4.4
Snow Balling	19	42.2
Total	45	100.0

Table 3. List of papers across the various continents.

Continent	Frequency	Percent
Asia	13	28.9
Europe	21	46.7
N. America	6	13.3
Mixed	5	11.1
Total	45	100.0

Table 4. List of papers across the two decades.

Period	Frequency	Percent
2000-2010	20	44.4
2011-2015	25	55.6
Total	45	100.0

(directories) are shown in Table 2. The research papers selected through snow balling having higher frequency are shown in Fig. 2. We have also used snowballing technique to find out most related
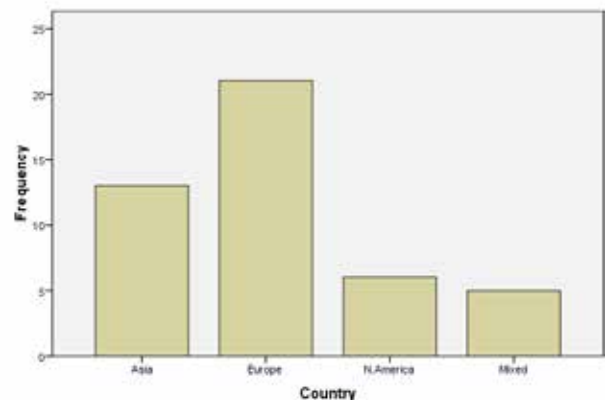

Fig. 2. Database wise distribution of research papers.

Fig. 3. Continent wise research papers detail and their percentage.

papers that have been missed out through formal search. The results shows that limited number of researchers have worked in this area.

Table 3 shows research papers distribution across the various continents. Results shows that 46.7% of all selected research papers are from Europe which means that researchers from this area gives more attention and interested in exploring the hazards faced in management of software projects in offshore environment. The results also show that researchers from Asia are also working in this area.

6.2 Decade-wise Detail of Selected Publications

We have divided search periods into two decades, the first decade is from 2000-2010 and second decade is from 2011 to 2015. In our trail search, we have found that no research paper has been found before 2000 which discussed the project management in offshore multi-sourcing from vendors' prospective. Our search and results also show that this is new area of software project management maturing since 2000 and limited numbers of researchers has contributed to this area. The search results also show that this area require more attentions of researchers to dig out the practices/solutions of barriers in second decade because many of the software organizations from all over the world adopting GSD strategy for secured widening of their business and making positive decisions [40].

The analysis of data in each decade has been made by using multiple tests as indicated in Table 5. Each critical barrier has been compared decade wise. Linear by linear association Chi-Square test has been used for finding any significance difference in the critical barriers across the two decades. The reason behind using linear by linear association Chi-Square test in our analysis is that it is more powerful than Pearson's $\chi 2$ test [41]. The highlighted values having statistical significance difference (P<0.05). The below Table 5 shows that there is a minor difference between the two decades for the critical barriers 'Lack of Communication and Collaboration between Stakeholders', 'Difference in Language Culture Time and Geographical Distance', 'Ambiguous software design', 'Lack of Experience in Multi-sourcing Projects',' Volatile Customers Requirements', 'Lack of Trust', 'Lack

of Standard PM Practices and Processes in Multi-sourcing '. This means that these factors have been considered most important in both decades and still the focus points for researchers of this field.

While the factors like 'Complex Relationship Between Vendors', 'Organizational Politics', 'Lack of Training', 'Hidden Costs', 'Issues in software coding and testing' got attention and importance in second decade because of increasing trend of GSD. 'Delayed Feedback', 'Poor planning and estimation', 'Change in Roles and Responsibilities' has gained less researcher attention in 2nd decade because of new approaches to software development like RAD, COTS reuse, Extreme programming and agile techniques etc.

The three components 'Lack of Client and Top Management Involvement', 'weak monitoring and Control' and 'Lack of Team Spirit' have big difference between two decades.

In Table 6, we further compared each identified barriers from each study strategy. In below Table 6, we have combined Case study, Interview and Literature review. The linear-by-linear Chi-square test has been performed also for each identified barriers on the basis of study methodology used for finding any major difference between study strategies if any. The Table shows that there is no significance between barriers on the basis of study strategy. The Table also shows the detail of each barrier in each study strategy.

6.3 Continent-wise Comparison of Critical Barriers

The data comparisons between different continents, i.e., Asia, Europe and N. America are shown in Table 7. The data from other continents has been ignored because of low sample size. The objective of this analysis is to find out any differences in these continents with respect to the identified critical barriers. We have used linear-by-linear association chi-square test to find any significant difference between barriers throughout the continents. There are 22 barriers in Asia, 23 in Europe and 17 in N. America. The Table 7 shows three major variations of identified factors for all three continents that are 'Lack of Communication and Collaboration between Stakeholders', 'Difference in Language

Table 5. Comparative analysis of critical barriers in each decade.

Critical Barriers Lack of Communication and Collaboration between Stakeholders	Decade-1st 2000-2010 (N = 20)		Decade-2nd 2011=2015 (N = 25)		χ2 test (linear-by-linear association)α =0.05		
	Frequency	%	Frequency	%	χ2	df	P
Lack of Communication and Collaboration between Stakeholders	18	90	24	96	.629	1	.428
Difference in Language Culture Time and Geographical Distance	17	85	20	80	.186	1	.666
Complex Relationship between Vendors	5	25	12	48	2.445	1	.118
Lack of Experience in Multi-sourcing Projects	8	40	13	52	.629	1	.428
Lack of Technical Skills	11	55	17	68	.781	1	.377
Delayed Feedback	6	30	3	12	2.200	1	.138
Volatile Customers Requirements	5	25	9	36	.613	1	.434
Poor Planning and Estimation	9	45	9	36	.367	1	.545
Ambiguous software design	5	25	6	24	.006	1	.939
Issues in Software Coding and Testing	3	25	9	36	2.450	1	.118
Lack of Trust	13	65	14	56	.367	1	.545
Software Integration Problems	1	5	1	4	.026	1	.873
Lack of Client and Top Management Involvement	**3**	**15**	**13**	**52**	**6.491**	**1**	**.011**
Security and Privacy Issues	4	20	6	24	.101	1	.751
Weak Monitoring and Control	**6**	**30**	**15**	**60**	**3.929**	**1**	**.047**
Lack of Standard PM Practices and Processes in Multisourcing	8	40	11	44	.071	1	.790
Organizational Politics	6	30	13	52	2.155	1	.142
Complexity in Multi-sourcing contracting	3	15	5	20	.186	1	.666
Lack of Training	8	40	15	60	1.739	1	.187
Change in Roles and Responsibilities	4	20	4	16	.119	1	.730
Hidden Costs	4	20	8	32	.800	1	.371
Lack of Knowledge Sharing	7	35	11	44	.367	1	.545
Lack of Team Spirit	**5**	**25**	**1**	**4**	**4.146**	**1**	**.042**

Culture Time and Geographical Distance', 'Lack of Training'. First two barriers have highest frequencies for Asia and Europe and low frequencies for N. America. It means that these two factors are more critical in Asia and Europe as compared to N. America. Lack of training has the highest frequency in Asia and Europe i.e. 62% and lowest in N. America, i.e., 33%.

'Complex Relationship Between Vendors',

'Lack of Experience in Multi-sourcing Projects', 'Lack of Technical Skills', 'Lack of Trust', 'Lack of Client and Top Management Involvement', 'Organizational Politics', 'Lack of Knowledge Sharing' are considered as most important and most critical barriers in all the three continents because of their higher frequencies as shown in Table 7. These factors are given more attention in each continent. Similarly, the Delayed Feedback and Lack of Team

Table 6. Comparison of barriers based on methodology used.

Critical Barriers Lack of Communication and Collaboration between Stakeholders	Case Study (N=15)	Interview (N=14)	Literature Review (N=16)	χ2 test (linear-by-linear association) α=0.05		
	Frequency %	Frequency %	Frequency %	χ2	df	P
Lack of Communication and Collaboration between Stakeholders	14	12	16	.577	1	.447
Difference in Language Culture Time and Geographical Distance	11	10	16	3.769	1	.052
Complex Relationship between Vendors	5	3	9	1.762	1	.184
Lack of Experience in Multi-sourcing Projects	8	7	6	.772	1	.380
Lack of Technical Skills	12	8	8	2.869	1	.090
Delayed Feedback	4	1	4	.008	1	.929
Volatile Customers Requirements	4	7	3	.253	1	.615
Poor planning and estimation	7	6	5	.758	1	.384
Ambiguous software design	3	4	4	.098	1	.755
Issues in software coding and testing	3	3	6	1.206	1	.272
Lack of Trust	8	6	13	2.546	1	.111
Software Integration Problems	2	0	0	3.106	1	.078
Lack of Client and Top Management Involvement	4	10	2	.764	1	.382
Security and Privacy Issues	5	1	4	.273	1	.601
Weak monitoring and Control	7	7	7	.028	1	.868
Lack of Standard PM Practices and Processes in Multi-sourcing	6	6	7	.043	1	.835
Organizational Politics	8	5	6	.759	1	.384
Complexity in Multi-sourcing contracting	3	1	4	.146	1	.702
Lack of Training	6	7	10	1.538	1	.215
Change in Roles and Responsibilities	4	1	3	.300	1	.584
Hidden Costs	4	2	6	.485	1	.486
Lack of Knowledge Sharing	5	4	9	1.704	1	.192
Lack of Team Spirit	2	0	4	.952	1	.329

Spirit have higher frequencies in Europe than Asia and N. America, which means that vendor's organizations and researchers in Europe give more attention to these factors as compared to others continents. The Volatile Customers Requirements and Lack of Standard PM Practices and Processes in Multi-sourcing have higher frequencies in Asia and Europe than N.America. Its means that less attention has been given to these factors by researchers and vendor organizations in N. America.

Table 7. List of CBs across the various continents.

Critical Barriers Lack of Communication and Collaboration between Stakeholders	Asia N=13		Europe N=21		N. America N=6		χ2 test (linear-by-linear association) α = 0.05		
	Frequency	%	Frequency	%	Frequency	%	X2	df	P
Lack of Communication and Collaboration between Stakeholders	**13**	**100**	**21**	**100**	**5**	**84**	**9.331**	**1**	**0.002**
Difference in Language Culture Time and Geographical Distance	**12**	**92**	**19**	**90**	**5**	**84**	**9.612**	**1**	**0.002**
Complex Relationship Between Vendors	3	23	10	48	3	50	.081	1	0.777
Lack of Experience in Multisourcing Projects	5	38	12	57	2	33	.016	1	0.899
Lack of Technical Skills	6	46	16	76	4	67	.002	1	0.965
Delayed Feedback	1	7	7	44	0	0	.025	1	0.874
Volatile Customers Requirements	4	31	6	29	0	0	1.106	1	0.293
Poor planning and estimation	3	23	9	43	3	50	2.419	1	0.120
Ambiguous software design	2	15	6	29	1	17	.701	1	0.402
Issues in software coding and testing	4	31	5	24	2	33	.082	1	0.774
Lack of Trust	7	54	16	76	2	33	.823	1	0.364
Software Integration Problems	0	0	2	9	0	0	.011	1	0.918
Lack of Client and Top Management Involvement	5	38	7	33	2	33	.000	1	0.982
Security and Privacy Issues	3	23	3	14	3	50	.259	1	0.611
Weak monitoring and Control	6	46	10	48	2	33	.036	1	0.849
Lack of Standard PM Practices and Processes in Multisourcing	6	46	10	48	0	0	.166	1	0.684
Organizational Politics	6	46	7	33	3	50	.310	1	0.577
Complexity in Multi-sourcing contracting	2	15	3	14	2	33	.371	1	0.543
Lack of Training	**8**	**62**	**13**	**62**	**2**	**33**	**5.723**	**1**	**0.017**
Change in Roles and Responsibilities	2	15	5	23	0	0	.049	1	0.825
Hidden Costs	5	38	4	19	2	33	.418	1	0.518
Lack of Knowledge Sharing	6	46	9	43	3	50	1.852	1	0.174
Lack of Team Spirit	1	8	5	24	0	0	.427	1	0.513

7. SUMMARY

Through SLR, we have identified different barriers classes that should be addressed and keep in view by vendor organizations when managing multi-sourced software projects in offshore software development environment. In our study, the defined criteria for criticality of barriers is 30%, the barriers which have frequency greater than defined frequency, it will be considered as critical. According to this criterion there are 16 critical barriers out of 23 identified barriers as shown in Table 1, Our research reveals some of the barriers need special attention because their occurrence creates serious threats to management of software projects in GSD environment and may result in the projects failure. We also found out the impact of different barriers through different decades and continents for vendor guidance because some barriers were most critical in one region while less critical in other region. Similarly, some of the factors were more critical in previous decade but less critical presently because of different improvements in software processes and technologies.

8. LIMITATIONS

There are 45 research papers selected through SLR for conducting this research. In these research papers, maximum have been written and published

by scholars, academics and faculty members of the universities. Most of these researchers may not have the practical experience of managing the multi-sourced software projects in GSD. Theoretical work has been done by most of the researchers. We have used these research papers for finding the barriers in faced in managing multisourcing projects from vendors prospective in GSD. Now problem is that up to what extant our research findings are valid? To prove these findings correct and to the point, we plan to conduct questionnaire survey and empirical study in Software industry and take feedback of practitioners who practically working in multi-sourced software projects in GSD and to find other Factors apart from identified one which has been skipped in this study.

9. CONCLUSIONS AND FUTURE WORK

Through SLR, we have identify 23 different barriers faced by vendors in multi-sourced software projects in GSD as shown in Table 1, in which 16 were critical barriers according to our set criteria. These identified barriers may help the vendor organizations for successful completion of OSDO project by keeping these barriers in mind at the time of project start and during execution. These barriers are also analyzed from different angles like decade wise and continent wise for vendor guidance. In our study we have identified following goals that we will follow in future:

- The Validation of identified barriers by using the technique of questionnaire survey and empirical study with the help of experts and practitioners working in OSDO environment.
- Additional critical barriers will be identified from experts and practitioners through empirical study if any.
- Finding the practices and solutions against identified barriers through SLR and empirical study.
- Development of PMMSM.
- Validation and verification of PMMSM from practitioners working in OSDO.

10. ACKNOWLEDGEMENTS

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