

Communication and Coordination Challenges Mitigation in Offshore Software Development Outsourcing Relationships: Findings from Systematic Literature Review

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Abstract— Over the last decade, many firms in the world have started adopting Global Software Development (GSD) in order to reduce software development cost, and access to qualified resources and modern technology. Due to the rapid development of ICTs, the GSD has become an acceptable business strategy with several paradigms. One of the rising business paradigms of GSD is Offshore Software Development Outsourcing (OSDO). The objective of this research is to provide mitigation advice for addressing communication and coordination challenges from vendors' perspectives in OSDO relationships. We have performed systematic literature review (SLR) process for identifying the practices/solutions for these challenges. We have identified 65 practices for addressing these challenges. This paper can help the OSDO vendor organizations to use the identified practices in order to address the communication and coordination challenges in OSDO relationships.

Keywords—Global Software Development; Software Outsourcing; Communication and Coordination challenges and its Solutions/Practices; SLR

I. INTRODUCTION

Many software development companies from the last decade have been trying to enhance their business profits by improving the time-to-market of their products, reducing costs by hiring people from countries with cheaper work-hours. These days, a large number of software development projects are distributed at many different sites and normally located in different countries. This distributed setting of managing a software project is termed as Global Software Development (GSD) and the discipline is termed as Global Software Engineering (GSE) [1]. One of the rising business paradigms of global software development is Offshore Software Development Outsourcing (OSDO) [2]. OSDO represents the practices of holding an outside party to carry out software development work/processes in a state/country other than the one where the products or services are actually developed [3]. Today many software organizations have turned to software outsourcing to get economic cost advantages [4]. Over the last decade outsourcing functions gain competitive advantages due to different reasons, such as the drastic growth in the ICTs market and shortage of information system professionals [4]. In addition, China and India have made the OSDO a reality due to the presence of

qualified persons, the availability of resources, skills and better business and economic environment [4].

However, several researchers [5]-[6] recommended that increased globalization of software development creates challenges due to cultural differences, time zone differences, lack of trust, language differences, geographical distance and diversity of communication and coordination. Ali-Babar et al. [7] suggested that the main stumbling block to OSDO is the geographical dispersion. The two major pillars and the backbone of successful OSDO activities are the communication and coordination processes, but it can be hampering due to geographical dispersion, cultural and language differences [8]. The lack of face-to-face meetings is one of the challenges and it affects the process of OSDO [9].

In OSDO relationship, Khan et al. [10] identified various critical challenges faced by vendor organizations. In these challenges, communication and coordination is a critical challenge to vendors in OSDO. Our prior research identified a list of 18 communication and coordination challenges faced by vendors in OSDO relationships [5]. Amongst the identified list of challenges 6 were marked as critical challenges. These identified critical challenges are: 'Geographical Dispersion', 'Cultural Differences', 'Language Differences', 'Lack of Credence', 'Lack of ICT/Technological Cohesion' and 'Lack of Informal/ Face-to-Face Communication' [5].

It is also important to provide mitigation advice in the form of practices for the identified critical challenges as this will help organizations facing these challenges. For this reason, we conducted a SLR process for finding the practices for addressing the aforementioned critical communication and coordination challenges in OSDO outsourcing relationships from vendor's perspectives.

We have formulated the following research question in order to understand the practices/solutions for communication and coordination challenges in OSDO relationships.

RQ. What are the solutions/practices, as identified in the literature, for addressing communication and coordination challenges in OSDO relationships from vendors' perspective?

The structure of the paper is organized as follows: Section II explains the background. Section III explains the research methodology. Results are presented in Section IV. Study limitations are discussed in Section V. Conclusion and future works are presented in Section VI.

II. BACKGROUND

In software outsourcing paradigm, various challenges and hurdles are faced by vendor organizations. Different researchers and practitioners have conducted case studies, questionnaire surveys, focus group sessions, interviews and literature reviews to dig out various aspects of the OSDO relationship.

Alberto Avritzer et al. [11] conducted a case study and suggested that geographic dispersion in global software engineering can be reduced by organizing face to face meetings, effective time management among the team members and "hands-on and Shake-off session", providing possibilities of synchronous communication, giving support for video conference at all sites and also giving suitable selection of communication tools. Cultural differences in OSDO can be reduced by providing the facilities of face to face meeting, cultural training, adopt low-context communication style, cultural liaison/Ambassador and reduce interaction between team from different cultures [12]. The problems of cultural differences can also be mitigated by adapting agile and scrum methods [13]. Similarly the temporal distance in offshore outsourcing can be reduced by establishing a bridging team, relocate to adjacent time zone, adopt and follow the sun development, using appropriate and advance technology, such as ICT, audio and video conferencing, instant messaging, online chat, email, web came and mobile alerts [11].

We can reduce the lack of trust in global software development by managing efficient outsourcing relationships, establishment of an appropriate communication and infrastructure, to encourage effective communication through the adaptation of tools and techniques and promotion of informal communication [12]. The probable solutions of language differences in global software development are composed of translating policies and practices into local languages and by putting emphasis on spoken language skills [14].

The lack of ICT or technological cohesion in global software development can be reduced by using proper communication technologies or tools, such as, internet, video conferencing, data conferencing, teleconferencing, telephone calls, chats, emails, instant messaging, shared databases, Wikis, shared desk top technology, net meeting, change management system, virtual whiteboards, photo gallery, team Intranet websites, electronic meeting systems, voicemail, CAMEL, NEXTMOVE, TAMRI, Dropbox, Mendeley, IRC and Skype etc [15]. Lack of face-to-face or informal communication problems in OSDO relationship can be reduced by provision of multiple communication

mode counting support to face-to-face synchronous communication, creation of communication protocols, to promote informal interactions, to apply agile practices (SCRUM), to deploy knowledge transfer mechanisms [16].

By using SLR for identifying the practices/solutions for communication and coordination challenges in OSDO relationships from a vendor's perspective will confine the missing communication and coordination practices in OSDO relationship. The novelty of our research shows that nobody has conducted SLR in this domain to find out practices for addressing communication and coordination challenges faced to vendors in OSDO relationships. The findings will assist OSDO vendor organizations to adopt the identified practices in order to avoid/mitigate the communication and coordination challenges in OSDO relationships.

III. RESEARCH METHODOLOGY

A SLR [17] process was used for data collection, because it is more thorough, less biased, rigorous and open as compared to ordinary literature review [17]. In finding, evaluating and summarizing all available evidences on a specific research question, a systematic review may provide a greater level of validity in its findings than ordinary literature review. A number of researchers [5][18] have used the SLR approach for reviewing the literature. Protocol development is the first phase of the SLR process and it describes planning of the review. In this connection, a systematic review protocol was written first to describe the plan for the review. Details of the various steps in our SLR methodology are available in our SLR protocol [18].

A. Search the Literature

Based on the available access, the digital libraries IEEE Explore, ScienceDirect, ACM Digital Library, SpringerLink and CiteSeer were used to carry out the search phase of the SLR. We used the following search string as a trial search:

((Solutions OR practices OR "best practice" OR "lessons learned" OR Advice) AND ("communication and coordination problems" OR " communication and coordination challenges" OR " communication and coordination norms" OR " communication and coordination barriers" OR " communication and coordination risks") AND ("offshore software outsourcing" OR "information systems outsourcing" OR "IS outsourcing" OR "IT outsourcing" OR "global software development" OR GSD OR "offshore software development outsourcing" OR OSDO))

The major search string was developed and validated after thoroughly getting information and guidance from the trial search. Some digital libraries required different concrete syntax for the search term; we developed the

search string for each resource. In our study, we identify the paper based on the publication’s type, such as conference proceeding, databases, specific journals, technical magazines, book chapters, technical books, web pages and reports, etc. In Table I, we represent the final list of resources to be searched also including their search terms and number of publications found in each resource.

TABLE I DATA SOURCES AND SEARCH STRATEGY FOR PRACTICES/SOLUTIONS

S. NO	Resources	Total Results Found	Primary Selection	Final Selection
1	IEEE	1424	166	39
2	Science Direct	1055	82	7
3	ACM	925	114	2
4	Springer Link	347	80	10
5	Cite Seer	500	29	4
Total		4251	471	62

We have selected these resources based on our previous SLRs [5][20] experiences and discussions with our colleagues at the University.

B. Literature Selection

In this section, we are going to presents the criteria for inclusion and exclusion of relevant articles.

a. Inclusion criteria

We use the following inclusion criteria for the selection of relevant papers:

- The paper must be relevant to Computer Sciences or Engineering research background because quality research topics in software applications are keep growing from time to time.
- Priority usually goes to journal and conference published papers- that is why in our final selection the majority of papers are journal and conference papers.
- The papers should at least contain challenges, practices and solutions related to communication and coordination in OSDO relationships.
- The papers should contain communication or coordination practices/solutions affecting the continuation or termination of outsourcing relationships.
- Studies that is relevant to outsourcing.

b. Exclusion criteria

We use the following exclusion criteria to exclude the irrelevant papers:

- The papers not relevant to Computer Sciences or Engineering research background.

- The studies not relevant to the research questions.
- The papers that are not written in English.
- Studies not mentioned the challenges/ practices/ solutions of communication or coordination in OSDO relationships.
- Studies that contain duplicate data.
- Studies not relevant to outsourcing.

C. Publication Quality Assessment

The publication quality assessment is performed after final selection of publications. During the selection process of studies, some questions were asked to ensure the quality of selected studies. The questions in Table II were constructed to facilitate the studies selection process and to ensure that only relevant papers are being selected. The questions used in the study selection process are shown in the Table II.

TABLE II STUDY SELECTION PROCESS

Question	Answer
Is it clear how communication or coordination practices/solution was measured in OSDO relationship?	Yes/No/Partially
Is it clear how the practices in the selection of software outsourcing vendors were identified?	Yes/No/Partially

By using publication quality assessment questions, studies that are not scholarly reviewed were excluded. Only those studies are selected that aim practices at addressing communication and coordination challenges in OSDO relationships. Similarly, studies that did not provide persuasive results in practices for addressing communication and coordination challenges in the aspects of OSDO relationships were excluded.

D. Data Extraction and Synthesis

The following data was extracted from each publication: Date of review, Title, Authors, Reference, Database, Practices/Solutions: factors that have a positive impact on software development outsourcing vendors, Methodology (interview, case study, ordinary literature review, systematic literature review, report, survey, etc), Target Population, Sample Population, Publication Quality Description, Organization Type (software house, university, research institute etc), Company size (small, medium, large), Country/location of the Analysis and Year.

The data synthesis phase was done by the primary reviewer (the primary author) with the help of secondary reviewer (the co-author). After a thorough review with external reviewer, we have identified 65 practices/solutions from the sample of 62 papers for addressing communication and coordination challenges.

E. Classification of Communication and Coordination practices/solutions

After identifying practices/solutions for addressing communication and coordination challenging in OSDO relationships through SLR, we classified a few practices/solutions in different tables as shown in Section IV. The classification of practices/solutions was based upon the relevant practices/solutions for the identified critical challenges in our previous research [5]. The following criterion for the selection of critical challenges was used:

- Those challenges were considered as critical challenges whose frequency was equal to 40% or higher than 40%. The identified critical communication and coordination challenges are 'Geographical dispersion', 'cultural differences', 'language differences' 'lack of technological cohesion', 'Lack of Informal/Face-to-to face Communication' and 'Lack of Credence'.

IV. RESULTS

This section presents the results of the SLR process for finding the practices/solutions for addressing communication and coordination challenges faced by OSDO vendors.

We identified 65 mitigation advices/practices/solutions for addressing communication and coordination challenges faced to OSDO vendors. SLR has been conducted in the area of OSDO relationships for the identification of these practices. The OSDO vendor organizations can also get help from these practices in order to know that how they can solve the problems of their clients. We have followed SLR guidelines [17] for synthesizing the different practices for the identified critical communication and coordination challenges.

The subsequent sections present the 6 critical challenges and their respective identified practices.

A. Geographical Dispersion

Ali-Babar et al. [7] suggested that the main stumbling block to OSDO is the geographical dispersion. Table III presents the list of our identified 15 practices for addressing the communication and coordination challenge 'Geographical Dispersion'.

TABLE III PRACTICES FOR ADDRESSING GEOGRAPHICAL DISPERSION

CCCC1: Geographical Dispersion		
S/N O	Practices/Solutions for Addressing Geographical Dispersion	% of Practices via SLR (N=62)
1	Use of technology to make knowledge sharing easier between the teams. Such as, webcams and instant messaging software to improve communication and coordination between the team members distributed across multiple sites	50

2	Synchronous communication, such as face-to-face meetings, online chats, teleconferences, and web conferences, is ideal for quick status meetings, brainstorming sessions, and reviews. Asynchronous communication, such as email, discussion forums, and shared documents, provides a persistent record of discussions and decisions, and don't require participants to be available at the same time	47
3	Shifting the working hours of both the onshore and offshore teams, by adjusting direct meetings to the time zones or by creating asynchronous meetings via project managers.	23
4	Communicate with clients timely	23
5	Negotiate teams working hours for Synchronicity	21
6	Create a team calendar aiding in project planning	18
7	Encourage both asynchronous and synchronous communication	15
8	Establish communication guidelines, technical infrastructure for information and communication, for example, effective tools and work environments	15
9	Provides opportunities for synchronous interactions without prior schedule definition	15
10	Be online or stay connected	6
11	Assign technical lead to each site that would be responsible to coordinate process, development and schedule activities	3
12	Create bridging team	2
13	Create roles, relationships and rules to facilitate coordination and control over geographical, temporal and cultural distance	2
14	Promote visits and exchanges among sites	2
15	Utilize the global distribution to conduct tasks "over night", e.g. the test of new components so that the results are available on the following morning	2

B. Cultural Differences

Cultural differences is a critical challenge faced in the communication and coordination processes because it can slow down the OSDO activities [20].

TABLE IV PRACTICES FOR ADDRESSING CULTURAL DIFFERENCES

CCCC2: Cultural Differences		
S/N O	Practices/Solutions for Addressing Cultural Differences	% of Practices via SLR (N=62)
1	Establish open communication between stakeholders through face to face meetings, instant messaging and onsite visits	57
2	Use of online tools for online team-building if visits won't work	49
3	Arrange training and workshops to understand both client organization and people culture involved in OSDO	31
4	Define a cultural ambassador for the project to create teams with complementary skills and cultures	13
5	Create close cooperation between team members involved at both client and vendor side to built trust-worthy relationship	8
6	Build mixed teams with memberships from different cultural backgrounds.	7
7	Create roles, relationships and rules to facilitate coordination and control over geographical, temporal and cultural distance	7
8	Increase project members' domain knowledge and	5

	reduced cultural distance by using Agile Methods	
9	Introduce a neutral third-party Agile coach	5
10	Appoint strong leadership for each team	5
11	Make visible the work progress for all stakeholders	4
12	knowledge of the client’s language and culture	4
13	Take equality and justice approach in management activities.	2

Table IV presents the list of our identified 13 practices for addressing the communication and coordination challenge 'Cultural Differences'.

C. Lack of Credence

Several researchers [5][12][20] recommended that increased globalization of software development creates challenges due to cultural differences, time zone differences, lack of trust, language differences, geographical distance and diversity of communication and coordination.

TABLE V PRACTICES FOR ADDRESSING LACK OF CREDESCENCE

CCCC3: Lack of Credence		
S/N O	Practices/Solutions for Addressing Lack of Credence	% of Practices via SLR (N=62)
1	Investing in building and maintaining trust and good relations	30
2	Arrange frequent meetings in various forms such as video conferencing, personnel rotations, and team building exercises	21
3	Improve vendor’s capability such as technical, managerial, and staffing capabilities as this play a cardinal role in maintaining a client’s trust in an ongoing business relationship.	18
4	Improve personal relationship with clients	15
5	Promote efficient outsourcing relationship	13
6	Promote informal meetings	10
7	Effective and frequent communication between clients and vendors at all levels of the organizational hierarchy are pivotal for managing trust	10
8	Build efficient a contract and Conform to the contract and quality of deliverables	9
9	Spending resources on reducing socio-cultural distance by means of facilitating face-to-face meetings.	9
10	Implement the contract successfully is it was signed without cost overrun etc.	5
11	Have at least some people at each node who have met people at peer nodes in person. This also reduces the perceived geographical distance, if not the physical. This helps promote trust and reduce fear	4
12	Early and frequent delivery of working software	4
13	Travel to client location for establishing friendly ties	4
14	Use status (every three weeks) to signal transparency	4
15	Run series of workshops	2
16	Using Scrum practices in GSD improved communication, trust, motivation and product	2
17	Use Trusty, a tool which was designed to support the distributed software development process	2

Table V presents the list of our identified 17 practices for addressing the communication and coordination challenge 'Lack of Credence'.

D. Language Differences

The two major pillars and the back of OSDO relationships are the communication and coordination processes, but it is not properly achieved due to several challenges like geographical dispersion, culture, time zone and language differences [8].

TABLE VI PRACTICES FOR ADDRESSING LANGUAGE DIFFERENCES

CCCC4: Language Differences		
S/N O	Practices/Solutions for Addressing Language Differences	% of Practices via SLR (N=62)
1	Use of communication media to support a sense of co-located and synchronous interaction by employing facial expressions, body language, and speech	50
2	Understand the language and business culture of clients	12
3	Encourage face-to-face meetings	10
4	Select a vendor with knowledge of the client’s language	7
5	Review project document by a native speaker	4
6	Encourage team members to use standard language/common language in order to avoid mis-interpretation	2
7	Appoint team members having fluency in English language	2
8	Appoint language translator	2

Table VI presents the list of our identified 8 practices for addressing the communication and coordination challenge 'Language differences'.

E. Lack of Informal/Face-to-face Communication

Lack of face to face meetings is raised due to the parties being widely dispersed from each other, and hence it affect the process of OSDO [9]. Table VII presents the list of our identified 14 practices for addressing the communication and coordination challenge 'Lack of Informal/Face-to-face Communication'.

TABLE VII PRACTICES FOR ADDRESSING LACK OF INFORMAL/FACE-TO-FACE COMMUNICATION

CCCC5: Lack of Informal/Face-to-Face Communication		
S/N O	Practices/Solutions for Addressing Lack of Informal/Face-to-Face Communication	% of Practices via SLR (N=62)
1	Adopt appropriate communication tools like videoconferencing, Teleconferencing, Data Conferencing and Web-Based Technologies	52
2	Encourage frequent communication through latest technologies	50
3	Daily exchange of the project status by technologies such as, telephone calls, video conferences or emails etc	50
4	Create a Communication Protocol	15
5	Increase frequency of communication between team	15

	members	
6	Create team having technical skills and cultural awareness	10
7	Establish cooperation by to one member from each team. This might possibly solve some of the communication decencies, e.g., when decisions are made at informal meetings.	9
8	Arrange conferences/workshops for distributed team members	7
9	Build trustworthy relationship	7
10	Sponsor team members for site visits	4
11	Create a database that contains the areas of expertise of the individual project participants	4
12	Arrange weekly conference calls by the central team or the remote team(s) to talk about the status of the project and clarify questions, or they take place at dates specified in the project plan, usually to discuss deliverables	2
13	Use Distributed Agile models e.g. SCRUM	2
14	Use of tools such as 'Trusty' to support software development process	2

F. Lack of ICT/Technological Cohesion

Communication and coordination processes in OSDO relationships can be hampered due to high cost and lack of ICT [12].

TABLE VIII PRACTICES FOR ADDRESSING LACK OF ICT/TECHNOLOGICAL COHESION

CCCC6: Lack of ICT/Technological Cohesion		
S/N O	Practices/Solutions for Addressing Lack of ICT/Technological Cohesion	% of Practices via SLR (N=62)
1	Adopt Different Latest Technologies such as: Teleconferencing (two-way audio) e.g., NetMeeting, CU-SeeMe, Microsoft Exchange, Dropbox, Wikis, Mendeley etc. Videoconferencing (two-way audio and video) e.g., NetMeeting, CU-SeeMe, Microsoft Exchange, Dropbox, Wikis, Mendeley Data Conferencing (whiteboards, application sharing, data presentations) e.g., NetMeeting, Evoke, WebEx, etc. Web-Based Technologies Tools (Intranets, Listservs, Newsgroups, chat, message boards) e.g., E-groups, Yahoo Groups, Open Topics, etc. Proprietary (with or without web browser interface) e.g., Lotus Notes, IBM Workgroup, ICL Team WARE Office, Novell GroupWise, The Groove, etc. Voice over IP Electronic Meeting Systems e.g., Group Systems, Meeting Works, Team Focus, Vision Quest, Facilitate.com, etc.	52
2	Adopt both Asynchronous (text) and Synchronous (voice) tools like: Telephone, E-mail, Instant Messaging, Wiki, Internet, Voicemail, Shared Databases, Mailing lists, IRC, Messenger, Skype, Chat, Phone, Net meeting, Change Management System, Virtual white boards, Photo Gallery, Team Intranet Websites, Group Calendars, Fax, Power Point Presentations, Blog, Nor-real-time database, CAMEL, NEXT MOVE, TAMARI and Team space	50
3	Arrange ICT Training Sessions for the team members	10
4	Use of Web Technologies for Collaboration e.g.	5

	Web-based tutoring, web-based mentoring, web-based knowledge mining and web-based knowledge profiling	
5	Arrange Knowledge Sharing Activities between team members	5
6	Arrange social events for awareness between team members	5
7	Build Communication Protocol	4
8	Adopt Distributed Agile Models such as Distributed pair programming and Urgent request	4

Table VIII presents the list of our identified 8 practices for addressing the communication and coordination challenge 'Lack of ICT/Technological Cohesion'.

V. STUDY LIMITATIONS

By using the SLR process, we have extracted data about the practices/solutions for addressing communication and coordination challenges; however, we might have omitted some practices? For internal validity, one possible threat is that any specific article may have not in fact described underlying reasons to report practices/solutions for addressing these challenges. This threat has not been independently controlled by us. Other threat is publication bias during SLR process. By using our SLR process, we may have missed out some relevant papers, due to the increasing number of papers in software outsourcing. However, like other researchers of SLR, this is not a systematic omission [21].

How valid are our findings? The results of our finding are not based on studies that used a random sample of software developing outsourcing organization in the world. Yet, in the exploration of our research question, our study is the most comprehensive up to date. As discussed in result sections, the dilemma of simplifying our findings can also be measured by evaluating the finding of other related studies. To provide support for simplification, we found many similarities in our findings as compare to other people’s findings. In order to decrease the researcher’s bias, we have carried out the inter-rater reliability tests in the selection of primary studies and data extraction phases. Due to limited resources and not enough access to every digital library, we were unable to find out all the relevant papers in our area, although, the used digital libraries are sufficient for the simplification of findings in our study.

VI. CONCLUSION AND FUTURE WORK

In this paper, we have provided mitigation advice in the form of practices for addressing communication and coordination challenges from vendors' perspectives in OSDO relationships. Our results reveal that focusing on these practices can help vendor organizations in order to strengthen their relationships with client organizations in OSDO. However, we recommend independent studies on this topic in global software development. This will increase confidence in our results and also track changes in attitudes to OSDO activities over time. We have identified the

following goals that we plan to follow in future from the findings of this study:

- The practices/solutions for addressing communication and coordination challenges will be validated using empirical studies with practitioners working in outsourcing industries, as done by other researchers [22][23].
- The practices/solutions in OSDO relationships from client's perspectives will be analyzed.

Our future work will focus on developing a Communication Coordination Challenges Mitigation Model (CCCMM). This paper gives only one component of the CCCMM, such as the identification of various practices/solutions for addressing communication and coordination challenges via SLR. The proposed CCCMM will bring together and advance the work that has been undertaken on frameworks and models for outsourcing relationships.

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