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Research Article

Empirical Exploration of Communication and Coordination Practices in Offshore Software Development Outsourcing

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Abstract: Offshore software development outsourcing (OSDO) has become an increasingly popular Global Software Engineering (GSE) paradigm for companies to rely the permanent improvement and tailoring with lower cost, in order to develop high quality software more efficiently. However, OSDO is not out of risks and software development organizations face various challenges like geographical dispersion, cultural and language differences, communication and coordination challenges and lack of ICTs etc. A research survey was conducted in OSDO industry to explore different communication and coordination challenges and its mitigation in OSDO relationships. Data were collected through questionnaire survey from 42 experts relevant to outsourcing companies. Our findings reveal that cultural differences, geographical dispersion, language differences, lack of ICT/technological cohesion, lack of credence and lack of informal/face-to-face communication are the critical challenges faced by OSDO vendors in communication and coordination process with their client organizations in outsourcing relationships. We have also identified a total of 75 practices in order to mitigate these critical challenges. The understanding of these challenges and its practices will assist OSDO vendors in order to successfully plan and manage communication and coordination activities in OSDO relationship with their clients.

Keywords: Offshore software development outsourcing, communication and coordination, challenges, practices, empirical study

1. INTRODUCTION

Software development is increasingly heading in the direction of combining software development practices and outsourcing software development to external vendors worldwide and become a popular paradigm of Global Software Engineering [1, 2]. Over the last two decades many software development companies are trying to boost their business profits by improving the time-to-market of their products, reducing costs by hiring people from countries with cheaper work-hours and defying the "clock" by running the projects during 24 hours. By this way in different countries a large number of software development projects performed at globally distributed sites. This distributed setting, across the globe, of managing a software project is termed as Global Software Development (GSD) [3]. Global Software Development is gaining rapid reputation due to a number of advantages it offers to both clients and vendors. These include geographically closer to the end-consumer, advantage of competition, access to global resource pools and opportunities for vendors in new markets [4, 5]. Global Software Development is highly dynamic environment and bears a number of different paradigms. These include outsourcing, partnership, crowd sourcing, freelancing, subsidiary establishment etc [6]. Outsourcing is an important and fast growing paradigm of GSD [7]. Offshore Software Development Outsourcing can be defined as a contractual relationship between vendor and client organizations in which one or more vendors can get contracts of all or part of the clients' software development activities, and the vendors provide agreed services in return for payment [8]. The main reasons behind the drastic growth of OSDO are round the clock development and access to high qualified skilled persons, high quality

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software production at low cost and the availability of the latest Information and Communication Technologies (ICTs) [8-10].

Apart from the numerous benefits, OSDO also encompasses several challenges like diversity of communication and coordination, geographical dispersion, cultural differences, lack of trust, language differences, time zone differences and lack of ICT/technological cohesion [8, 10-13]. Khan and Khan [8, 14] conducted systematic literature review and found that the most critical challenge in OSDO is the geographical dispersion. Because some of this dispersion the controlling and supervision the software development activities at the same time is quite difficult [15]. Verner et al. [10] found that vendor's poor infrastructure, instability, lack of intellectual property rights, incompatibility with clients and opportunistic behaviour can also makes hurdles in OSDO activities. Software development process risks like asymmetry in processes, policies and standards, collaboration difficulties, limited tools and resources, poor communication bandwidth and large team size effect GSD [10, 16]. Alam and Khan [17] conducted SLR and found that time zone, social-cultural and geographical distances can hamper communication and coordination processes, it needs to be overcome in order to strengthen OSDO activities. Khan and Azeem [12] also conducted SLR and found that cultural differences is a critical challenge in OSDO relationships because it can affect communication processes.

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.

Avritzer et al. [18] 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 [14]. The problems of cultural differences can also be mitigated by adapting agile and scrum methods [19, 20]. 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 [14, 21].

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 [10]. 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 [22].

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 [23]. 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 [10, 24-26].

In OSDO relationships several researchers [27] found different types of critical challenges faced by vendor organizations. Amongst these identified challenges, communication and coordination has been reported as the critical challenge in OSDO relationship. The key motivation of this research is that to further elaborate the communication and coordination challenges in OSDO relationships and to find its

practices. From the literature we have suggested that most of the outsourcing projects have been failed due to poor communication and coordination between vendor and client organizations [10, 12, 27, 28]. It is argued that proper communication and coordination between vendor and client organizations are the backbone and two major pillars of the outsourcing relationship [28-30].

This paper presents the communication and coordination challenges and also it practices for addressing these challenges, through empirical study. The development of Communication and Coordination Challenges Mitigation Model (CCCMM) for OSDO vendors is the final and future goal of this research project. The model will assist OSDO vendors in identifying, analyzing and mitigating the communication and coordination challenges by providing solutions.

The focus of this paper is on the following research questions:

RQ1. What communication and coordination challenges, as identified in the real-world, faced by vendors in offshore software development outsourcing relationships?

RQ2. What are the practices/solutions for addressing communication and coordination challenges faced by vendors in offshore software development outsourcing relationships, as identified in the real-world?

2. BACKGROUND

Communication and coordination activities are important to be addressed for successful outcomes of OSDO relationship. Effectiveness in OSDO relationship can occur when communication and coordination process are enhanced between client and vendor organizations. The literature has shed some light on the importance of communication and coordination in OSDO, which is discussed as follow:

Cultural bias may lead to erroneous decision and insecurity about other participants' qualification and it can have a devastating impact on communication, coordination and collaboration efforts [12, 31, 32]. Geographical dispersion can make hurdles in face-to-face communication, increases complexity of planning and coordination activities, causes unproductive waits, delays feedback, makes multisite virtual meetings hard to plan and complicates simple things [8, 32]. The lack of media richness in ICT communications in outsourced software projects can lead to miss-communications and team members may have more difficulty in establishing trust-rooted relationships [33]. Problems such as lack of a common frame of reference, time delays, language differences and language understanding make frequent and uninterrupted communication among offshore software development teams difficult [34]. Nonverbal communication, which is an important component of team communication, is usually missing in OSDO teams because our current technology is able to convey only a limited set of perceptual cues [34].

The four fundamental coordination challenges such as increased coordination cost, reduced informal contact, inconsistent work practices and reduced cooperation arising from misunderstanding create problems in coordination activities in OSDO relationships [35]. Lack of trust and confidential problems affect the relationship of communication and coordination and would bring about many potential problems in GSD process [36]. The lack of informal communication results in lower awareness and poor coordination [37].

The literature reveals that most of the outsourcing projects have been failed due to poor communication and coordination between vendor and client organizations [8, 10, 11, 28]. It is argued that proper communication and coordination between vendor and client organizations are the backbone and two major pillars of the outsourcing relationship [28-30]. There is increasing interest in studying and applying GSD activities. Much has been published on GSD communication and coordination processes. There is a need to systematically review and synthesize the literature on GSD communication and coordination challenges and its practices. Using the systematic literature review (SLR) approach, we have identified 17 communication and coordination challenges faced to OSDO vendors [8]. We have also found, a total of 75 practices/solutions in order to mitigate these challenges [14].

The intent of this paper to empirically validate the findings of communication and coordination challenges faced to OSDO vendors and its practices through industry practitioners and to find

any new challenge or practice apart from the identified ones. The findings of this research serve as a resource for OSDO practitioners and researchers when setting future research priorities and directions. Previously, no empirical study has been performed on this topic. Research in this area is expected to provide useful information for OSDO vendor organizations.

3. RESEARCH METHODOLOGY

The study takes the form of a survey and uses questionnaires for data collection. Survey research is considered particularly suitable method for gathering self-reported quantitative and qualitative data [38]. A similar approach has been used by other researchers [39-41]. In this section, we describe the data collection, the approach taken for the selection of participants, the questionnaire procedures and the data analysis strategy.

3.1 Data Collection

Since the goal of the study is to explore the experiences and opinions of industry practitioners in the context of OSDO relationships, it can be considered primarily as being qualitative in nature. Qualitative research focuses on investigating and understanding social and cultural phenomena in context [42] and is appropriate where the purpose is to explore a topic and obtain an overview of a complex area [43]. Questionnaire survey is particularly suitable for collecting qualitative data because, they provide the opportunity for discussion or exploration of new topics that arise during data collection. Questionnaires allow for considerable freedom in the sequencing of questions and in the amount of time and attention given to each topic. Questions can be open-ended, allowing for a variety of responses. This approach to data collection helps to reduce the risk of bias relating to the researchers preconceptions and it allows for the use of elaboration probes to encourage the participant to keep talking about a particular subject [44].

3.1.1 Questions

Questions driving the questionnaire were grouped into five categories as shown in Table 1.

3.1.2 Selection of Participants

The questionnaire distribution process was performed by writing an invitation letter containing short summary of the research and was posted to the following websites.

1. LinkedIn Groups (www.linkedin.com)
2. Software Companies at Pakistan
3. We also invited for participations the authors of the industry papers selected through the SLR; emails were available in the published papers.

From this invitation a total of 110 participants showed their willingness and the questionnaire link. Finally we received 48 completed questionnaires. After applying the quality criteria six questionnaires were dropped. So our total sample became 42, among these responses 36 participants are in the vicinity and 6 participants from overseas.

3.2 Questionnaire Procedures

Questionnaires were carried out between November and December 2014. Prior to Questionnaire, each participant was sent questionnaire invitation letter. This letter outlined the main themes to be covered during the questionnaire, the expected duration, and measures which would be taken to ensure privacy and confidentiality. All questionnaires were communicated online, using the Google Docs free online tool.

3.3 Data Analysis Strategy

We sent the questionnaire's link to 110 participants upon receiving their consents. Amongst these 48 participants filled the online questionnaire. Out of these 48 responses, we have dropped down 6 responses because the participants were not directly relevant. Therefore the final sample size is reduced to 42 responses. Thus we got the response rate of 38.18% in the survey. These 42 completed questionnaires were further analyzed based on different variables as shown in the next session.

4. RESULTS

Table 2 presents a list of communication and coordination challenges identified through empirical study, in order to answer RQ1.

In the questionnaire different participants have selected different options on the 7-point Likert scale suggestion for each of the listed

communication and coordination challenge. For analysis, we have categorized their responses into three categories as shown in Table 2. First category is Optimistic (Extremely Agree + Moderately Agree + Slightly Agree). Second category is Pessimistic (Extremely Disagree + Moderately Disagree + Slightly Disagree). Third category is Impartial (Neither Optimistic nor Pessimistic).

All the challenges have greater than 70% in optimistic list (Table 2). Cultural differences and Geographical dispersion among the identified list, i.e., 98% are the most common challenges in communication and coordination to outsourcing vendor organizations.

This validated the findings of the literature as reported below:

- Offshore software developing outsourcing companies face many challenges like cultural differences, geographical dispersion in the communication and coordination process [12].
- The essential elements in GSD projects are the communication and collaboration among OSDO developers with distinct cultural backgrounds and geographical separation [45].

Among the identified list, another challenge Haziness (uncertainty) i.e., 93% is the third ranked challenge for OSDO vendor organizations. This in turn supports the findings of the literature which is reported as:

- Requirement uncertainty is a peculiar challenge for coordination mechanism in GSD project implementation [46].

Our findings also represents that language differences' i.e., 88%, lack of informal/face-to-face communication, i.e., 88%, incongruity in infrastructure, processes and goals i.e., 88% and lack of knowledge management and transfer among teams i.e., 88%, are the fourth common challenges which affects the OSDO vendors. These empirical results complement the findings of the literature which is reported as follows:

- Language understanding and language differences can negatively impact communication among OSDO team members [34].
- Lack of informal/face-to-face communication negatively impacts relationship building, social integration of teams, scheduling, task assignment and cost estimation in the GSD environment [10].

We also found that both increased coordination cost i.e., 85%, and lack of common understanding of requirements, i.e., 85% are the fifth significant communication and coordination challenge to OSDO vendor's organization. The literature reveals these challenges as:

- Increased coordination cost becomes more problematic in GSD environments as a result of volatile requirement diversity and lack of informal communication [10].
- Lack of common understanding of requirements can also negatively impact the OSDO organizations [8].

In the pessimistic and impartial category no one of the challenges got a frequency greater than 24%. This suggests that all the participants of survey were completely sure about the role and importance of these challenges in OSDO relationships from vendor's perspectives.

4.1 Practices for Addressing Critical Communication and Coordination Challenges

After identifying communication and coordination challenging in OSDO relationships through systematic literature review [8], we classified few challenges as critical challenges. The classification of critical challenges is based upon the criteria, such as: those challenges are considered as critical challenges whose frequency equal to 40 or higher than 40 [8]. The identified critical challenges are geographical dispersion – 79%, cultural differences – 74%, language differences – 59% and lack of technological cohesion – 53%, lack of Informal/face-to-face communication – 46 and lack of Credence - 40% [8]. In order to answer research question 2, Table 3-8 present the practices/solutions for addressing these critical communication and coordination challenges. In the following tables CCCC represent critical communication and coordination challenge.

4.1.1 Geographical Dispersion

Ali-Babar et al. [15] suggested that the main stumbling block to OSDO is the geographical dispersion. In Table 3 we present the practices for addressing the communication and coordination challenge Geographical Dispersion.

4.1.2 Cultural Differences

Khan and Azeem [12] identified that culture difference is a critical challenge in OSDO, because it negatively affect the process of OSDO. In Table

Table 1. Questions grouped by topic.

Group Name	Question Type						
Company Size	Small, Medium, Large						
Company Type	National, Multinational, Both						
Experts' Job Location	Local, Foreign						
Levels of Expert Experience	Level-1, Level-2, Level-3						
Communication and Coordination Challenges and Its Practices	Extremely Agree	Moderately Agree	Slightly Agree	Not Sure	Extremely Disagree	Moderately Disagree	Slightly Disagree

Table 2. Summary of communication and coordination challenges identified through empirical Study.

S. No.	Challenges	Total Expert Responses = 42									
		Optimistic				Pessimistic				Impartial	
		Extremely Agree	Moderately Agree	Slightly Agree	Optimistic%	Extremely Disagree	Moderately Disagree	Slightly Disagree	Pessimistic%	Not sure	%
1	Cultural Differences	20	11	10	98	0	0	0	0	1	2
2	Geographical Dispersion	17	16	8	98	1	0	0	2	0	0
3	Haziness	4	12	23	93	0	0	1	2	2	5
4	Increased Coordination Cost	7	20	9	85	1	0	1	5	4	10
5	Incongruity in Infrastructure, Processes and Goals	3	12	22	88	0	2	0	5	3	7
6	Inappropriate Task Coupling	3	11	21	83	0	2	2	10	3	7
7	Language Differences	13	17	7	88	2	2	0	10	1	2
8	Lack of Team Cohesion	5	13	16	80	2	1	1	10	4	10
9	Lack of Knowledge Management and Transfer among Teams	6	11	20	88	0	1	0	2	4	10
10	Lack of Informal/ Face-To-Face Communication	26	7	4	88	0	1	1	5	3	7
11	Lack of Common Understanding of Requirements	7	17	12	86	0	1	0	2	5	13
12	Lack of Training in Communication and Collaboration Tools	14	13	6	79	1	1	3	12	4	10
13	Lack of Credence	4	15	11	71	1	0	1	5	10	24
14	Lack of Change Management Activities	2	9	20	73	2	2	0	10	7	17
15	Lack of Frequent Feedback	7	17	8	76	3	1	0	10	6	14
16	Legal, Political and Intellectual Property Rights Issues	8	19	4	73	3	2	1	15	5	12
17	Lack of ICT/Technological Cohesion	11	13	9	78	0	0	1	2	8	20
18	Lack of Antagonism Management Activities	2	6	22	71	0	2	1	7	9	22

Table 3. Practices for addressing geographical dispersion.

CCCC1: Geographical Dispersion		
Practice No.	**Practices/Solutions for Addressing Geographical Dispersion**	**% of Practices via Empirical Study (N=42)**
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	95
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	93
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.	88
4	Communicate with clients timely	88
5	Negotiate teams working hours for Synchronicity	91
6	Create a team calendar aiding in project planning	93
7	Encourage both asynchronous and synchronous communication	98
8	Establish communication guidelines, technical infrastructure for information and communication, for example, effective tools and work environments	95
9	Provides opportunities for synchronous interactions without prior schedule definition	81
10	Be online or stay connected	81
11	Assign technical lead to each site that would be responsible to coordinate process, development and schedule activities	98
12	Create bridging team	83
13	Create roles, relationships and rules to facilitate coordination and control over geographical, temporal and cultural distance	88
14	Promote visits and exchanges among sites	91
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	83

Table 4. Practices for addressing cultural differences.

CCCC2: Cultural Differences		
Practice No.	**Practices/Solutions for Addressing Cultural Differences**	**% of Practices via Empirical Study (N=42)**
1	Establish open communication between stakeholders through face to face meetings, instant messaging and onsite visits	95
2	Use of online tools for online team-building if visits won't work	95
3	Arrange training and workshops to understand both client organization and people culture involved in OSDO	86
4	Define a cultural ambassador for the project to create teams with complementary skills and cultures	95
5	Create close cooperation between team members involved at both client and vendor side to built trust-worthy relationship	95
6	Build mixed teams with memberships from different cultural backgrounds.	93
7	Create roles, relationships and rules to facilitate coordination and control over geographical, temporal and cultural distance	88
8	Increase project members' domain knowledge and reduce cultural distance by using Agile Methods	81
9	Introduce a neutral third-party Agile coach	81
10	Appoint strong leadership for each team	98
11	Make visible the work progress for all stakeholders	88
12	knowledge of the client's language and culture	88
13	Take equality and justice approach in management activities.	88

Table 5. Practices for addressing Lack of credence.

CCCC3: Lack of Credence		
Practice No.	**Practices/Solutions for Addressing Lack of Credence**	**% of Practices via Empirical Study (N=42)**
1	Investing in building and maintaining trust and good relations	93
2	Arrange frequent meetings in various forms such as video conferencing, personnel rotations, and team building exercises	91
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.	91
4	Improve personal relationship with clients	100
5	Promote efficient outsourcing relationship	93
6	Promote informal meetings	91
7	Effective and frequent communication between clients and vendors at all levels of the organizational hierarchy are pivotal for managing trust	91
8	Build efficient a contract and Conform to the contract and quality of deliverables	91
9	Spending resources on reducing socio-cultural distance by means of facilitating face-to-face meetings.	88
10	Implement the contract successfully is it was signed without cost overrun etc.	81
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	88
12	Early and frequent delivery of working software	81
13	Travel to client location for establishing friendly ties	93
14	Use status (every three weeks) to signal transparency	91
15	Run series of workshops	83
16	Using Scrum practices in GSD improved communication, trust, motivation and product	71
17	Use Trusty, a tool which was designed to support the distributed software development process	88

Table 6. Practices for addressing language differences.

CCCC4: Language Differences		
Practice No.	**Practices/Solutions for Addressing Language Differences**	**% of Practices via Empirical Study (N=42)**
1	Use of communication media to support a sense of co-located and synchronous interaction by employing facial expressions, body language, and speech	95
2	Understand the language and business culture of clients	93
3	Encourage face-to-face meetings	93
4	Select a vendor with knowledge of the client's language	83
5	Review project document by a native speaker	81
6	Encourage team members to use standard language/common language in order to avoid miss-interpretation	93
7	Appoint team members having fluency in English language	86
8	Appoint language translation	83

Table 7. Practices for addressing lack of informal/face-to-face communication.

CCCC5: Lack of Informal/Face-to-face Communication		
Practice No.	**Practices/Solutions for Addressing Lack of Informal/Face-to-face Communication**	**% of Practices via Empirical Study (N=42)**
1	Adopt appropriate communication tools like videoconferencing, Teleconferencing, Data Conferencing and Web-Based Technologies	95
2	Encourage frequent communication through latest technologies	91
3	Daily exchange of the project status by technologies such as, telephone calls, video conferences or emails etc	95
4	Create a Communication Protocol	91
5	Increase frequency of communication between team members	93
6	Create team having technical skills and cultural awareness	93
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.	88
8	Arrange conferences/workshops for distributed team members	91
9	Build trustworthy relationship	91
10	Sponsor team members for site visits	86
11	Create a database that contains the areas of expertise of the individual project participants	86
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	91
13	Use Distributed Agile models e.g. SCRUM	86
14	Use of tools such as 'Trusty' to support software development process	86

Table 8. Practices for addressing lack of ICT/technological cohesion.

CCCC6: Lack of ICT/Technological Cohesion		
Practice No.	**Practices/Solutions for Addressing Lack of ICT/Technological Cohesion**	**% of Practices via Empirical Study (N=42)**
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.	98
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	93
3	Arrange ICT Training Sessions for the team members	91
4	Use of Web Technologies for Collaboration e.g. Web-based tutoring, web-based mentoring, web-based knowledge mining and web-based knowledge profiling	86
5	Arrange Knowledge Sharing Activities between team members	95
6	Arrange social events for awareness between team members	93
7	Build Communication Protocol	88
8	Adopt Distributed Agile Models such as Distributed pair programming and Urgent request	91

4 we present the practices for addressing the communication and coordination challenge Cultural Differences.

4.1.3 Lack of Credence

Several researchers [8, 10, 12, 13, 15] 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. In Table 5 we present the practices for addressing the communication and coordination challenge Lack of Credence.

4.1.4 Language Differences

Communication plus coordination are the backbone and two major pillars of software outsourcing, but it is negatively affected due to geographical dispersion, time zone differences, cultural differences and language differences [28-30]. In Table 6 we present the practices for addressing the communication and coordination challenge Language differences.

4.1.5 Lack of Informal/Face-to-face Communication

Lack of face to face meeting is raised due to the parties are widely dispersed from each other, and hence it affect the process of OSDO [47]. In Table 7 we present the practices for addressing the communication and coordination challenge Lack of Informal/Face-to-face Communication.

4.1.6 Lack of ICT/Technological Cohesion

High cost and lack factors of ICT can hamper the communication and coordination process in offshore software outsourcing [10, 33]. In Table 8 we present the practices for addressing the communication and coordination challenge Lack of ICT/Technological Cohesion.

5. DISCUSSION AND SUMMARY

We have identified, through empirical study, 18 communication and coordination challenges and 75 practices for addressing critical challenges in total faced by OSDO vendor organizations in outsourcing relationships. Our findings represent some basic consideration for software outsourcing organization. To develop better OSDO idea and plan, the communication and coordination challenges and its practices presents some basic key areas which need management's attention and awareness. The OSDO vendor organization can also get help from these findings in order to know that what their clients actually want.

In order to answer RQ1, we identified 18 communication and coordination challenges in total, through empirical study, faced by vendors in OSDO relationships. Out of these eleven challenges have occurrences of greater than or equal to 80% as shown in Table 2. These eleven most cited communication and coordination challenges are: cultural differences, geographical dispersion, haziness, increased coordination cost, incongruity in infrastructure, processes and goals, inappropriate task coupling, language differences, lack of team cohesion, lack of knowledge management and transfer among teams, lack of informal/face-to-face communication and lack of common understanding of requirements.

We have identified 75 practices/solutions for addressing communication and coordination challenges faced to OSDO vendors, through systematic literature review (SLR) [14]. After identifying practices/solutions for addressing communication and coordination challenges in OSDO relationships through SLR, we have validated these practices/solutions through empirical study in outsourcing industries. The OSDO vendor organizations can also get help from these practices in order to know that how can they solve the problems of their clients.

We have found 15 practices for addressing the geographical dispersion challenge. From the Table 3 we have identified through both SLR and empirical study that most suitable practices/solutions for addressing geographical dispersion are the following two practices (% ≥ 47):

i. 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.

ii. 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.

For addressing the cultural differences challenge our SLR and empirical study finds 13 practices. Table 4 noted that cultural differences can be best avoid by follow the following two practices (% ≥ 49):

i. Establish open communication between stakeholders through face to face meetings, instant messaging and onsite visits.

ii. Use of online tools for online team-building if visits won't work.

For addressing the lack of credence challenges our SLR and empirical study finds out 17 practices. Table 5 noted that lack of credence can be best avoid by follow this practice (% ≥ 30):

- Investing in building and maintaining trust and good relations.

We have found 8 practices for addressing language differences challenge through both SLR and empirical study. From the Table 6 we have noted that most suitable practice/solution (% ≥ 50) for addressing lack of language is:

- Use of communication media to support a sense of co-located and synchronous interaction by employing facial expressions, body language, and speech.

For addressing the lack of informal/face-to-face communication challenges our SLR and empirical study finds out 14 practices. Table 7 noted that lack of this challenge can be best avoid by follow the following three practices (% ≥ 50):

i. Adopt appropriate communication tools like videoconferencing, Teleconferencing, Data Conferencing and Web-Based Technologies.

   We have found this practice in 32 papers symbolize 52 %.

ii. Encourage frequent communication through latest technologies.

   We have found this practice in 31 papers symbolize 50 %.

iii. Daily exchange of the project status by technologies such as, telephone calls, video conferences or emails, etc.

Table 8 represents 8 practices for addressing lack of ICT/Technological cohesion challenge. From the table 10 we noted through both SLR and empirical study that most suitable practices/solutions for addressing geographical dispersion are the following two practices (% ≥ 47):

i. 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 etc. 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.

ii. 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.

6. STUDY LIMITATIONS

In this section, the threats of validity concerning the empirical study have been discussed. Our total OSDO respondents in the online survey are 42, in which 6 participated from abroad and 36 participants are local/Pakistani nationals. For better results, we should have to involve more foreigners OSDO participants but due to limited resources and time it was not possible at this stage. Further we have utilized all the available resources to approach international experts by sending requests for participation through different LinkedIn software outsourcing groups. However,

their participation was based on voluntary basis. Due to the limited number of respondents from abroad, one should be careful while generalizing the results.

However, we have full confidence in our results because these findings complement the findings of our systematic literature review (SLR) [8, 11, 14]. There is no major difference between the finding of the SLR and the empirical study. This may lead towards bridging the gap between the opinions of the academicians and industry practitioners in the context of software outsourcing.

7. CONCLUSIONS AND FUTURE WORK

We have identified 18 communication and coordination challenges in total, through empirical study, faced by vendors in OSDO relationships. Out of these eleven challenges have occurrences of greater than or equal to 80% as shown in Table 2. These eleven most cited communication and coordination challenges are cultural differences, geographical dispersion, haziness, increased coordination cost, incongruity in infrastructure, processes and goals, inappropriate task coupling, language differences, lack of team cohesion, lack of knowledge management and transfer among teams, lack of informal/face-to-face communication and lack of common understanding of requirements. Our results reveal that focusing on these challenges and its practices can help vendor organizations in order to strengthen their relationships with their client organizations in OSDO relationship. Overall these findings complement the findings of our SLRs [8, 11, 14]. There is no major difference between the findings of the SLR and the empirical study. This may lead towards bridging the gap between the opinions of the academicians and industry practitioners in the context of software outsourcing.

Our results suggest that OSDO vendors should focus on all of the identified challenges and practices as mentioned in Table 3-8.

The final and future focus on to develop a Communication and Coordination Challenges Mitigation Model (CCCMM) for OSDO vendors. In this paper we have only represent one component of the CCCMM, such as the identification of communication and coordination challenges and its practices through empirical study. The model will assist OSDO vendors in identifying, analyzing and mitigating the communication and coordination challenges in outsourcing relationship.

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