Effects of Geographical, Socio-cultural and Temporal Distances on Communication in Global Software Development during Requirements Change Management
A Pilot Study

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Abstract: Trend of software development is changing rapidly most of the software development organizations are trying to globalize their activities throughout the world. This trend leads towards a phenomenon called Global Software Development (GSD).The main reason behind the software globalization is its various benefits. Besides these benefits, software organizations are facing various challenges. One of these challenges is communication which is considered a big challenge in GSD and it becomes more complicated during the Requirements Change Management (RCM) process due to three factors, they are Geographical, Socio-cultural and Temporal distances. This paper presents a framework which shows the effect of these factors on communication during RCM process in GSD. Communication is the core function of collaboration which allows information to be exchanged between the team members. A pilot study has been conducted in three GSD organizations. A quantitative research method has been used to collect data. The findings from the survey data show that these three factors have a strong negative impact on communication process in GSD.

1 INTRODUCTION

Global Software Development (GSD) or Global Software Engineering (GSE) is the development of software projects consisting of teams working together to accomplish project goals from various geographical locations (Biffl and Halling, 2003; Helena et al., 2006; Šmite et al., 2008). About a decade ago, different experiments have done in order to develop the software projects at geographically distributed locations. Most of the organizations try to find solutions around the world and GSD appears to be a good option in such an environment (Rafael et al., 2006). The acceptance of the GSD process is to get the business benefits and competitive advantages. Software companies are distributing their work globally in order to get benefits such as low cost, good productivity, access to skilled work forces and access to market (Khan et al., 2012).

Along with benefits, most of the studies have discussed some issues related to the distribution of work and the constraints associated with it (Helena et al., 2006; Khan et al., 2012; Khan et al., 2011). In these studies, constraints such as geographical distance, socio-cultural distance and temporal distance are recognized, and they indeed increase the scope of an organizational operation (Sahay, 2003), but there is a little doubt that these constraints challenge communication, coordination and control in GSD (Da Silva et al., 2010; Herbsleb and Mockus, 2003).

In GSD, requirements continuously change during the software development life cycle. It is very difficult to manage the changed requirements due to certain communication and coordination challenges. Communication is one of the major issues during requirements change management in GSD due to geographical, socio-cultural and temporal distances (Casey and Richardson, 2008; Huang and Trauth, 2007).

The objective of this study is to identify the negative effect of factors geographical distance, socio-cultural distance and temporal distance on

communication. During literature review it is observed that no study has been done to explore the effect of factors on communication during RCM process. In this study a self-questionnaire pilot survey in the Pakistani GSD industry is conducted. Based on survey in three GSD organizations, the effect of geographical, socio-cultural and temporal distances on communication is explored in this study.

2 BACKGROUND STUDY

Software development is generally defined as "any software development lifecycle activity" (Holmstrom et al., 2006). The term "activity" refers to a human action taken specifically for a purpose either individually or collectively at any stage during the production of software life cycle. A "development activity" refers to either separate or combined action that brings a meaningful change in software system's lifecycle (Cottmeyer, 2008; Herbsleb, 2007). The development of a software system may involve multiple teams coordinating at various degrees in order to produce the resultant product. Based on the involvement of development teams, the software development is divided into types of Collocated and Global Software Development (GSD) (Conchuir, 2009). In Collocated software development the development activities take place on single site. In this type of software development, the single sites do not distribute the development activities on multiple sites (Damian, 2007). However the development process GSD OR Geographically Distributed Software Development is restricted by geographical, cultural and temporal limits (Smite et al., 2008). In geographically distributed software development, missions are accomplished by the joint efforts of the group of people that belong to different geographical locations. Software development companies are looking forward to GSD because of its well-recognized and known benefits that comprise low cost, high ratio of productivity, access to skilful work force and access to market etc. (Herbsleb and Mockus, 2003).

However, GSD also faces different challenges (Da Silva et al., 2010 ; Herbsleb and Mockus, 2003). Some of the researchers found the poor communication is the key issue that cause global software projects to fail (Bass et al., 2009; Herbsleb, 2007). Communication is the core function used to exchange the information between the team members (Shujian, 2012). In GSD the

communication challenge generally occur when team members are geographically, socio-culturally and temporally apart from each other (Hofner and Mani, 2007; Korkala and Abrahamsson, 2007).

The key objective of this research work is to observe the negative effects of geographical, socio-cultural and temporal distances on communication process in the context of GSD. For this purpose a framework as shown in Figure.1 is proposed that could explain the effect of the above three factors on communication. The proposed framework is empirically evaluated in GSD industry using the questionnaire survey approach.

The major terms used in this research study is explained in the following sections:

2.1 Requirements Change Management

The software product requirements in software engineering are considered to be fixed which gives a wrong idea to the management team and make them to stop the requirements before the project is initiated (Zhu et al., 2008). Contrary to this traditional principle software, requirements continuously change from requirements gathering to the maintenance phase of development life cycle. The factors like change in user needs, government policies and technologies cause the requirements to change (Ramzan and Ikram, 2006). According to (Zhu et al., 2008), change in requirements behaves as a main driver for software maintenance and re-engineering activities.

The process used to manage those changes is called Requirements Change Management (RCM) and is one of the most thoughtful happening which produces many problems in distributed environment (Hussain and Clear, 2012). Requirements Change Management (RCM) is a process which decides whether a requested change should be implemented or not. It faces hindrances when performed globally due to different challenges faces by communication process (Hussain and Clear, 2012).

These challenges are mainly distributed as geographical distance, socio-cultural distance and temporal distance. These factors make communication a major issue during RCM process (Casey and Richardson, 2008; Huang and Trauth, 2007; Moe and Šmite, 2008).

The main reason to focus on RCM is that requirements change during all phases of software development life cycle and various communication issues make it even harder to manage (Hussain and Clear, 2012). As discussed before, requirements

change from start to the end of development life cycle and the management of these requirements is crucial job in GSD (Ramzan and Ikram, 2006). Therefore it's become important to address the communication issue during RCM process.

In this article a framework has been propose to exhibit the effect of geographical, socio-cultural and temporal distances on communication during RCM. The proposed framework is based on the available literature that has been categorized into geographical distance, socio-cultural distance and temporal distance as shown in Figure.1.

2.2 Geographical Distance

Geographical distance is the effort required for one team member to visit another and it shows the physical separation between the system development team members (Holmström et al., 2006). Geographical distance causes hindrance during communication of one team member with another (Holmstrom et al., 2006). Two sites within the same country with regular flights can be considered close even if separated by a huge distance, but different sites which have little transportation and perhaps intervening borders cannot be geographically close. Furthermore, even two actors within the same building but separated by long corridors and many levels will be impacted by geographical distance (Agerfalk et al., 2005).

Geographical distance has a direct effect on communication in GSD. When the geographical distance increases communication decreases and a huge geographical distance leads to miscommunication ((Da Silva et al., 2010). So, based on the relationship among geographical distance and communication, we propose the following hypothesis.

H1: Geographical distance has a negative effect on communication.

2.3 Socio-cultural Distance

In GSD, socio-cultural distance is a measure of an actor understanding of another actor's values and normative practices (Winkler et al., 2008). Culture can have a strong effect on how people discuss certain issues, and how they react to them (Winkler et al., 2008). Cultural distance involves national culture, organizational background, language, policies, and moral principles (Helena et al., 2006)

In GSD, people from different national and organizational backgrounds are involved which may lead to misunderstanding and miscommunication

(Conchuir, 2009). Generally socio-cultural distance relates to the geographical distance between the actors. Due to the small geographical distance the actors may also experience cultural distance which can negatively affect the communication process (Damian, 2006). Based on the above discussion we propose the following hypothesis

H2: Socio-cultural distance has a negative effect on communication.

2.4 Temporal Distance

Temporal distance is the measure of the time difference experienced by two actors wishing to communicate (Holmstrom et al., 2006). Temporal distance is the result of different factors including two actors located at two different time zones ((Agerfalk et al., 2005). Geographical distance causes the temporal distance among the different actors who want to communicate. Temporal distance interrupts the communication process among team members due to less time overlapping (Shahzad, 2011). Due to the relationship between temporal distance and communication, we propose the following hypothesis

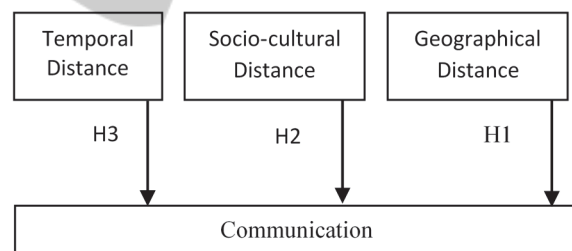*H3: Temporal distance has a negative effect on communication.*

Figure 1: Proposed Framework for Factors Affecting Communication in GSD.

3 RESEARCH METHODOLOGY

In this study the influence of geographical, socio-cultural and temporal distances on communication in GSD during RCM have been investigated. The survey questionnaire used for this research focused on the following information:

- Demographic profile (in terms of respondent gender, position, education, experience, organization and nature of projects developed).
- Effect of geographical, socio-cultural and temporal distances on communication during RCM in GSD.

The steps used for this research study were a background study, survey instrument development, conducting of a survey and data analysis (Liao and Shi, 2009). The objectives were based on existing literature discussed in section 2. For survey study the questionnaire was designed and the piloting was performed in order to refine the survey instrument. The survey questionnaire sample is exhibited on the given link (http://goo.gl/forms/e7f8NfBpdV). The questionnaire was distributed among team members of three GSD organizations in Islamabad (Pakistan) and data was collected using a self-administrated questioner (Gunasekaran and Ngai, 2008). These three organizations were randomly selected from the website of Pakistan Software Export Board (www.pseb.org.pk). The selected GSD organizations were visited with an approval letter declaring the objectives of our research for conducting the survey. A total of 53 responses were collected, 12 responses were incomplete and other 41 responses were analyzed. For the data analysis, statistical package for social sciences (SPSS version-19) is used.

4 RESULTS

4.1 Demographic Profile of Respondents

Brislin in (Brislin et al., 1973) discussed the significance of detailed information on a sample of descriptive statistics, in which the information could provide close view of respondents and companies which are deemed to interpret more significant results.

From the selected three organizations a total of 53 responses were collected in which 41 responses were usable. The respondents shown in Table 1 include 65.8% male and 34.2% female.

Table 1 also discussed the job position and education level of the respondents. According to the analysis most of the respondents were developers followed by analysts with 36.5% and 19.5% respectively. Other job positions were designer, team manager, tester and CEO representing 14.8%, 12.3%, 7.3% and 4.9% of overall respondents respectively.

The knowledge of the respondents can be determined by analyzing their education level. In this research out of 41 respondents, 23 have bachelor degree which presents 56.1%; subsequently 12 and 5 respondents have diploma and postgraduate, presenting 29.2% and 12.2% respectively. Just one respondent has been a high school certificate holder,

representing 2.5% as shown in Table 1. Results from the analysis show that the respondents were well educated and well positioned. This shows the significance of the collected survey data.

The context of this research is GSD industry. It is important to investigate the working experience of employees in GSD. In this study the highest working experience in GSD industries ranged from 1 to 5 years representing 75.6% and the second highest value is less than year representing 12.1%. The remaining respondents have working experience ranged from 6 to 10 years and 11 to 15 years presenting 9.8% and 2.5% respectively. The overall statistics show that most of the respondents have experience in the range from 1-5. This shows that generally the respondents were well experienced in the GSD industry.

Table 1: Summary on Respondent's Demographics.

	Respondents	Frequency	%
Gender	Male	27	65.8
	Female	14	34.2
Total		41	100.0
Position	Developer	15	36.5
	Analyst	8	19.5
	Designer	6	14.8
	Team Manager	7	12.3
	Tester	3	7.3
	CEO	2	4.9
Total		41	100.0
Education	Bachelor	23	56.1
	Diploma	12	29.2
	Postgraduate	5	12.2
	High School	1	2.5
Total		41	100.0
Working Experience	1-5	31	75.6
	Less than year	5	12.1
	6-10	4	9.8
	11-15	1	2.5
Total		41	100.0

4.2 Organizations Profile

It is important to inspect the complete background of companies where research survey was conducted (Rea and Parker, 2012). It is vital to investigate the geographical nature of selected GSD organizations.

In this study the GSD industries were the focus of research. For confidential reasons we are not permitted to discuss the names of the selected organizations. The selected three organizations are tagged as Companies X,Y,Z.

Company X is a leading IT distributer company provding end to end business solutions to the enterprise and mid market sector.The main office of

Table 2: Organizations Profile.

Company X	
Distributed Sites	3
Development Methodology	Agile
Type of Global Software Development	Offshore Insourcing
Time difference between Pakistan and UAE	1 hour
Time difference between India and UAE	1.5 hours
Time difference between India and Pakistan	½ Hour
National languages	Arabic, Hindi, Urdu
Company Y	
Distributed Sites	2
Development Methodology	Agile
Type of Global Software Development	Offshore Outsourcing
Time difference between Pakistan and US	12 hours
National languages	English, Urdu
Company Z	
Distributed Sites	2
Development Methodology	Scrum
Type of Global Software Development	Offshore Outsourcing
Time difference between Pakistan and Denmark	8 Hours
National languages	Danish, Urdu

company A is located in UAE. The two site branches are in India and Pakistan. The company is working in GSD environment since 2007. The complete detail of Company X is discussed in Table 2.

Company Y is US based distributed software development organization and working on system development for law firms, management and marketing firms and information technology consultants since 2006. Company Y consist of US headquarter office and other site branch located in Pakistan. Table 2 gives the thorough detail of Company Y.

The headquarter of Company Z is located in Denmark and started distributed software development for the last six years. The other branch of Company C is in Pakistan. The main focus of Company C is on digital signage systems. Table 2 listed the distributed characteristics of Company C.

4.3 Reliability Analysis of Survey Data

Reliability analysis technique is used to check the reliability of the data collected from respondents. According to (Ahire et al., 2007) there are four methods for testing the reliability, namely the test-retest method, alternative form method, split-halves method, and the internal consistency method. The internal consistency method is utilized in this study for estimating the reliability between the observed variables of interest. The internal consistency method is chosen because it requires only one administration of the survey instrument and is commonly used in empirical research. It shows the

internal consistency of data items as a group and is used in various forms to test empirical data (Santos, 1999). In this research the Cronbach Alpha test has been used to analyze the reliability of the data (Santos, 1999). According to (Joreskog et al., 1989), 0.70 is an acceptable Alpha reliability value. Hence Alpha reliability was set to 0.70 as an acceptable reliability. The results of the Alpha Reliability are shown in Table 3.

The first variable was the geographical distance having four items and the reliability score 0.766 Alpha. The second variable was the socio-cultural distance with four items and the Alpha score was 0.777. The last independent variable was the temporal distance having four items and the Alpha score was 0.823. Alpha value for dependent variable (communication) is 0.783. The alpha values of the variables was greater (>0.70) (Joreskog et al., 1989), so all of these variables were reliable for the data analysis.

Table 3: Reliability Analysis.

Variables	Number of Items	Cronbach's Alpha
Geographical Distance	4	0.766
Socio-Cultural Distance	4	0.777
Temporal Distance	4	0.823
Communication	3	0.783

4.4 Hypothesis Testing

In this section we have shown the hypotheses results

and also discuss the analysis of the results. A major tools used for hypothesis testing is Regression analysis (Weisberg, 2014). Regression analysis has been used to analyse the relationship between at least two variables (i.e., At least one independent and one dependent variable) (Weisberg, 2014).

Before presenting the results of regression analysis it is important to present the interpretation for various correlation and regression coefficients, based on which the strength, direction and impact of a relationship can be determined. The values of R, R-square and P (significance) value have been used to analyse the results.

The value of R showed the strength of the relationship. It ranged from +1 to -1. A value of R which closer to '+1' shows a strong positive correlation, whereas a value of R closer to '0' shows a weaker or no correlation and the same time a value of R below '0' gives a negative correlation (Sweet and Grace-Martin, 2011). The positive or negative signs with the value show the direction of the relationship among the independent and dependent variables. For example a positive sign shows that if one is increased then the other will also increases. The value of R-square indicates the percentage of variance in the dependent variable caused by the independent variable. At the same time value of P shows the significance of the relationship. If P-Value is less than 0.05, then we can consider that the relationship is significant (Sweet and Grace-Martin, 2011).

The proposed framework has been investigated through the multiple regression analysis and the relationship of the dependent and independent variables has been analyzed. Based on the proposed framework, the relationship of geographical distance, socio-cultural distance, temporal distance and communication has been analyzed.

Table 4: Model Summary of the Proposed Framework.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.815a	0.664	0.655	0.773
a.	Predictors: (Constant), Geographical Distance, Socio-cultural distance, Temporal Distance			

The above Table 4 shows that the value of R is 0.815; this indicates a strong correlation among the predictors (geographical distance, socio-cultural distance, temporal distance) with communication. The value of R Square shows the variance in the dependent variable (Communication) which can be predicted by independent variables (Geographical distance, Socio-cultural distance, Temporal

distance). As shown in Table 4, the value of R Square is 0.664, indicating that a 66.4% variation in communication can be predicted by independent variables (geographical distance, socio-cultural distance, temporal distance).

Based on the Table 5 results the relationship of each variable and significance has been explained one by one based on their hypothesis statement which is given below:

- H1: Geographical distance has a negative effect on communication.

Table 5 shows the results of the geographical distance having a beta value of -0.718. This shows a negative influence of the geographical distance for communication and also the value of P (significance) is 0.000 which is less than 0.05. This specifies that there is a significant relationship between the geographical distance and the dependent variable communication. This also implies that there is sufficient evidence to conclude that the geographical distance is significantly related to communication. Based on the above discussion hypothesis (H1) is supported in this research.

- H2: Socio-cultural distance has a negative effect on communication.

Hypothesis (H2) shows relationship among socio-cultural distance and communication. In Table 5 independent variable socio-cultural distance has a beta value of -0.245. This shows a negative relationship of socio-cultural distance and communication. Table 5 also shows another important value, P (significance) which is 0.000 and less than 0.05. This result implies that socio-cultural distance is significantly related to communication. Based on the above discussion we can conclude that socio-cultural distance and communication have negative and significant relationship. This indicates that hypothesis (H2) is supported in this study.

- H3: Temporal distance has a negative effect on communication.

To study the relationship between the temporal distance and communication the beta value is -0.120. This also shows a negative influence of the temporal distance for the communication. The value of P (significance) is 0.011 which is less than 0.05. This shows that there is a negative and significant relationship among the temporal distance and communication. Based on the above evidence, hypothesis (H3) is supported in this research.

4.5 Discussion

This section is about the discussion of the hypothesis

Table 5: Model Summary of the Proposed Framework.

Model	Un-Standardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-1.184	0.325		-3.643	0.000
Geographical Distance	0.734	0.047	-0.718	15.466	0.000
Socio-Cultural Distance	0.326	0.064	-0.245	5.094	0.000
Temporal Distance	0.210	0.082	-0.120	0.557	0.011
a. Dependent Variable: Communication					

results obtained from the data analysis. We will discuss each hypothesis under the results discussed in section 4.4.

- H1: Geographical distance has a negative effect on communication.

Geographical distance is one of the main factors that affect communication in GSD. The results of this hypothesis were presented in section 4.4. The beta value obtained from geographical distance was -0.718, which shows that the geographical distance has a negative influence over communication process. Meanwhile, the value of P (Sig) was obtained as 0.000 (p<0.05), which shows that the relationship between geographical distance and communication is significant.

It shows that geographical distance can negatively affect the communication process between team members. It implies that there is sufficient evidence to conclude that as much geographical distance increases between the team members, the level of communication will decreases.

- H2: Socio-cultural distance has a negative effect on communication.

In GSD people may be coming from different cultural backgrounds and they have their own cultural styles (Sahay and Walsham, 1997). Variations in culture styles can create misunderstanding among distributed sites which can cause the damage of communication process (Imsland et al., 2003). In this case, the results of hypothesis 2 (H2) have been presented in section 4.4. The beta value obtained for socio-cultural distance was -0.245, showing a negative influence of socio-cultural distance over communication. Other key value was P (Sig). The P (sig) value was obtained as 0.00 (p<0.05), this shows a significant relationship between socio-cultural distance and communication. The above results come to be the evidence about the presence of a negative and significant relationship between socio-cultural distance and communication. This respectively shows that cultural distance among dispersed team members can negatively affect the communication

process in GSD. This hypothesis was also proved and supported as an influence factor in communication adopted by various studies of researchers (Sahay and Walsham, 1997) in different domains.

- H3: Temporal distance has a negative effect on communication.

Temporal distance is actually the reducing of overlapping hours between distributed sites (Casey and Richardson, 2008). Less time overlapping is challenging and problematic matter for GSD industry. Sometime dispersed team members try to develop something very quickly than delay in response become an immense problem due to the temporal distance (Noll et al., 2010). In this case, the results of hypothesis 3 (H3) have been presented in section 4.4, where the beta value obtained for temporal distance was -0.120 and values of P (sig) was 0.011 (P<0.05). It is showing a negative and significant relationship between temporal distance and communication. Hence the hypothesis 3 (H3) is supported.

The above results come to be the evidence about the presence of a negative and significant relationship between temporal distance and communication. Similar findings have been proved and supported by various studies of researchers in other domains. For example in (Damian et al., 2007; Helena et al., 2006) the authors stated that as a result of temporal distance the team members may unable to find track of the overall developing process and it can be a serious problem in GSD. The study here confirms this as an issue. Based on the above discussion about results, the summary of all the hypothesis results have been presented in Table 6.

4.6 Final Proposed Framework

An attempt has been made in this study to develop a framework that consolidates relevant factors that have been categorized as geographical distance, socio-cultural distance and temporal distance. The framework has been applied in GSD industries of

Table 6: Summary of Hypothesis results.

S. No	Hypothesis No	Independent Variables	Dependent Variables	Results
1	H1	Geographical Distance	Communication	Supported
2	H2	Socio-Cultural Distance	Communication	Supported
3	H3	Temporal Distance	Communication	Supported

Pakistan to validate the hypothesis of the proposed framework. Based on aforementioned discussions, three hypotheses were highlighted separately to examine the relationship of independent and the dependent variables. It has been found that all the three hypotheses have been supported. Therefore, the final proposed framework is given below in Figure 2.
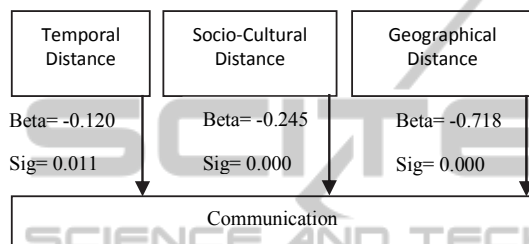

Figure 2: Final Proposed Framework.

The above framework has three independent variables namely geographical distance, socio-cultural distance and temporal distance. A multiple regression analysis was conducted to evaluate the each independent variable relationship with the dependent variable. The results of Beta for independent variables geographical distance, socio-cultural distance and temporal distance was obtained as -0.718, -0.245 and -0.120 respectively. Similarly the significance score of the independent variables geographical distance, socio-cultural distance and temporal distance was 0.000, 0.000 and 0.011 respectively. This indicated that these three variables have a negative and significant correlation with communication.

Based on the above framework discussion, it can be concluded that the communication process depends on three vital factors, geographical distance, socio-cultural distance and temporal distance. As the effect of these factors increases the communication process will be negatively affected.

5 THREATS TO VALIDITY

Threats to validity are possible risks that could come up throughout the planning and execution phases of the empirical research studies (Wohlin et al., 2012). The identification and alleviation of these risks are crucial activities that involve a lot of effort from researchers (Neto and Conte, 2013). According to (Biffl and Halling, 2003) every empirical study address threats to validity. These threats must be determined and tackled (Biffl and Halling, 2003).

There are several threats towards the design of this study. During literature review phase most of the data was collected by a single researcher. Though we tried to alleviate this threat by observing any unclear problems and discuss them together still there exist a higher risk that a single researcher could be biased and continually extract the wrong data. For the future we will try to have at least two reviewers for each research article.

The context used for survey data collection was limited to single country. In extending of this work we should consider more GSD organizations in different other countries. This would give a chance to collect more data with big sample size, which could allow well and more thorough statistical analysis as well as could cover more GSD organizations in different countries.

In the current study we have defined three key factors that could negatively affect the communication process. Therefore there is clear threat to the validity of the framework in the sense of additional factors that might affect the communication process. The results of this study can be used in order to identify additional factors from literature and industry.

6 CONCLUSIONS

In this study communication during the requirements change management process in GSD has been assessed on the bases of three key factors geographical, socio-cultural and temporal distances. The negative effect of these factors on communication has been examined. In this study a framework was proposed to examine the relationship among dependent variables and the independent variables. The findings from the survey data shows that geographical distance, socio-cultural distance and temporal distance have negative and significant relationship with communication. This indicates that with a high geographical distance, socio-cultural distance and temporal distance among distributed

team members, the level of communication will be decreases. To the best of the knowledge of the authors this study is the one attempted to investigate the impact of factors on communication process for the first time through literature survey and state of the practice (industrial study) during requirements change management process.

7 FUTURE WORK

The results from this exploratory study can be used for future research in the GSD area in relation to communication during requirements change management. Following topics can be potential future of this study.

- In future the proposed framework of this study can be tested with a bigger sample size.
- For future research it is important to identify the mitigation practices which could alleviate the effect of the identified factors.
- For future research study it is vital to identify additional factors that can affect the communication process.

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REFERENCES

Agerfalk, P. J., Fitzgerald, B., Holmstrom Olsson, H., Lings, B., Lundell, B., & Ó Conchúir, E. 2005. A framework for considering opportunities and threats in distributed software development, In Proceedings of the International Workshop on Distributed Software Development (Paris, Aug. 29, 2005).Austrian Computer Society, 47–61.

Ahire, S. L., Golhar, D. Y., & Waller, M. A. 2007. Development and validation of TQM implementation constructs. Journal of Decision Sciences, 27(1), 23-56.

Bass, M., Herbsleb, J. D., & Lescher, C. 2009. A Coordination Risk Analysis Method for Multi-site Projects: Experience Report. Paper presented at the Fourth IEEE International Conference on Global Software Engineering, ICGSE, 2009.

Biffl, S., & Halling, M. 2003. Investigating the defect detection effectiveness and cost benefit of nominal inspection teams. IEEE Transactions on Software Engineering, , 29(5), 385-397.

Brislin, R. W., Lonner, W. J., & Thorndike, R. M. 1973. Cross-cultural research methods: J. Wiley.

Casey, V., & Richardson, I. 2008. Virtual teams: understanding the impact of fear. Software Process: Improvement and Practice, 13(6), 511-526. doi: 10.1002/spip.404

Cottmeyer, M. 2008. The Good and Bad of Agile Offshore Development. Paper presented at international conference on Agile, 2008. AGILE '08.

Da Silva, F. Q. B., Costa, C., Fran, A. C. C., & Prikladinicki, R. 2010. Challenges and Solutions in Distributed Software Development Project Management: A Systematic Literature Review. Paper presented at the 5th IEEE International Conference on Global Software Engineering (ICGSE), 2010

Damian, D. 2006. Requirements Engineering in Distributed Projects. Paper presented at the Proceedings of the IEEE international conference on Global Software Engineering.

Damian, D. 2007. Stakeholders in Global Requirements Engineering: Lessons Learned from Practice. IEEE, Software, 24(2), 21-27. doi: 10.1109/ms.2007.55

Damian, D., Izquierdo, L., Singer, J., & Kwan, I. 2007 Awareness in the Wild: Why Communication Breakdowns Occur. Paper presented at the Second IEEE International Conference on Global Software Engineering (ICGSE), 2007.

E. Conchuir, O. H., H. Olsson, P. Agerfalk, B. Fitzgerald. 2009. Benefits of global software development: exploring the unexplored. Software Process: Improvement and Practice, 14(5), 301-301. doi: 10.1002/spip.444

Gunasekaran, A., & Ngai, E. W. 2008. Adoption of e-procurement in Hong Kong: an empirical research. International Journal of Production Economics, 113(1), 159-175.

Helena, H., Eoin, O. C., Par, J. A., & Brian, F. 2006. Global Software Development Challenges: A Case Study on Temporal, Geographical and Socio-Cultural Distance. Paper presented at the International Conference on Global Software Engineering, ICGSE, 2006.

Herbsleb, J. D. 2007. Global Software Engineering: The Future of Socio-technical Coordination. Paper presented at the Future of Software Engineering, FOSE, 2007.

Herbsleb, J. D., & Mockus, A. 2003. An empirical study of speed and communication in globally distributed software development. IEEE Transactions on Software Engineering, 29(6), 481-494.

Hofner, G., & Mani, V. S. 2007. TAPER: A generic framework for establishing an offshore development center. Paper presented at the Second IEEE International Conference on Global Software Engineering (ICGSE) 2007.

Holmström, H., Fitzgerald, B., Ågerfalk, P. J., & Conchúir, E. Ó. 2006. Agile Practices Reduce Distance in Global Software Development.

Information Systems Management, 23(3), 7-18.

Huang, H., & Trauth, E. M. 2007. Cultural influences and globally distributed information systems development: experiences from Chinese IT professionals. Paper presented at the Proceedings of the ACM SIGMIS CPR conference on Computer personnel research: The global information technology workforce, St. Louis, Missouri, USA.

Hussain, W., & Clear, T. 2012. GRCM: A Model for Global Requirements Change Management, presented in 2nd International Requirements Engineering Efficiency Workshop (REEW 2012).

Imsland, V., Sahay, S., & Wartiainen, Y. 2003. Key issues in Managing a Global Software Outsourcing relationship between a Norwegian and Russian firm: Some Practical Implications. 26th Information Systems Research Seminar in Scandinavia Finland

Joreskog, K. G., Sorbom, D., & Jhoreskog, K. 1989. LISREL 7 user's reference guide: Scientific Software Mooresville, IN.

Khan, A. A., Basri, S., & Dominic, P. D. D. 2012. A proposed framework for requirement Change Management in Global Software Development. Paper presented at the International conference on Computer & Information Science (ICCIS), 2012

Khan, A. A., Basri, S., Dominic, P. D. D., & Fazal-e-Amin. 2012. A process model for Requirements Change Management in collocated software development. Paper presented at the IEEE Symposium on E-Learning, E-Management and E-Services (IS3e), 2012.

Khan, S. U., Niazi, M., & Ahmad, R. 2011. Factors influencing clients in the selection of offshore software outsourcing vendors: An exploratory study using a systematic literature review. Journal of Systems and Software, 84(4), 686-699. doi: 10.1016/j.jss.2010.12.010

Korkala, M., & Abrahamsson, P. 2007. Communication in Distributed Agile Development: A Case Study. Paper presented at the 33rd EUROMICRO Conference on Software Engineering and Advanced Applications. .

Liao, Z., & Shi, X. 2009. Consumer perceptions of internet-based e-retailing: an empirical research in Hong Kong. Journal of Services Marketing, 23(1), 24-30.

Moe, N. B., & Šmite, D. 2008. Understanding a lack of trust in Global Software Teams: a multiple-case study. Software Process: Improvement and Practice, 13(3), 217-231. doi: 10.1002/spip.378

Neto, A. A., & Conte, T. 2013. A conceptual model to address threats to validity in controlled experiments. Paper presented at the Proceedings of the 17th International Conference on Evaluation and Assessment in Software Engineering.

Noll, J., Beecham, S., & Richardson, I. 2010. Global software development and collaboration: barriers and solutions. ACM Inroads, 1(3), 66-78.

Rafael, P., Jorge Luis Nicolas, A., & Roberto, E. 2006. A Reference Model for Global Software Development: Findings from a Case Study. Paper presented at

International Conference on the Global Software Engineering, ICGSE '06.

Ramzan, S., & Ikram, N. 2006. Requirement Change Management Process Models: Activities, Artifacts and Roles. Paper presented at the IEEE Multitopic Conference, INMIC, 2006.

Rea, L. M., & Parker, R. A. 2012. Designing and conducting survey research: A comprehensive guide: Jossey-Bass.

Sahay, S. (2003). Global software alliances: the challenge of 'standardization'. Scandinavian Journal of Information Systems, 15(1), 3-21.

Sahay, S., & Walsham, G. 1997. Social structure and managerial agency in India. Organization Studies, 18(3), 415-444.

Santos, J. R. A. 1999. Cronbach's alpha: A tool for assessing the reliability of scales. Journal of Extension, 37(2), 1-5.

Shahzad, F. 2011. Communication Challenges in Success of Offshore Software Development. International Journal of Reviews in Computing, 8(31st of decemebr 2011).

Shujian, W. 2012. Overview of communication in global software development process. Paper presented at the IEEE International Conference on Service Operations and Logistics, and Informatics (SOLI), 2012.

Šmite, D., Moe, N., & Torkar, R. 2008. Pitfalls in Remote Team Coordination: Lessons Learned from a Case Study Product-Focused Software Process Improvement (Vol. 5089, pp. 345-359): Springer Berlin Heidelberg.

Smite, D., Wohlin, C., Feldt, R., & Gorschek, T. 2008. Reporting Empirical Research in Global Software Engineering: A Classification Scheme. Paper presented at the IEEE International Conference on Global Software Engineering, ICGSE, 2008.

Sweet, S. A., & Grace-Martin, K. 2011. Data Analysis with Spss + Mysearchlab With Etext: A First Course in Applied Statistics: Pearson College Division.

Weisberg, S. 2014. Applied linear regression: John Wiley & Sons.

Winkler, J. K., Dibbern, J., & Heinzl, A. 2008. The impact of cultural differences in offshore outsourcing Case study results from German–Indian application development projects. Information Systems Frontiers, 10(2), 243-258.

Wohlin, C., Runeson, P., Höst, M., Ohlsson, M. C., Regnell, B., & Wesslén, A. 2012. Experimentation in software engineering: Springer.

Zhu, J., Liang, Y., & Gu, Y. 2008. The Requirements Change Analysis for Different Level Users. Paper presented at the International Symposium on Intelligent Information Technology Application Workshops, 2008. IITAW '08.