

How to Overcome Communication Barriers in Global Software Development?

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ABSTRACT

This research study was conducted to identify team-level coordination issues and to make strategies that help in overcoming these hurdles between Global Software Engineering (GSE) teams. In GSE projects, a steady flow of communication and coordination between the team members is required throughout the project. Communication and coordination make top in the list of challenges currently faced by GSE projects. Geographically dispersed teams members often face lack of coordination problems because of minimal communication. In GSE, teams coordinate on different level from requirement engineering (RE) phase to project deployment phase. Our main focus in this research was achieving coordination between dispersed GSE teams of requirements engineers, software designers and software developer.

Keywords: **Global Software Engineering, barriers in GSE, Communication barriers, GSE.**

1 INTRODUCTION

In GSE environments, geographically distributed software engineers practice software engineering principles while working on a project. The adaptation of GSE environments is increasing with the increasing trend in outsourcing IT services. Moreover, as more open source projects hit the web, the trend of distributed software developers working together strengthens up. Diversity of talent pool and lower development cost are the main reasons for selecting GSE environments [1]. The diverse and dispersed talent also brings challenges like cultural issues, time-zone differences for teams working on GSE projects [2]. These challenges directly affect the communication layer between teams. In co-located projects, an efficient communication channel is essential for project success and it bears even more importance in GSE projects. Informal and ad-hoc interaction plays an important role in effective coordination [4]. It is usually not enough to make the necessary coordination only through defined processes and well-defined system. The opportunity to have discussions over lunch or during a coffee break might help people to get critical information that was missed earlier. People usually feel comfortable to express their point of view in informal atmosphere. Lack of good communication channels is a major cause of failure and issues such as cost overruns schedule slippage, and quality problems.

In GSE projects often different teams are formed for different tasks. Some of the common teams in GSE projects are requirement engineering teams, designing teams, development teams and testing

teams. In case of commercial projects, the project usually starts from elicitation of the requirements from the customer. In case of open source projects, software engineers have a meeting at the start of the project for requirement elicitation and clarification. The coordination between teams is a necessity for GSE project from the start.

2 PROBLEM AND BACKGROUND

The problem arises in GSE when teams start to lack the ability to coordinate and collaborate with other teams. Good coordination and collaboration helps in forming high cohesive teams for projects. In GSE, team members are often distributed and experience issues like lack of trust, understanding due to cultural, language barriers. The coordination has wider meaning in GSE environments. It is not just exchanging of information to and fro. It is about building trust level, confidence and responsibility in teams working in GSE [3]. The teams formulated in GSE are often not familiar with other teams working on the same project. So teams take time to understand and build trust level. Often a team that has priority over some skills takes control over communication channel which eventually leads towards low level of coordination. So to minimize such type of scenarios, it is important to identify issues and make appropriate strategies to handle them in GSE environment.

3 RELATED WORK

As communication and coordination are the foremost important factors in GSE environments, so there has

been already good amount of research conducted on these topics. Lanubile, F presented collaboration tools currently used in GSE projects so that the teams stick together and achieve desired goals [5]. He argued about tools like version control systems, bug trackers and project management tools and defines their typical usage in GSE projects. Klein, H. proposed a process based collaboration model for GSE projects [6]. The model was based on structured approach and explains a simple scenario of two teams working together. But the model can be expanded to any number of teams.

Lopez, A, Nicolas, J and Toval, A. had research regarding specifically the collaboration problems in RE process of GSE projects [7]. They conducted a literature review and came up with a repository structure that gathers risks in RE process in GSE projects. This repository is used to store all the information of RE process like requirement change management, and prioritized requirements. Santhosh N. Murthy did a research about a classical GSD project environment, the client-vendor offshore-outsourcing relationship [8]. He came up with the success factors and best practices in such structure that can address various RE challenges.

4 RESEARCH QUESTIONS

Following research questions were formulated to address the coordination issues among different team levels in GSE. The questions were structured to first identify coordination problems and then proposing strategies to increase the coordination in teams.

- **RQ1:** What are the challenges in collaboration and coordination among different team levels in global Software engineering?
- **RQ2:** How to improve the coordination mechanism among different team levels in global software engineering?
- **RQ3:** What suggestions can help to solve the problems in communication in global software engineering?

5 RESEACRH METHODOLOGY

The research methodology selected for the topic is mixed i.e. qualitative and quantitative. Systematic Literature Review Interpretation of Findings Industrial Survey Experiments based on proposed strategies about different issues and problems that various other companies face in distributed environment [10]. First we conducted qualitative research by performing systematic literature review about the topic. Then we moved towards survey for collection of data. With the help of SLE and survey results, we quantified our data and proposed a strategy that can overcome identified problems.

6 QUALITATIVE RESEARCH METHOD

Qualitative part of research design deals with systematic literature review that highlight the key challenges of GSD in the area of collaboration and

coordination over distance [16].

Other research techniques like survey or case study involves the studies to specific context and scope only limited to a few companies as a result we cannot draw a complete picture about different issues and problems that various other companies face in distributed environment [10].

7 SYSTEMATIC LITERATURE REVIEW

Systematic literature study is considered as a secondary study but contribution of individuals in distinct fashion makes it primary study. In primary phase we followed the guidelines by Barbara Kitchenham [9] that helped us to gather and accommodate the related research to find empirical evidences focusing on risks and safeguards faced at team-level coordination and collaboration in Global Software engineering.

8 KEYWORDS

Initially, we used general keywords such as global software engineering, team coordination, distributed teams etc. to get related studies. A plethora of articles were observed by against each mentioned keyword. Many of amongst them were irrelevant to our topic. We refined keywords by

extracting keywords from abstract, conclusion, controlled and uncontrolled keywords form mentioned in different articles and their meta information stored in different databases for removing ambiguity and to get relevant articles. Finally the refined keywords were 'Global Software Engineering', 'distributed teams', 'coordination', 'collaboration', 'process' and 'methods'.

9 SEARCH STRINGS

The final search strings based on the pilot searches and containing Boolean expressions were:-

- (Global software engineering And Challenges)
- ((achieve coordination) AND ((methods) OR (communication tools) OR (processes)) AND
- (global software Engineering) AND (distributed team))
- Solutions for Global Software Engineering challenge
- (Global Software Engineering AND collaboration)

10 SEARCH STRATEGY

To search credible research studies (papers/articles), we selected following online well-reputed resources amongst researchers, to attain the objectives of systematic literature review in accordance with the quality and authentic articles.

- Inspec
- IEEE Xplore Articles
- ACM Digital Library
- EI Compendex (Ei Village 2)

- SpringerLink

GSE evolved as the internet-era emerged, so apparently articles published before 2004-2005 were not included in the search. The search results from selected databases are mentioned in **Appendix B**.

11 Inclusion/Exclusion Criteria

We developed a specific criterion for inclusion and exclusion of the articles. There were a few guidelines that were followed in inclusion/exclusion of articles.

11.1 Inclusion / Exclusion Criteria

- Articles contained data concerning to problems and their solutions of coordination in global software engineering, were included.
- Articles presenting model, case studies, survey, systematic literature review, empirical studies, experiment etc. about the concerned topic.
- Papers, cited and cross-reviewed by other researchers.
- Articles that comes with full-text to the reader.

11.2 Exclusion Criteria

- Duplicate articles were excluded.
- Articles that don't allow readers to read full-text.
- Papers other than the English language were neglected.
- We excluded all those articles that were not meeting the above mentioned inclusion criteria.

12 SYNTHESIS AND CONCLUSION

This section summarizes the details to gather results acquired from primary studies. Chosen articles were based upon different distinct research methodologies, containing issues and risks involved in the coordination of global software engineering, conducting different case studies, surveys and interviews to understand the problem domain. Some articles, suggesting solutions to overcome the coordination problems by highlighting issues in general like time zone, language barriers and cultural differences amongst different distributed team in global software engineering but still limited to some specific solutions by focusing on communication and coordination problems in different tools and processes.

12.1 Findings from literature

An analysis based on systematic literature review in GSE area is presented as different team level issues and the nature of issues that they face in the distributed settings. These issues can be highlighted in terms of communication tools, processes, methods that teams like requirement, development, and testing teams experience while working globally. A GSE team experience various challenges while aligning with their concerned distributed teams in accordance with time zone, culture and language

differences and specially the technology been used at various team levels between sites. Most of the research in GSE field was conducted with the collaboration of different universities around the globe. Some studies were addressed by performing surveys and case studies in the industry.

13 Survey

Survey is one of the information gathering techniques in form of observations from the people by their attitude, behavior and their comments. Mostly surveys are used to over look complex problems [17]. Surveys consist of questionnaires and results in turn can be experienced in term of observations directly from people working in a specific environment. Surveys should have been conducted by following the proper procedure. There are certain steps that need to be taken in order to conduct survey [17].

13.1 Research Objectives

The main purpose of performing this survey was to get people's opinion working in Global software engineering industry and faces issues in the collaboration and coordination among different team levels i.e. requirement engineering team, designing team and development team level. This survey helped us to understand the current issues that an industry is facing in collaboration and coordination while working globally. The survey was consist of some questions addressing the issues that can easily be understandable by the respondent audience.

13.1.1 Identification of Target Audience:

In our survey the target audience was IT industry dealing with the out sourcing projects. More specifically the survey was for those people who are working in the different teams i.e. development team, requirement engineering team, designing team and testing team located at different places.

This was a web based survey as the target audience belongs to IT industry and had an easy access to internet services.

13.1.2 Sampling plan design

We selected three IT companies with good reputation in global software engineering. Two companies (Digital spinner and Soft solutions) were selected from Pakistan and one company (Edixen solutions) was selected from Sweden. We selected two members from each team i.e. requirement team, designing team, development team and testing team from each companies. The selection of participants of survey was based on the experience. The selected people have more than four years working experience. We had total 24 participants in order to respond the questionnaires.

13.1.3 Design and Questionnaire Preparation

Designing a questionnaire is an important step in order to conduct an effective survey [17]. The questionnaire should be easy and understandable by the respondent audience. We designed the questionnaire after the discussion with the managers and team leaders of the selected companies. We kept in mind the working knowledge of audience and the issues regarding the collaboration among different teams in designing a questionnaire. The designing of questionnaire was based on the issues in the communication and collaboration within the team and with other teams and their effect on the performance of working teams. We followed the likert scale [18] in order to collect data and observation from survey. There were five options to answer each question, so participant can easily interpret their observations. We did not bound participants in “Yes” or “no”. The questionnaire is attached in **Appendix ‘A’**.

13.1.4 Pilot Test Questionnaire

We conducted a pilot test in order to evaluate the problems and weakness in the questionnaires to avoid the interpretation problems for the participant. The purpose behind the pilot test was to point out the weaknesses in questionnaire procedure, layout, nature of questions and the way used to deploy a survey i.e. web or paper. We conducted pilot test on lower scale of individuals before deploying the survey for real target audience in order to observe the weaknesses and errors in the questionnaire. This whole process really helped us to eliminate the erroneous data and put the questions in the right sequence so that target audience can easily navigate with the questions.

13.1.5 Distribution of Questionnaires

After the completion of pilot test, we deployed survey to our target audience through email to their accounts with a unique ID. Each participant of survey was bound to solve the survey once and no repetition was allowed. We gave participants one week to answer the questionnaire in order to avoid stress on them. They were free to answer the survey in their own way by using the options provided for each question. We also encouraged participants to give their suggestions in order to address and overcome the collaboration issues that in end affect the whole software product. While collecting the results of survey we were focused to consider one attempt of each participant, we did not consider the repetition of answers. We also sent regular reminder to participants every day after deploying the survey.

14 Analysis Report

By analyzing the feedback gathered from the survey.

We can say that there are communication and collaboration challenges for the teams working at different location. The communication problems among teams affect the overall performance of whole company on the specific project. The collaboration problems slow down the product development process and off course it delays the launching of product in market that in turn affects the cost overrun of company. In most cases the problems in coordination also affects the software reliability and it seems difficult to develop 100%

reliable software. Communication problems can be the results of language barrier, timing overlap and because of some cultural aspects.

There is a need of solutions or suggestion as per survey feedback to counter the coordination problems. The absence of problems can make the performance of teams more efficient and that can also be helpful in boosting the business activities.

15 Suggestions/ Strategies to overcome coordination challenges

There are some below mentioned suggestions that can be helpful in achieving the coordination and collaboration among different teams working at different locations.

15.1 Muddled Message

In global software development where teams are distributed at many locations, so time for meeting or discussion through any communication channel is limited. The sender tries to convey all the information to the other team within that duration, which makes message muddled, leaving the listener in confusion. To overcome this communication barrier we must place “feedback” process, so that listener can assure that he got accurate and complete requirements and information.

15.2 Selection of Communication Channel

Channel selection in global software development is equally important with other factors. There are various ways for communication such as through instant messaging, email, face to face, calling, using VoIP etc. The thing is to select the best channel of communication(s) taking care of the urgency of work. We may use multiple channels for communication so that the listener can feel the importance of that task. Such as by conveying the requirement on VOIP to the other team members, a confirmation email is also sent to the resources giving detail about the discussion and task they have to complete within specified time.

15.3 Language

Whenever Requirement Engineer conveys requirements he/she uses specific words sometimes that have different meaning in dictionary but conveys

the meanings in that situation to the team. In Global Software Development, teams are distributed at various locations and teams at various locations speak different languages, so there are many chances that resource may get distracted or get some different understanding. In order to overcome this barrier we must train resources before they actually involve in requirement gathering, also multiple communication channel must be selected so that everything regarding requirements must be cleared to the resources.

15.4 Goal oriented Communication

The communication must be goal oriented. Meetings between resources distributed at different location must have a goal in mind which they have to achieve in the meeting, so that they may not distract from the goal.

15.5 Approach communication as a creative process

One must see and analyze what channel must be adopted if there are more than "x" people (what are the results). If results are not achieved, change the channel and check for other medium. Don't take communication as a core process only but take it as a creative part.

15.6 Accept reality of miscommunication

If the resources know what the effects of miscommunication are and what is its cost to the product/project and repute of organization, the team will be more attentive and give extra concentration to the processes and requirements. There should be motivation lectures within the company in order to mobilize resources for their best.

15.7 Minimize the physical distraction

When there is a meeting going on between resources located at different sites then distraction may be due to the resource sitting in meeting and calling on cell, talking with the person sitting opposite to him or beside him. This physical distraction may result in losing of some important requirement at that time.

15.8 Record the conversations

The conversation between resources should be record, so that if something is missed during meeting or is unclear, so participant may listen conversation again and get clarified.

16 Risks that need to be focused in Global Software Development

- Time Difference between various Development sites.
- Familiarization and Trust Issues (between local as well as Global sites.)
- Difference in Language and Culture.
- How to improve collaborations and Interaction

between team members working globally on same project.

- Inflation may change the expected prices .

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APPENDIX A**A. Questionnaire for survey**

1. How many working hours overlapped between resources presented at different locations/sites?

- a) Less than 8 hours
- b) More than 8 hours
- c) None of above
- d) No overlapping
- e) Few hours

2. How often and frequently do you get feedback and response from remote teams?

- a) Less than 1 hour
- b) More than 2 hours
- c) Take 1 complete day
- d) More than one day
- e) None of Above

3. Does the delay between resources at different sites result in the delay of the project task?

- a) Yes
- b) No
- c) Absolutely
- d) May be
- e) Partially

4. How do you communicate with resources at remote sites (located at dispersed sites) ?

- a) Skype
- b) Email
- c) Cell Contact
- d) Instant Messaging
- e) Private tool for communicate

5. Is the communication with resources at remote sites properly scheduled or not?

- a) Yes
- b) No
- c) Depends
- d) Properly scheduled
- e) Informal

6. How frequently teams at remote sites communicate?

- a) More than 1 time in a day.
- b) Depends on situation.
- c) Once in a week
- d) Once in a month
- e) Once in a day

7. What is the level of awareness between teams in terms of their competence and culture?

- a) Got training of Global Software Engineering (GSE) issues.

b) Train with the passage of time.

c) None of above.

d) To some extent

e) Reasonable knowledge

8. Who take decision if any request for the requirement changing is received?

- a) Project Manager
- b) Team Lead-Development
- c) Team Lead-Quality assurance
- d) Project Manager-After taking team into confidence
- e) None of above

9. Which language you use to communicate with distributed team members having different culture and language?

- a) English
- b) Swedish
- c) Depends on team
- d) Urdu
- e) None of above

10. Which communication procedure you mostly use between different team members located at different sites?

- a) Formal way of communication.
- b) Informal way of communication.
- c) Through email
- d) Video conferencing
- e) None of above

11. What you think is the solution to overcome Communication issues in Global Software Engineering (GSE) ?

Answer:

APPENDIX B**DATABASES**

Sr No	DataBase Name	Results
1	Inspec	1198
2	IEEE Xplore Article	982
3	ACM Digital Library	78
4	EI Compendex (Ei Village 2)	261
5	SpringerLink	10

APPENDIX C**PRIMARY STUDIES**

Sr No	Title	Extraction
1	Improving contextual skills in global software engineering: a corporate training experience.	Talks about how to prepare productive industry professional in the distributed environment with the help of conducted interviews [10].
2	Collaboration tools for global software engineering.	Presents the collaboration tools to leverage the successful collaboration amongst remote parties [11].
3	Dimensions of collaboration in global software engineering teams: explorations of 'collaborative technology fit'	This article discusses the challenges for the GSET and how they are maintained and controlled using technology fit [12].
4	Process-based collaboration in global software engineering	How processes can be used to best utilization of organization resources and for effective team work in global setting [13].
5	Model for global software engineering project life cycle and how to use it in classroom for preparing our students for the globalization.	This paper promotes how students can be prepared for upcoming challenge and desired skills in globalization [14].
6	Globally distributed component-based software development: an exploratory study of knowledge management and work division.	Author proposes the component based development as a key to reduce the inter-sites communication and collaborative activities while conducting a case study and provides his finding for the CBD projects [15].
7	Classes of Distributed Agile Development Problems .	Article identifies the problems and suggests their solutions after considering 12 case studies and classifying them into six categories [16].
