Temporal Distance Challenges in Distributed Agile Software Development: Case Study of a Global Company

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Abstract – Over the last decade, distributed software development (DSD) becomes very popular for most of the major companies. According to the effects of globalization, software development methodologies and practices are also impressed. Because of the underlying philosophy of agile, agile teams concentrate on communication that is mostly applicable for collocated teams. Most of the companies that apply distributed development, adopted Agile software methodology into their software development lifecycle to mitigate challenges. Regarding this, DSD brings along various challenges to be conducted by the distributed development team and also difficulties to apply Agile practices at different locations. In this paper, the findings from a case study on temporal challenges in three small, one medium and one large distributed agile software development projects are presented. In-depth interviews were conducted with 12 interviewees who are working for a German-based global company that operates more than twenty countries.

Keywords – *distributed software development, agile, temporal distance-based, case study, in-depth interview*

I. INTRODUCTION

Globalization is vital for most of the companies to expand their business all over the world. Within the effects of globalization, software development methodologies and practices are also impressed. The traditional way of software development, product management, and development teams worked as co-located. However, these teams might work at different locations as the matter of the fact development team members may be at different locations in the current environment. In fact, the results from the globalization of companies give a start to integration and transformation of DSD. In the literature, DSD is known as Global Software Development (GSD) and also Global Software Engineering (GSE) that is defined as software development teams in different geographical locations [10]. Software development is a complex process that needs to have good collaboration among team members; therefore, DSD creates a more complex and challenging environment. According to Karolak (1998), DSD projects are considered more complex to conduct than the most collocated in-house project.

Ideally, software development team members are working at the same location. Thus, developers have face-to-face meetings, same culture, and organization that enhance the collaboration among team members and also makes easier to control. Within the existence of DSD, team members work at distributed locations that cause challenges such as different time-zones, communication difficulties, social and cultural differences. Furthermore, team members need to make up a network of distributed sites due to locating in various isolated locations during software development lifecycle. In some instances, outsourcing of different organizations may occur; in other cases, these developers may be working for the same company.

According to Smite, the team works across geographical, cultural, temporal, organizational and political boundaries to success a common software project, defined as DSD team [8]. Distributed development brings up new dimensions that can be mentioned as temporal, geographical and socio-cultural distances [6].

Nevertheless, the existence of GSD was revealed by various virtual channels for communication as phone or internet and also for asynchronous interaction as e-mail. Regarding asynchronous communication, there might be some advantages in terms of follow-the-sun development (Damian & Zowghi, 2002) while tasks of the project were distributed to different time zones.

The objective of this paper is to present challenges that associate with temporal distance in DSD by describing key elements that may create risks for projects by considering the current software development industry.

II. RESEARCH METHOD

Describe in detail the materials and methods used when conducting the study.

This study focused on a global company that develops software at geographically distributed locations. Regarding identify challenges that are not reported in the literature, in-depth interviews were conducted to collect data for qualitative research that are related to temporal distance.

Conducted in-depth interviews were in a semi-structured interview format that is the most useful interview form to conduct qualitative research. The semi-structured interview is not highly structured that the interviewee is free to talk about whatever comes up in mind regarding open-ended questions.

Interviews were executed through online meeting tool and live meetings with interviewees lasted from 45 minutes to 90 minutes. Interviewees were selected at different hierarchal

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levels from software development engineers to team managers and also from different projects, geographical locations as Germany, Hungary, and Turkey who collaborate with different time zones and locations as India, USA, and China etc.

Information was gathered from multiple data source (see Table 1) with qualitative semi-structured interviews. In-depth interviews were conducted with 12 interviewees from different projects, regions, and cultures to create a wide perspective for this study.

Table 1 - DATA SOURCE

Project Name	Project Type	Team Location	Project Size	Data collection
A	SW product development	TR DE HG IN US	Large Project	Scrum Master and Architect
B	SW pilot product development	TR DE	Small Project	Product Owner and Software Specialist
C	SW product development and maintenance	TR DE	Small Project	Team Manager, Project Leader and Software Development Engineer
D	SW product development	HG TR DE	Medium Project	Project Manager and Two Software Development Engineers
E	SW product development	DE TR NE	Small Project	Test Engineer, Architect, and Scrum Master

TR: Turkey; DE: Germany; HG: Hungary; US: United States of America; IN: India; NE: Netherlands

III. FINDINGS

In this section, the collected challenges from interviews were presented that was done with team members of five software development projects.

RQ1: What are the temporal distance challenges that affect communication process at DSD projects?

The best for transferring knowledge or interaction is face-to-face communication that is a basic prototype for communication [1] [2]. Agile values and principles promote informal communication to create team spirit as mentioned in Agile Manifesto, "Individuals and interactions over processes and tools" [3]. Thus, agile sympathize with face-to-face communication to have efficient shared information among co-located team members. Due to the dispersion of teams, team members are located in different countries that block effective communication.

According to interviewees, temporal distance is challenging for communication process between team members of the projects that are executing different locations. In addition, there is an undeniable fact as loss of concentration having long meetings at late hours. After some time, participants of the meeting might have difficulty to keep their concentration on the meeting;

"Having meetings with an online application is useless when I compared to face-to-face meetings. There is a must for confirmation to reduce effects of misunderstandings at online meetings. After a while, I lost my concentration and I found myself in a brown study. However, this is an impossible situation at face-to-face meetings because people are near to you. Nobody eye contact is not unignorably fact especially at meetings." (Software Specialist, Project B)

Moreover, the time difference is a disadvantage due to having different work hours between distributed software development sites, which result in a reduction in overlapped work hours. Most of the responders mention the late response from remote colleagues and if the late response is waiting from Product Owner, some of the interviewees could not make progress until getting an answer. This situation can be a boring and overwhelming process for developers who start the day by waiting for remote colleague response;

"We had to wait till Product Owner came to office. Because we cannot evaluate requirements of user stories and cannot take a step for development." (Software Development Engineer, Project C)

RQ2: What are the temporal distance challenges that affect coordination process at DSD projects?

According to Herbsleb (2007), management of dependencies over tasks defined as coordination in software development. One of the important challenges for coordination process is no overlapping work hours due to the time difference. Due to the time difference, finding time slots for the meeting is hard for team members who are working at different sites. Regarding the lack of communication or interaction in real time, there are some quotations from the interviews;

"For next year, we try to arrange our working hours to minimize time difference. Because we receive a lot of problem about time difference especially the United States. For instance, colleagues need to work at nights who are working with the United States to execute meetings. For this reason, people can adjust their work hours by considering their meetings." (Project Leader, Project B)

"If you are working at the global company, you accept to not having regular work hours to be reachable from all corners of the world." (Scrum Master, Project A)

"It is really hard to find a time slot for meeting with USA, India, and China so that we had to organize meetings after our work hours, nearly 10 pm. At that time, we could not be as efficient as regular work hours. Sometimes it takes more time than expected and we had to go to the office at the next day." (Software Development Engineer, Project D)

Because of time delay and asynchronous communication, a project manager feels behind;

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"When I open my inbox in the morning, I observe that conversation jump ahead which feels me behind. Apart from that, when I initiated an e-mail before I left the office, sometimes conversations went to wrong directions and colleagues discussed redundant topics at different locations. Therefore I have to follow my e-mails even at nights to be synchronized with colleagues." (Project Manager, Project D)

On the other hand, most of the responders mention the late response from remote colleagues and if the late response is waiting from Product Owner, some of the interviewees could not make progress until getting an answer. This situation can be a boring and overwhelming process for developers who start the day by waiting for remote colleague response. Feedbacks from different locations are delayed and reveals with lack of communication or interaction in real time. Most of the responders were mention to this issue;

"At the release phase, developers were waiting 7 or 8 hours to reach latest defect/bug status that was tested by people in India." (Architect, Project A)

RQ3: What are the temporal distance challenges that affect control process at DSD projects?

The maintenance and producing quality is matched with control process in software development life cycle. The achievement of control process was generally using formal processes in software development [9]. However, formal processes might not applicable in different time zones. In conjunction with not overlapping work hours and asynchronous communication, feedbacks from different locations are delayed and reveals with lack of communication or interaction in real time. According to the time difference, waiting for remote team member response to continue their work is a considerable challenge for distributed teams. Complains from most of the developers were as;

"If there is an urgent problem happening at the back of beyond and I need the knowledge from a colleague to solve that problem. Sometimes it is impossible to reach that person." (Test Engineer, Project E)

"If we cannot understand acceptance criteria or description for a user story, we had to wait till product owner is available or come to the office. Therefore sometimes we wait 3 or 4 hours without doing anything by the reason waiting for a remote colleague." (Software Development Engineer, Project C)

Furthermore, time delays in response – by the cause of not overlapping work hours – might be resulted as focus shift of overall work process or make a trouble at distributed sites especially time-critical or urgent work. Problems due to late responses wear on over days that can result in an increase in vulnerability costs [4].

IV. CONCLUSION

The objective of this paper was to identify, through empirical investigation of five different projects of a company and, the temporal distance challenges in distributed software development. Temporal distance is obviously challenged with communication, coordination and control processes. Lack of communication or interaction in real time, time difference due to no overlapping of working hours, waiting for remote team member response to continue and delays in response times for problems were findings of this study for challenges in the temporal distance.

According to latest studies in literature, temporal distance challenges did not excite attention. In recent years, there are

considerable improvements in communication technology that can create a chance to mitigate challenges in DSD projects. This paper aims to facilitate future researchers can find out temporal distance challenges of current industry within a perspective of a global software development company.

THREATS TO VALIDITY

In this study, responses were collected from different development sites; however, all of the interviewees were selected from the same company. There might be some companies that had the same pattern or not. Therefore, this study can be expanded to multiple companies.

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