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ABSTRACT

As virtual software projects are becoming more popular, it is also more common for software design, one of the key activities in software development process, to be conducted in the distributed context. Previous research has shown that communication media had an impact on the development of shared-understanding among team members in virtual teams. However, how communication media influences the development of shared-understanding among team members in software design, an activity where communication among team members are intense and complicated, is not well-understood. Therefore, within the scope of this study, we would like to conduct a case study to examine how virtual software development teams use communication media in their software design activities and how their usage influence their shared-understanding of the user requirements and design solutions. The outcome of the study is expected to validate the Media Synchronicity Theory in the distributed software design context as well as informing practitioners of the appropriate communication media usage for conducting distributed software design.

Keywords

Distributed software design, shared understanding, media synchronicity theory, communication media.

INTRODUCTION

Advances of information technology and globalization trends have made distributed software development feasible and a popular phenomenon of interest to a large community of researchers. In software development, software design is a core activity. As a collaborative process that involves intensive communication of varied stakeholders (Taylor and Hoek, 2007), software design process in distributed environments is challenging.

One of the challenges that confronts effective distributed software design activities, as well as distributed collaboration in general, is constructing a shared-understanding (Peters and Manz, 2007). Shared understanding, which can be understood as "the degree of cognitive overlap and commonality in beliefs, expectation, and perceptions about a given target" (Gibson and Cohen, 2003, p. 8), is desirable because it helps team members act in ways that are consistent and in coordination with one another and in order to perform well (Mathieu, Heffner, Goodwin, Salas, and Cannon-Bowers, 2000; Salas, Goodwin, and Burke, 2009).

The fact that members in distributed teams have to communicate with one another indirectly through information and communication technologies, has made creating a shared-understanding more difficult. According to (Olson and Olson, 2000), individuals rely on their interlocutors' appearance and behaviors during conversations to adjust their assumptions about them so that a common ground can be established among them. Telecommunication media, such as email, text/voice chat or video conference, if used inappropriately, might limit peoples' ability to monitor those cues as compared to face to face context and as a result hinder people to create common ground or shared-understanding (Olson and Olson, 2000).

Theory of Media Synchronicity

While there are a variety of media theories in the literature such as Media Richness Theory or Social Influence Theory, we choose the Media Synchronicity Theory (MST) proposed by Dennis, Fuller, and Valacich (2008) as the backbone for our research as this theory directly addresses how communication media influence the development of shared-understanding, our main phenomenon of interest. According to the Media Synchronicity Theory (MST), communication between individuals includes two fundamental processes: conveyance i.e. the communication process where individuals receive new information to make sense of the situation and convergence i.e. the communication process where individuals exchange their interpretation of the situation to create shared understanding. Whether the development of shared understanding is enhanced or impaired depends on the fit between the different communication processes (conveyance vs. convergence) and the level of

media synchronicity i.e. "the extent to which the capabilities of a communication medium enable individuals to achieve synchronicity"(Dennis et al., 2008).

The theory has been supported in a number of empirical works. For example, Dennis et al. (1998) conducted an experiment to validate the theory in the group decision-making context. More specifically, in the experiment, written communication (low media synchronicity) and face to face communication (high media synchronicity) were used interchangeably in the conveyance process, represented as a solution generation process in the group and convergence process, represented as a solution evaluation process in the group decision-making process (Dennis, Valacich, Speier, and Morris, 1998). The experiment results supported the theory. A similar experiment was conducted in (Murthy and Kerr, 2003), except for the fact that in this experiment, a CMC "chat" tool was used instead of written communication like in (Dennis et al., 1998)'s experiment. The study's results showed that the groups using face to face communication had an equal performance to the groups using the "chat" tool in the conveyance process and better performance than them in the convergence process. The theory was also supported in (DeLuca and Valacich, 2006), where an action research study was conducted to examine the influence of communication media on the performance of eight virtual teams working on business process improvement problems (DeLuca and Valacich, 2006).

In the software design context, the theory implies that the suitable communication media will be the ones whose degree of media synchronicity fit the types of communication processes (conveyance or convergence) taking place during a software design activity. However, the validity of the theory in such a context has not been demonstrated. We argue that examining the validity of the theory in the software design context is worth doing because software design is distinctive from other environments for the possible participation of people of very different backgrounds e.g. project owners, users, and developers, which makes the development of shared-understanding among the participants a complicated process. Therefore, in this study, we would like to explore the communication process taking place in the design activities of virtual software development teams through the lens of media synchronicity theory with an aim to validate the theory in this context. Generally, we propose the following research questions:

How do virtual software development teams use communication media in their software design activities?

How does different uses of communication media affect team shared-understanding in the distributed software design activity?

RESEARCH METHOD

The method we are going to employ in this study is the case study. For the research design, we followed the instructions for case study research by (Dube and Pare, 2003 ; Lazar, Feng, and Hochheiser, 2010).

The cases under examination in this research are the teams of master-level students working on developing Web applications as a part of their coursework. As the case study method is employed, the cases are examined in their natural settings without the manipulation of the researchers. The researchers will have no control of the communication tools the teams use or the tasks they perform. During the time of the pilot study, we had access to nine teams in total. Every team carried out different software projects. Each of the teams was composed three sub-groups two of which stayed in the US but in different states and the other one in India. Each sub-group had three or four team members. Among the three sub-groups, one took the role of project manager, one took the application design responsibilities and the other one was in charge of coding. During their projects, the sub-groups collaborated with one another via telecommunication tools. For the full study to be performed in the future, we expect to collect data about teams of similar structure.

For data collection, we employ exploratory survey. The survey questionnaire included both open-ended questions and Likert –scale ratings. The purposes of the questionnaire were to find out how the fundamental communication processes took place in the software design activity of the teams, what communication tools or media the teams used in the communication processes, and the degree of the shared-understanding of the system requirements and the design solutions in the teams, which serves as an indicator of the team communication performance. In this study, the software design stage is specified as the period starting at the time when the project requirements are given to the point when the team agrees on the final design solution for the application.

PILOT STUDY RESULTS AND LESSONS LEARNED

As a pilot step, the survey questionnaire was delivered to the members of the subgroups that took the project owner role of the nine virtual teams that we had access to. While the pilot data seemed to support the MST, this result was not very reliable since during the analysis of the data, we had discovered some problems in the design of the survey questionnaire and the delivery method (the subjects gave the answers through email). Specifically, asking the subjects to send us their answers

through email instead of interviewing them directly limited our opportunities to guide the subjects to give the information that we wanted. Consequently, the answers were either too abstract or too ambiguous to analyze. In addition, we used the Likert-scale measurement of perceived shared-understanding from (Mulder, Swaak, and Kessels, 2002) to measure the level of shared understanding in the subjects' teams. During the data analysis, we realized that this measurement should only be used as an initial indicator for further information probe since the rated level of shared-understanding did not tell us whether it was the result of the communication media usage or of any other factors. Also, the fact that we only got information from the project owner sub-teams might leave out important information that we might access to from the design and development sub-teams given our topic of interest i.e. communication in software design activity.

In summary, based on the lessons learned from the pilot study, for further development of the research, we would like to interview the subjects directly, add more probe questions to the questionnaire, and interview members of all the three sub-teams. The lessons we learned from the pilot study will be presented in details in the conference.

CONTRIBUTIONS

As far as the significance of the research is concerned, the research will have both academic and practical contributions. With regard to academic contributions, this study will contribute empirical evidence to confirm or dispute the media synchronicity theory in the context of distributed software design activity. With regard to practical contributions, the study is expected to inform practitioners the "best practices" for using communication media in distributed software design activities.

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