Toward a Theory of Communication in Distributed Software Development Teams: A Research Proposal*

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ABSTRACT

Context: Communication plays an essential role in the professional software development, as it stands as one of the pillars of this collaborative activity. Communication is also one of the leading challenges in Distributed Software Development (DSD) teams, which may be hindered by this business model. Still, little is known about how communication occurs in this specific context. Objective: This work aims to present a doctoral research proposal for studying communication in DSD teams to propose a new theory, and thereby, establish a theoretical base for future studies. Additionally, to stimulate discussions about the relevance of this proposal. Method: I propose Grounded Theory research. Results: To help in the consolidation of this study gap, I present the preliminary results of a non-extensive literature review. Conclusions: Based on preliminary findings, I conclude that a new, and specific communication theory in DSD may have its place in literature.

CCS CONCEPTS

• **Social and professional topics** → **Project and people management**; **Project management techniques**; **Project staffing**; *Systems planning*;

KEYWORDS

Communication, Distributed Software Development, Project Management

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1 INTRODUCTION

Software engineering is a collaborative activity [28, 45], which consumes the knowledge, expertise, and experience of a group of individuals [28]. The 3C model [17] characterize collaboration in three integrated dimensions, identified as communication, cooperation, and coordination respectively [37]. Thus, as stated by Layzell et al. [28], the lack of these dimensions in software development projects may lead to reduced technical quality. In this context, communication takes its place in this research proposal, for being an essential aspect of collaboration [46], and for belonging to the central spot of almost all collaboration practices and processes [34]. Effective Communication is one of the main issues in DSD [5, 24, 44] and in Global Software Development (GSD) [3]. Several organizations have been adopting DSD with pros, but also with cons such as communication challenges, that often impose risks for the implementation of development projects and affect the software process quality [9, 48]. In DSD the frequency of communication is low when compared with co-located development [24], with a limitation on face-to-face and informal meetings. And the lack of these factors poses a challenge in creating and sustaining social ties between its members [33].

But despite the importance of communication in DSD and the substantial number of studies in this area, little was theorized about how communication occurs in this specific context. Classic communication theories are part of the academia for a long time, such as the Hypodermic Theory [42], the Functionalist Theory [30], the Mathematical Theory [29], the Semiotic Theory [38], the Scheduling Theory [30], the Persuasion Theory [29] among others. Still, a specific theory for explaining the communication phenomena in DSD could bring benefits for DSD research area. I present a doctoral research proposal for studying communication in DSD teams, to explain this phenomenon and to propose a new Communication Theory, which will differ from existing ones by its specific nature, that is, by explaining communication specifically in DSD teams. Thus, bringing benefits to the academia, by establishing a theoretical base for future studies in communication processes, models, methods or frameworks to support better communication results in DSD.

2 BACKGROUND

DSD is a business model in which software is developed by a geographically distributed team, whose distribution may be established in different dispersion levels, e.g., between cities, countries or continents. In the following topics, I present a brief overview of the state of DSD literature and communication aspects.

2.1 DSD Literature

As stated by Prikladnicki et al. [40], it is possible to find registers of DSD projects since the 1990s, and so forth, DSD literature had the support of relevant researchers, who I may cite: Hawryszkiewycz and Gorton [22]: which was one of the first research works focused in DSD. Carmel [5]: with his high relevance book in DSD area, named "Global Software Teams." Karolak [27]: With his book that discussed motivation and challenges in DSD. Aoyama [2]: which presented a new software process model that encompassed distributed multi-site processes in the 20th International Conference on Software Engineering (ICSE). The next decade, the 2000s, were marked by significant DSD conferences, workshops, and works, such as the first specific edition about DSD in a journal, which was edited and published in the IEEE Software [23]. The first edition of the Workshop on Global Software Development on the ICSE. The relevant works of the Brazilian researchers Prikladnicki and Audy [39, 40]. And in years 2010, due to the relevance of the contributions of Brazilians on the academic community and industry at the global level, in 2012, an edition of the International Conference on Global Software Engineering (ICGSE) was organized and held again in Brazil [12].

2.2 Communication in DSD

Frequent communication is expected in any software development project, mostly in the beginning, when team members need to establish a common ground, to define work processes, and to establish social relations that will further support the software development [36]. As such, even though often neglected, the communication management is considered one of the most critical areas in project management [7]. In DSD, communication plays a more significant role in the success of projects of this nature than in co-located development, as it allows team members to share information with colleagues and stakeholders, to clarify project-related issues, among others [18]. DSD largely depends on communication among those involved in the project, either directly or indirectly. In this context, the means of communication have a significant influence in the projects in distributed environments [11], as challenges associated with communication increase when the media chose to support distributed teams are not as rich as what face-to-face communication offer [23]. For instance, facial expressions and gestures also contribute to the communication of the message, thus, depending on the level of interaction that the communication means can provide, it can affect the quality of communication and consequently can affect the DSD project quality [18].

3 RESEARCH METHOD

This section describes the methodological frame in which I plan to perform this research. The following subsections present the proposed research question, the methodological framework, and the proposed research design.

3.1 Research question

Based on the context presented in Section 1 (introduction), I get to the research question as follows: **(RQ1)** ***How does communication occur in distributed software development teams?***

3.2 Methodological framework

This research proposal comes from a Constructivist epistemology, i.e., a philosophy that considers the knowledge as a result of social construction, the truth relative to its context, the interpretation of theoretical terms, a tendency for qualitative methods, and a tendency for proposing local theories [16]. Table 1 presents the characteristics of this research proposal.

Table 1: Research characteristics

Philosophical instance	Constructivist
Question type	Exploratory
Research nature	Qualitative
Reasoning	Inductive
Research method	Grounded theory

Source: Author.

Considering that the primary goal of this research is the proposal of a new theory, I propose using the Grounded Theory (GT) method, because of being a research method oriented for generation of theories, based on a rigorous analysis of data [21]. The use of GT is appropriate when there is a lack of knowledge or theory of a topic [20, 43] and when no existing theories offer solutions [8].

The GT method was proposed in 1967 by the sociologists Barney Glaser and Anselm Strauss [20], and after its publication, this methodology became one of the most popular approaches to qualitative research [4]. By the early 1990s, the GT method evolved in two distinct thought schools, the Glaserian GT by Glaser, and the Straussian GT by Strauss and Juliet Corbin. These schools were followed by the works of researchers from the second generation of GT schools, which included the Constructivist Grounded Theory (CGT), Dimensional Analysis, and Situational Analysis [41]. Among these researchers, and still in the path of the evolution of the GT method, Kathy Charmaz proposed a new CGT approach in the mid-1990s. This proposal was based on the original ideas from Glaser and Strauss [4], that when compared to its original form, this new one was presented as a constructivist focused GT proposal [6, 31].

Although there are differences between the GT proposals from Charmaz, Glaser, and others, these methods are not much different in their approaches, but rather in their overarching goals and perspectives of the nature of reality, which suggests that researchers should consider their worldview when choosing a GT method [25]. Therefore, in the light of the constructivist orientation of my previous works, I chose the school of Charmaz as my primary reference, but without giving up on Glasserian GT practices or directives [20], such as preferring axial coding and delaying an extensive literature review in the research process.

3.3 Research design

I propose performing this research in three sequential steps, presented in Figure 1 and detailed as follows.

3.3.1 Consolidation of the study gap. One of the most problematic issues in GT is to decide when existing literature should be used during the research process, especially for Ph.D. students [15].

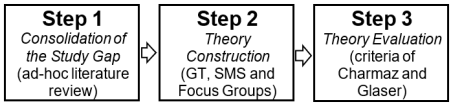

Figure 1: Research steps. Source: Author

Glaser advocates the delaying of a literature review, along with authors such as Nathaniel [32] and Holton [26], which are resolute in their purist view that GT requires the researcher to enter in the research field without any preconceived problem statement, interview protocols or extensive literature reviews [15]. Charmaz [6] states that the intended purpose of delaying the literature review is to avoid importing preconceived ideas and imposing them on a GT research, and that this approach would be fine in principle, but in practice, could result in "rehashing old empirical problems and dismissing the literature." In this context, I propose the usage of preexisting literature in an approach such as performed by Adolf [1] in his GT research. That is, **a first, and non-extensive literature review** (Ad-hoc, in my proposal) to frame this study as a relevant one and confirm the absence of a preexisting theory, and a later literature review, which I propose in the format of a Systematic Mapping Study (SMS), to be performed after the emergence of the new theory.

3.3.2 Theory construction. I propose using the Grounded Theory (GT) method for constructing the new theory. I will begin with the proposed research question (Section 3.1). Followed by data collection and both initial and focused coding and the proposal of categories, i.e., a "conceptual element in a theory" that usually are derivations from focused codes. All coding activities will be based on fresh data; thus, as stated by Charmaz [6]: "Grounded theorists often embark on their research journeys with plans to interview people, whose experiences can illuminate the topic they wish to study.", I propose using intensive interviews as my data collection technique. In parallel with the entire process, I will perform the practice of memo writing and axial coding. The proposed theory will emerge from the spiral process of sorting, diagramming and integrating memos, until the saturation of theoretical saturation, i.e., when fresh data no longer sparks theoretical insights.

After the emergence of the new theory, I propose performing a SMS to, as stated by Adolph [1]: "compare the emerging substantive theory with extant theory and situate it within the known theoretical landscape." Finally, I propose a set of focus groups to discuss the emerged theory and the results from SMS with experts in Software Engineering and DSD. Thus, characterizing a triangulated method approach, which enhances the strength of qualitative studies [35].

3.3.3 Theory evaluation. Charmaz [6] states that the line between process and product becomes blurred for our audiences, as other scholars will likely judge the GT process as an integral part of the product. And that grounded theorists should consider their audiences, being they teachers or colleagues, as they will judge the final product. I propose evaluating the new theory by reflecting my theory development process with a set of selected criteria and by collecting feedback from my target community, i.e., the DSD research community, by exposing my results and discussing my findings (such as performed by Dorairaj [14]). I propose the using of two sets of criteria. The first one proposed by Charmaz [6], in this manner: ***Credibility, Originality, Resonance and Usefulness***. And the second one, by Glaser [19], which was also adopted in GT works such as the one from Dorairaj [14], as follows: ***Fit, Work, Relevance and Modifiability***.

4 PRELIMINARY RESULTS

To confirm the absence of a theory that explains the phenomena of communication in DSD teams, and to help with the establishment of the basis for stating this study as a relevant one, I started the first step of this research, a non-extensive (Ad-hoc) literature review. To achieve this goal, plan to use the knowledge bases IEEE Xplore, ACM Digital Library and Google Scholar. And as a partial result, I present the results of my search in IEEE Xplore database. I performed this search in both Title and Abstract fields of published works, between January 8th and 12th 2018. And I used the search string as follows: **(S1): "theory" AND ("communication" OR "communicative") AND ("dsd" OR "distributed software development" OR "gsd" OR "global software development")**

I adapted the search string (S1) to the required syntax of the search engine, but still, maintaining the same semantics. After performing the search, I read both title and abstract from the retrieved papers. Then I tried to identify the relevance of the identified papers for my purposes, according to my search criteria, i.e., studies focusing on the phenomena of communication in DSD to propose a new theory or studies with an indication of preexisting communication theories in this area. The search results from IEEE Xplore database presented 13 studies. Among those, I selected eight studies according to my search criteria. And for the rest of the five papers, most of them, approached studies in DSD and GSD areas, or in which the search terms were cited, but without complying with my search criteria.

Three of the studies stated the usage of the Media Richness [10] or the Media Synchronicity [13] Theories as part of their studies or as means for sustaining their results. Two studies cited the usage of the Social Network Theory [47], also composing their studies or as analysis techniques. One study stated the usage of GT to investigate key concerns of distributed teams in Agile software development, and another study that also used GT, but now to describe how Agile teams gather, store, share and use knowledge in DSD. Finally, one study stated the usage of a collaboration theory (not named in the abstract) that captures communication behavior associated with teams in virtual environments as analysis mechanism. Further details and references on these results are available at https://goo.gl/JGb6Df.

5 FINAL REMARKS

Based on partial findings presented in Section 4, I conclude that none of the identified studies were focused in explaining the communication process in DSD, neither to propose a new theory in this specific context. As these studies approached their respective research goals, with the help of non-specific DSD communication theories to support their research process or their findings, e.g., the Media Richness [10], the Media Synchronicity [13], and the Social Network Theories [47]. Thus, I believe that a new, and specific theory to explain the communication process in DSD may have

its place in literature. Future works include completing the first research step, prospect DSD organizations for data collection, plan interviews, and perform the remaining research steps, as detailed in Section 3.3.

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