A conceptual framework to study the role of communication through social software for coordination in globally-distributed software teams

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A B S T R A C T

Background: In Global Software Development (GSD) the lack of face-to-face communication is a major challenge and effective computer-mediated practices are necessary to mitigate the effect of physical distance. Communication through Social Software (SoSo) supports team coordination, helping to deal with geographical distance; however, in Software Engineering literature, there is a lack of suitable theoretical concepts to analyze and describe everyday practices of globally-distributed software development teams and to study the role of communication through SoSo.
Objective: The paper proposes a theoretical framework for analyzing how communicative and coordinative practices are constituted and maintained in globally-distributed teams.
Method: The framework is based on the concepts of communicative genres and coordination mechanisms; it is motivated and explicated through examples from two qualitative empirical cases.
Results: Coordination mechanisms and communicative genres mutually support each other. In particular, communication through SoSo supports team members in establishing, developing and maintaining social protocols within the distributed team. Software Engineering tools and methods provide templates for coordination mechanism that need to be adapted and adopted in order to support the project at hand. SoSo serves as a medium for the necessary metawork. The theoretical framework proposed is used to describe both the practices in an established industrial project and the establishing of practices in three student teams. The framework allows explaining the heterogeneity of practices observed.
Conclusions: This paper presents a conceptual framework to study the role of communication through SoSo for coordination in GSD. The usefulness of the framework is supported by empirical findings on the role of SoSo. The theoretical framework can be beneficial for future research that aims to analyze and describe not only the role of SoSo, but also how communicative and coordinative practices can be established and maintained in GSD teams.

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1. Introduction

Software Engineering (SE) is cooperative work [1], and software developers must coordinate their individual activities with tasks performed by other team members [2] in their everyday practices. Coordination relies on communication, direct communication, as well as communication mediated by code, documentation and artifacts. Communication is fundamental not only to coordinating the cooperative work, but also to establishing and to maintaining effective coordination mechanisms [3]. In Global Software Development (GSD) settings, effective coordination is challenging [4] due to the lack of face-to-face communication [5] between distributed team members. On the one hand, research in GSD aims to overcome this challenge by improving processes and tools for supporting cooperation in distributed teams, e.g. reducing intensive collaboration [5], increasing formal documentation [6], and working on organizational factors such as processes, structure, and goal alignment [7]. On the other hand, GSD research shows the success of agile processes in GSD settings [8] that depend on close collaborations and frequent informal face-to-face communication, rather than lengthy documentation. These premises motivate the necessity of further studies on tools and practices in GSD, as no standard recommendations are as yet available in the field.

While the main media for communication in distributed teams have traditionally been email, phone, and video conferencing systems, nowadays communication also takes place in the so-called Social Software (SoSo). SoSo is often referred to as "social media", "web 2.0", "user generated content" by practitioners and researchers. Kaplan and Haenlein [9] combine the different terminologies

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defining SoSo as "a group of Internet-based applications, built on the ideological and technological foundations of Web 2.0, that allow the creation and exchange of User Generated Content (UGC)." Essentially, SoSo encompasses a range of software systems that allow users to interact and share information, such as: Instant Messaging (IM), Internet Forums, Blogs, Microblogs, Wikis, Social Network Sites, and Social Bookmarking. Very little research focuses on the usage of SoSo in GSD, as highlighted in a Systematic Mapping Study performed by the authors of this paper [10].[1] The use of SoSo in GSD practices might, however, be more wide spread than what is visible in the actual research publications [10]. Some indications are provided by the success of many open-source projects (OSS) that are often globally distributed and mainly coordinated through the wide use of SoSo, such as Wikis, Forums and Instant Messaging [11]. The real challenge lies in answering the question about why and how SoSo can provide useful communication channels for distributed collaboration; in other words, how it is used in the everyday practices of distributed software teams.

Traditional Software Engineering (SE) as a discipline is "mainly concerned with the formal principles, the technical basis and the methodological support for software development, rather than the reflection of software practice as a human activity that goes beyond the engineering framework" [12]. Often, practices in situated action [13] differ from pre-defined SE methods and processes. Detailed descriptions of practices provide the basis for understanding the social factors [12] that influence effective practices [14], as well as for designing better tools [15]. Practice-based approach studies are becoming more widespread in SE research, e.g., [14,16] as well as in GSD research, e.g., [17,18], compared to other approaches used to inform tool design, such as the cognitive approach, widely used in human–computer interaction to study the cognitive processes of programmers, i.e. the mental processes involved in programming [19]. A practice-based approach [20] is adopted by several researchers to illustrate GSD work practices: Sigfridsson and Sheehan [17] describe an Open Source community called PyPy, Boden et al. [21] study the coordination practices in distributed software development of small enterprises, and Avram [15] investigates a project with the purpose of better understanding collaborative work and knowledge management processes in distributed software development settings. These research studies all describe work practices of software engineers; however, they suffer in proposing an effective way of analyzing such practices.

Computer-supported Cooperative Work (CSCW) tradition offers many theoretical concepts that can be used to analyze and describe practices in SE as well as in GSD settings. In particular, in GSD most of the cooperation is computer-mediated, thus relying heavily on the use of artifacts, both for coordination and for communication. In particular, most of the GSD artifacts are traceable, and researchers can analyze them to investigate the actual practices. Coordination artifacts in GSD consist of, e.g., bug reports [2], documentation, files or source code, while communication artifacts can be, e.g., comments in the source code, descriptions provided while committing the code in versioning systems, email or SoSo. In CSCW tradition, the facilitating role of artifacts in collaboration is well recognized. Thus, it appears promising to find suitable theoretical concepts from the CSCW tradition to investigate the use of artifacts for communication and collaboration in GSD settings.

This paper presents a novel conceptual framework for analyzing and describing the role of SoSo in GSD everyday practices, motivated and explicated through examples taken from two empirical cases. The empirical cases are described in detail in two previous articles [22] [23]. The purpose of this paper is to develop and illustrate the theoretical framework, showing its applicability and flexibility in different situations. In particular, both established and establishing distributed teams have been employed to show the establishing and the development of common practices in GSD settings. For the authors of the present paper, a framework is a set of related concepts that is used to analyze cases and to explain phenomena: by relating concepts together in a single framework, it is possible to describe not only one specific case but several cases of different natures. Thus, a framework allows generalizing from individual empirical cases to general phenomena. The framework proposed is based on the theoretical concepts of communicative genres [24] and coordination mechanisms [3], both based on the notion of social protocols, a set of rules, conventions, and policies shared by people involved in the cooperative activity [3]. The idea behind the framework is that the development of common social protocols is crucial for achieving effective communicative and coordinative practices, as well as for the adaptation of models and methods. The framework shows the relationship between the concepts of coordination mechanisms and communicative genres both during the establishment and the implementation of common coordination and communication practices.

The analysis of communicative and coordinative practices of the two cases shows that SoSo is especially useful in establishing, developing and maintaining social protocols. In this context, the role of SoSo is to support communication and its key function is complementing collaborative SE tools that provide templates for coordination mechanisms. The theoretical framework allows for both describing practices in an established industrial project [22] and analyzing the development of practices in three establishing student teams [23], permitting the explaining of the heterogeneity of practices observed and showing how dynamics develop and evolve in the different teams. The framework proposed can be beneficial for future research that aims not only to analyze and describe the role of SoSo, but also to show how communicative and coordinative practices in general are established and maintained in globally-distributed teams.

The reminder of the paper is organized as follows. The next section summarizes related work on coordination and communication in Software Engineering. Section 3 describes the two empirical cases used for explicating the theoretical framework proposed in this paper and Section 4 explicates the research methodology. Examples taken from the two empirical cases are used in Section 5 to describe in greater detail the concepts that constitute the theoretical framework, and in Section 6 to highlight the relation between the concepts. Finally, Section 7 aggregates the theoretical concepts in a unitary theoretical framework for communicative and coordinative practices. Section 8 discusses the framework, highlights contributions and implications, and in brief, reports the limitations of the study. Final conclusions are presented in Section 9.

2. Related work

Global Software Development (GSD) is increasingly becoming common practice in the software industry [25]. GSD means splitting the development of the same product or service between globally-distributed sites [11]. There are many potential benefits that can arise from GSD: lower development costs due to salary savings,

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[1] Please note that the search string used in the Systematic Mapping Study is built to include a wide spectrum of research paper: the different terms used by practitioners and researchers to refer to SoSo have been employed—such as social media, social software, web 2.0, user generated media, user generated content, instant messaging, wiki, social network, social bookmark, blog, microblog, social tagging, facebook, twitter—and they have been combined with terms to identify: (a) teams which are not co-located; (b) SE and its main phases; and (c) known purposes for using SoSo. Moreover, the snowballing technique has been adopted to extend the amount of research paper retrieved.