

## DISTRIBUTED SOFTWARE DEVELOPMENT IN AGILE PROJECTS: A MODEL FOR THE PROMOTION OF SOCIAL INTERACTIONS

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### ABSTRACT

Agile methods address the challenge of an unpredictable world, relying on people and their creativity, flexible team self-organization with incentives for participation, social cooperation and less formalization being increasingly used in larger projects. The issues related to communication, trust, coordination, and social interactions among project stakeholders impact Information Technology team dynamics. This article investigates what the constructs are that lead to the promotion of social interaction in DSD environments. We conducted this qualitative and exploratory research using an interpretative approach to interview 35 project professionals. This paper contributes to the theory by delivering a model for the promotion of social interactions in distributed agile projects. We introduced the interaction coordination variable that emerged from the field, aiming to encourage and direct relationships between team members so that they are aligned with the mutual benefits of the project. These benefits include improving communication, knowledge sharing, and a sense of responsibility for the product. The study also draws the attention of practitioners to the promotion of social interactions in agile DSD environments.

**Keywords:** Social Interaction. Communication. Distributed Software Development. Agile.

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## 1 Introduction

Software is a critical resource in our society as it is the central element of any product, process or service. Although many organizations accomplish their tasks through projects (Kerzner, 2017), failure rates for Information Technology (IT) projects remain high and put billions of dollars at risk (Shenhar, Pinto, Winch & Huemann, 2018). The difficulty in dealing with IT team dynamics includes social interactions and communication among stakeholders. Social interaction has been identified as one of the causes of project problems (Iden & Bygstad, 2018), and communication has been historically reported among the main causes of project failures (Dwivedi et al., 2015; Kappelman, McKeeman & Zhang, 2006).

In recent years, a large number of organizations have adopted agile methodologies to manage their software development projects (Stojanov, Turetken & Trienekens, 2015). Scrum is one of the best-known agile frameworks (Ramos & Vilela Junior, 2017) and focuses on project management in situations where it is difficult to plan ahead (Schwaber & Sutherland, 2017), with feedback loops as the central element for process control (Schwaber & Beedle, 2002). Agile methods address the challenge of an unpredictable world, relying on people and their creativity (Dyba, 2000), flexible team self-organization with incentives for participation, social cooperation and less formalization (Prikladnicki & Magalhães, 2010). These challenges are even greater in distributed software development (DSD) settings (Damasiotis & Fitsilis, 2015).

In DSD, new variables and challenges are added to the already complex software project management problems: physical and geographical separation between teams, social and cultural differences between people (Mueller, 2015; Henderson, Stackman & Lindekilde, 2016) and time differences that affect communication and collaboration (Turkulainen, Kujala, Arto & Levitt, 2013), problem-solving, trust, and many other factors that influence project success. The physical distance between stakeholders brings greater challenges to the possibilities of contributing to the mutual benefit of a DSD, as it generates problems of communication (Henderson et al., 2016), collaboration (Turkulainen, Aaltonen & Lohikoski, 2015), coordination (Paasivaara, Lassenius & Heikkilä, 2012), and trust (Qureshi, Fang, Haggerty, Compeau & Zhang, 2018).

Collaboration between the development team and the customer, represented by the role of the Product Owner (PO), is one of the values expressed in the Manifesto for Agile Software

Development: “individuals and interactions over processes and tools” (Beck et al., 2001, p. 1). This value reinforces the importance of human relationships in the software building process, which is essentially done in teams. Social interactions can facilitate knowledge sharing, which is critical to product development (Ghobadi & Mathiassen, 2016), as well as facilitating the exchange of information spontaneously, autonomously, reflecting the team’s engagement in the project (Huck-Fries, Prommegger, Wiesche & Krcmar, 2019).

Despite the successful application of agile methodologies, especially Scrum, in projects developed by smaller teams of up to nine people and physically present in the same place, more and more large-scale projects are now adopting Scrum to enjoy the same benefits (Dingsøyr, Fægri & Ikonen, 2014). For this reason, the promotion of social interactions in DSD environments becomes important for the application of agile methods.

Communication has been studied as a construct of social interaction, as well as cooperation and coordination (Iden & Bygstad, 2018). However, promoting social interaction can affect communication as well. We argue that social interactions need to be studied in a detailed way by revisiting the constructs reported in the literature and listening to the experience of practitioners. To this end, this article uses a qualitative approach to gain insights from internal key stakeholders of distributed agile projects, Program Manager (PM), Scrum Master (SM), Product Owner (PO) and the Development Team (Dev Team), regarding the promotion of social interactions. This approach is in line with Avenier and Thomas (2015), Avison and Malaurent (2013) and McLeod and MacDonell (2011), who call for more qualitative studies on software development from a social science perspective.

Aligned with this context, we investigated the following research question: What are the constructs that lead to the promotion of social interaction in DSD environments?

## 2 Theoretical Background

### 2.1 Communication in distributed software development projects

Distributed projects can use time zone differences to increase the number of productive work hours in a day, and to guarantee scarce resources such as knowledge specialists and other specialized resources, regardless of where they reside (Yadav, 2016). Distribution can also provide employment for more people as there are no space

constraints. However, Nidiffer and Dolan (2005) warn that these benefits come with increased risks due to lack of face-to-face interaction, which may result in a lack of trust and ineffective communication, leading to difficulty in cooperating.

Software development is a knowledge-intensive and collaborative process that requires the mixing and intertwining of diverse knowledge across domains of expertise (Vasanthapriyan, Tian & Xiang, 2015). The unique and inherent characteristics of software development express the importance of effective knowledge sharing, referring to the exchange of information related to tasks, ideas, know-how and feedback about software products and processes, exploring available resources, addressing challenges and exploring emerging opportunities in software development and design (Ghobadi, 2015).

Communication in DSD is a challenging activity and projects developed in this environment end up hiding information that in traditional projects would be present in the very environment of a work team. Poor communication and coordination affect DSD projects by incorporating major risks such as delay in shipments of sprints, over-budgeted shipments, lack of motivation, unclear goals and friction among team members (Qureshi, Basher & Alzahrani, 2018).

In software development, it is important to be aware of what is happening, who is performing a particular task, where it is happening, and participants need to know each other's results to broaden collaboration (Sommerville, 2015). When the team is distributed we may not always know such things as when there is a holiday in the location where the other team members are, or exactly what time zone difference exists or what the best time to find a particular person is, showing that context sharing is also a challenge to communication. When new information comes up and the information worker does not know whom to inform about it, he or she may not inform anyone or send the information to unnecessary people, which may lead to conflicts.

In this context, we understand communication as the degree to which internal stakeholders such as PO, SM, PM, and the Dev Team create and share information effectively during the software development project.

## *2.2 Social Interactions in Distributed Software Development projects*

Software development can be perceived as a social process involving multiple participants (Ghobadi & Mathiassen, 2016; Kautz, Madsen &

Nørbjerg, 2007; McLeod & Doolin, 2012), including developers, users, businesses representatives, vendors, IT operations staff, and external consultants. These participants must integrate their knowledge to achieve project success (Ghobadi & Mathiassen, 2016). The nature and quality of interactions between participants influence project performance and its outcome (McLeod & MacDonell, 2011; Procaccino, Verner & Lorenzet, 2006). For example, a combination of knowledge is required to fully exploit the potential of project teams (Mueller, 2015) and has a significant impact on successful project outcomes (Park & Lee, 2014).

Established software development methods offer little help in managing complex interactions between actors, and projects often delay addressing integration issues (Bygstad, Nielsen & Munkvold, 2010). Turner (1988, p.14) defined social interaction as "a situation in which the behaviors of one actor are consciously reorganized and influence the behaviors of another actor, and vice versa". He stated that the basic unit of sociological analysis is not action but interaction. Thus, social interaction is a fundamental process in all social organizations. Social interactions are created, sustained, and altered throughout the software development project.

Significant interactions are possible as long as there is trust between participants (Ojansivu & Alajoutsijärvi, 2015; Park & Lee, 2014) and they can understand each other's perspectives (Mueller, 2015). Consequently, the sense of partnership between project members has been considered as a requirement for effective cooperation (Eskerod, Huemann & Savage, 2015; Kwak & Anbari, 2009; Turkulainen et al., 2015).

The success of projects lies in their ability to integrate diverse knowledge and specialties (Mueller, 2015). The disadvantage of diversity is that it can also hinder knowledge integration (Solli-Sæther, Karlsen & van Oorschot, 2015). As Turkulainen et al. (2013) argued: "The temporary nature of projects makes information processing vulnerable to misunderstandings and introduces information delivery barriers" (p. 224).

Dougherty (1992) proposed that those who belong to different domains of knowledge could actually live in different "worlds of thought" and not only know different things but also interpret the same things differently from others. The importance of shared knowledge is emphasized in research (Ghobadi & Mathiassen, 2016; McLeod & MacDonell, 2011; Mueller, 2015; Park & Lee, 2014).

The literature approaches social interaction from different dimensions which include trust, coordination, social ties, and IT Intermediation:

• **Social Ties** are formed largely through social interactions within or outside an employee's formal scope of work and often facilitate knowledge sharing by helping to extend employee contact - for example, meeting more people from different backgrounds, not just those within their immediate working limit; and their understanding of other employees in the company - for example, how good or competent they are (Qureshi et al., 2018). Social interaction bonds can improve cooperative behaviors (Nahapiet & Ghoshal, 1998), and can influence the willingness shown by agile teams to spend efforts to work cooperatively. In informal interactions such as lunch breaks or coffee breaks, members of software development teams can exchange information and discover new insights.

• **Coordination:** The importance of coordination for collaborative work was established in previous studies (Winograd, Flores & Flores, 1986). Malone, Malone, and Crowston (1994, p.4) defined coordination as "the act of managing interdependencies between activities to achieve a goal". Scheerer, Hildenbrand, and Kude (2014) present a conceptual framework on coordination strategies, differentiating mechanistic coordination, which includes coordination through plans or rules, with little communication, and organic coordination, regarding coordination through mutual adjustment or feedback via interaction, adding that communication can be formal and planned or informal and spontaneous. The authors explain that cognitive coordination is achieved implicitly, based on the knowledge that the actors have about one another, being a key facilitator of mechanistic and organic coordination.

• **Trust:** Mayer, Davis, and Schoorman (1995) define trust as the willingness of one party to be vulnerable to the other party's actions based on the expectation that the

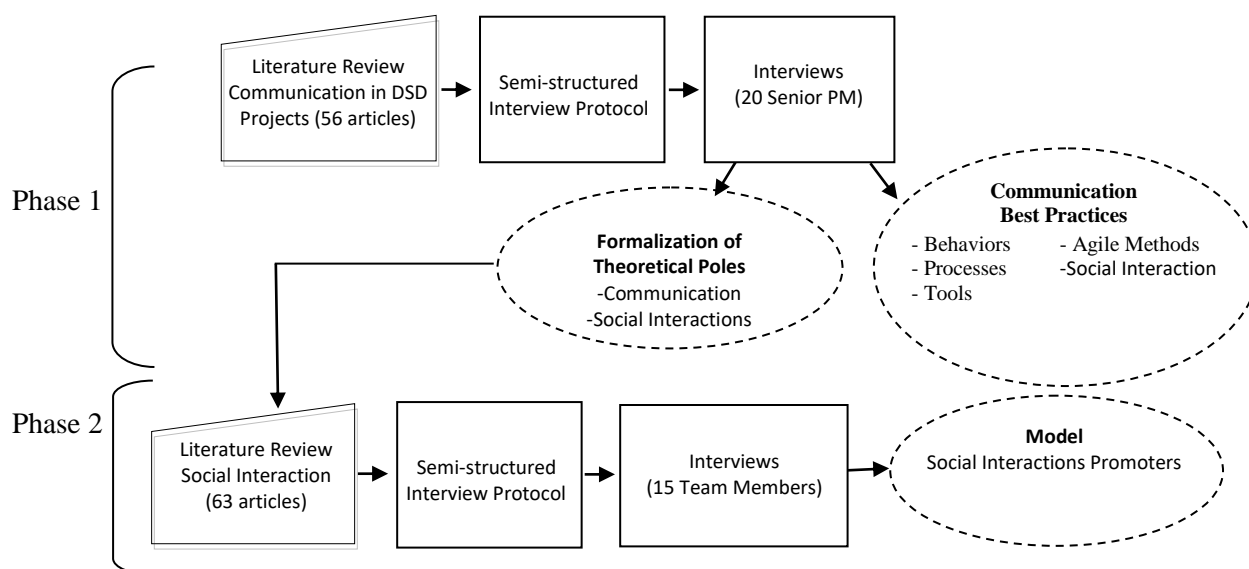
other party will take a particular action that is important to them, regardless of their ability to monitor or control that other party. The definition suggests that trust is an expectation that others whom one chooses to trust will behave reliably and socially appropriately (Gefen, Karahanna & Straub, 2003). It also indicates a party's willingness to be vulnerable to other people (Gefen et al., 2003; Kankanhalli, Tan & Wei, 2005) because they believe others will live up to their expected commitment (Gefen et al., 2003);

• **IT Intermediation:** Information technology is profoundly changing the way all interactions are conducted (Ou, Pavlou & Davison, 2014), including the interactions with which employees in contemporary organizations engage, making them less constrained by space and time (Qureshi et al., 2018). Employees routinely interact using a variety of IT tools such as email, mobile phones, instant messengers, and social networking tools (Koch, Leidner & Gonzalez, 2013).

### 3 Research Design

This qualitative and exploratory research used the interview technique to better understand the phenomenon of how senior project managers perceive communication and how professionals who adopt agile software development methodologies understand how aspects of social interaction influence projects with distributed teams. The article adopts an interpretive approach based on Gioia's assumption that the organizational world is socially constructed and that people at work know what they are trying to do and that they can clearly explain to us what their thoughts, emotions, intentions, and actions are (Gehman, Glaser, Eisenhardt, Gioia, Langley & Corley, 2018; Gioia & Chittipeddi, 1991). Figure 1 represents the research design.

Figure 1 - Research design with its respective phases



We searched the literature for relevant theories and then collected data (Gehman et al., 2018). For the first phase of the research, we conducted a review of the project management literature focused on communication. We systematically searched the ISI Web of Knowledge, Scopus, and Google Scholar databases. We used the following search terms: “Communication” and “Project Management”. We searched in the Google Scholar Advanced Search engine under the “all words” option. Considering the rapid development of technology and the rapid increase in numbers and types of communication tools (Esra'a Alhasanat & Hammad, 2015), we adopted a conservative timeline only considering papers published from 2008 to 2018 on Google Scholar.

From 150 publications returned, we removed the duplicates and after reading their abstracts or the full article, we removed those that did not address the research topic or that cited the terms sporadically. We considered 56 articles for the research corpus. We elaborated an interview protocol (Appendix A) based on this corpus. We conducted twenty interviews over six months with senior Project Managers that develop software for different industries (agriculture, aviation, communication, consultancy, oil, public service, and technology). The respondents have more than five years of experience in projects of this nature and have managed at least one project with teams geographically distributed. Most managers have already led projects with a budget above US \$ 500,000.00 and have solid training in the area, thus presenting a profile that adheres to the study. The interviews totalized thirteen hours and nineteen minutes of recording and generated 190 pages of

transcribed text. We identified a set of communication best practices and formalized communication and social interactions as the theoretical poles of this research.

For the second research phase, we conducted a review of the social interaction literature. We systematically searched the ISI Web of Knowledge on September 2018 using the search term “Social Interaction”, removing categories that were not related to the research objective, such as Psychiatry, Economics, Health Care, etc. From the 3054 returned, we filtered articles from 2008 to 2018 that had more than 50 citations in the past five years. We removed the journals not related to the research subject and read the abstracts or the full remaining articles. We also removed those that did not address the research topic or that cited the terms sporadically just to contextualize their arguments. Thus, we considered 63 articles for the research corpus. We devised an interview protocol (Appendix B), based on the 63 articles.

We conducted fifteen semi-structured interviews with agile team members, such as Product Owners, Scrum Masters, and Developers that develop software for different industries (agriculture, communication, consultancy, and technology). The respondents have more than two years of experience in agile DSD projects and have worked with at least two agile teams geographically distributed in the same project. The interviews lasted over four months, totalizing eleven hours and forty-eight minutes of recording and generating 180 pages of transcribed text. We analyzed the transcriptions in NVIVO v.11, created codes and categories that became concepts allowing us to develop a model of social interaction promotion as

the result of the research. The first phase generated 21 distinct codes and the second one 28 distinct codes.

#### 4 Results Analysis

In this section, we analyze the results obtained in the field according to research phases.

##### 4.1 Communication in DSD

We asked what the main goal of good communication in projects is. I1 explains “Good communication is when... all your stakeholders are clearly informed of what they have to do, what their responsibilities are, and what their project objectives are”. Conversely, I12 already has an understanding of communication as a constructive dialogue “I don't know if I see communication as a goal or as a means ... communication is a matter of understanding, in a sense, what needs to be done and in another sense, validating what is being done”. I8 follows in this same line “Making the team work productively and harmoniously. The key is to get a project team together, rather than a group of project professionals”.

Through the analysis carried out we obtained eighteen mentions from ten different interviewees regarding IT tools as necessary support for communication. We asked about IT tools used that help communication in DSD projects. Features such as planning/tracking, communication, synchronization, and configuration management emerged from this. I9 comments on the use of Kanban, “Trello... organizes the daily life of the teams... to give visibility to what each one is doing for the other”. Planning functions let you create user stories and problems, plan and distribute tasks. Project management tools such as Rally, Jira, TSVS and Access Soft emerged from the interviews. I6 refers to Jira which “is used all day long where all user stories are recorded, all tasks, we follow the point estimation of user stories, so this is a tool that has been used a lot ... more for conducting the project itself”.

A range of communication technologies, both synchronous and asynchronous, mentioned in the interviews include email, scheduling, video conferencing, telephones, conference bridge, WebEx, Wiki, Git, WhatsApp, and Slack. I9 elaborates on the current function of email:

“I think email is more of a formality, more to let other people know that it was actually aligned between the parties. Or to give continuity to distributed teamwork... if you can't make

synchronous communication work, then you end up doing asynchronous to give continuity.”

I3 comments on the importance of videoconferencing “... Without a doubt, this narrows the distance”. The use of group communication tools also emerged. I12 describes the use of WebEx:

“It allows everyone's voice conferencing ... screen sharing ... I may be talking to a group of people from different locations, sharing my screen to show what I'm doing, passing the control to someone else, that person will show their screen ... it allows everyone to have a picture ... use their camera to show their face ... That's what we use most.”

I11 stresses the collaboration functionality of the Wiki “It is a collaborative issue.

Anyone goes there and edits, updates a document, or some specific day-to-day project issue”. The use of Git for configuration management was described by I4 “we leave the technical documentation in Git itself. We leave things about development components in Git.”

The benefit of using WhatsApp for informal communications was recalled by the I11 “For informal customers, to bring people together, you can be free to talk about various issues, not just the project.” Slack has also been widely adopted. I4 reports its use:

“the official communication channel was Slack. We forgot about e-mail ... We just looked at Slack, on the phone or the computer. If we needed to upload a document, we used Slack ... you can link the tool to a Git repository system.”

Glória Jr., Oliveira, and Chaves (2014) propose the use of specific collaborative technologies for projects that use Scrum. However, we identified that the use of collaborative communication tools is independent of the paradigm adopted for managing DSD projects.

Among the communication practices mentioned, the relevance of behavioral characteristics such as transparency (eight mentions from six different interviewees), assertiveness (seven mentions from four different interviewees) and listening skills (ten mentions from five different interviewees) emerged. Some mentions of behavioral characteristics are as follows:

• **Transparency in Communication** - I7 “I always prefer to be transparent... I hardly consider that information cannot be open to staff”. Transparency in communication is also highlighted in Majdenbaum and Chaves (2020).

- **Be Assertive** - I1 “Know how to speak ... directly, assertively, without mincing words”.
- **Knowing how to listen** - I12 “You have to know how to listen, know how to understand what the person needs... have no reservations... confirm understandings, ask questions and make sure this is important”.

Besides that, some actions also emerged, such as: prioritizing social interactions in the team (thirty-two mentions from thirteen different interviewees); raising awareness for collaboration (nine mentions from five different interviewees); controlling communication flow (four mentions from three different interviewees). Excerpts of the interviews illustrating these actions are given in the following:

- **Prioritizing personal interactions on the team** - I4 “Make as much interaction as possible in communication... first prioritizing face to face... if video conferencing, teleconferencing... then tools that enable instant communication such as Slack”.

- **Raising Awareness for Collaboration** - I4 “I do a job of raising awareness that communication must be collaborative within the group that develops the project. If a member has a problem, a colleague might have a shortcut to help solve it”. Unlike Ziek and Anderson (2015), we found evidence of the need to create constructive dialogues between team members through prioritizing personal interactions on the team and Raising Awareness for Collaboration.

- **Control the communication flow** - I20 “if any discussion is going on without the inclusion of the responsible person, let them be included”.

The fieldwork brought to light the importance of communication as a construct to understand the promotion of social interactions in DSD settings.

## 4.2 Social Interactions

In this section, we examine aspects of social interaction found in the field, such as social ties, coordination and interaction influencers that led us to create the model for social interaction promotion.

### 4.2.1 Social Ties

We understood social ties mainly due to the frequency and intensity of interactions among stakeholders. We got eighteen mentions of interaction frequency in the analysis performed in

NVIVO from nine different interviewees. For the intensity of the interaction, we had ten mentions from nine different interviewees.

When asked how often he interacts with the development team, PO I25 states:

“I call people on the team or Scrum Master almost every day ... my interaction is daily and I would say that because I am not with the team I interact more than if I was in person. Because there are things that I can't see, that I am not following, and I care, I ask, I keep watching incessantly until it is clear to the staff what the difficulty is and it is clear to me that the task is being performed the way it should be.”

We asked how trust between the PO and the development team is influenced in situations where the software requirements are not yet mature or clear enough. I26 stated:

“Even if you still don't have concrete results, keep sharing things, your findings, even if they are not fruitful in solving the problem you need ... frequent interactions solve these problems. If you spend a lot of time working on research, trying to deliver something to your PO without giving visibility to what's going on ... it will generate a lot of distrust.”

The influence on the project of the intensity of social ties in the sense of how close one individual feels to another, such as the presence of emotional ties, appears in the following extracts. I28 considers that the intensity of social interactions facilitates the relationship between team members by increasing empathy:

“If the person already knows you, knows your work, already has empathy, they can help you to influence other members with whom you don't have that much empathy. If you do not have it, it is more difficult because the person does not see you, cannot interpret your signs and, depending on the way you speak, you may misinterpreted. If I'm known by the person, they already know how I think, how I act, even if I say something that may sound strange or have multiple interpretations in the emotional sense ... For example, I can say something and they interpret that I'm angry, but I'm really not because it's my way of talking.”

I24 considers that the intensity of the social ties can both positively and negatively influence the project:

“If you end up having too much intimacy with your colleagues, it can become a less serious thing. Therefore, in that sense, you have to be careful not to make it a negative thing. However, when people are well engaged and have good collective thinking it also helps with the team's speed.”

I22 considers that it facilitates the transparency of relationships in the sense that

people feel free to expose their technical difficulties:

“It mainly influences the freedom that the person will have to expose some difficulty of their own ... this emotional proximity of the person helps to make it transparent and allow the rest of the team to create the conditions to bridge technical gaps.”

#### 4.2.2 Coordination

The importance of coordinating agile processes as well as the coordination of stakeholder interactions emerged from the interviews. We obtained twenty-one mentions regarding the process of coordination in the analyses performed in NVIVO from eight different interviewees. We had eleven mentions from six different interviewees for interaction coordination

I22 reinforces the importance of regulating the execution of ceremonies (mechanical coordination):

“A Daily takes place with all teams. There are 35 people in the Daily, so you have to have an organization. If I cannot do it in 15 minutes, then in 20 minutes, 25 minutes, but it is pretty regulated, everyone talks. I personally call people.

I30 comments on the Scrum Master's role in educating the team to get results from agile ceremonies for project control. “It is not the Scrum Master's responsibility to perform these ceremonies, to be the protagonist of these ceremonies. Their role is to train the team so that the team knows how to get results from these events”.

Interaction coordination aims to encourage and direct relationships between team members so that they are aligned with the mutual benefit of the project, such as improving communication, knowledge sharing, the sense of belonging to the group and the sense of responsibility for the product. In all of the examples of cognitive coordination, we highlighted the need for coordination of stakeholder interactions in the following examples: I26 states “We have training sessions that deal with things you should observe within certain cultures ... even simple things like how to greet a person”. I23 describes a way to encourage interaction between remote teams through the video device by providing a vacant chair at the developer tables:

“We have a long table and then a chair in front of TV where nobody would sit ... if there was someone who wanted to go there, talk on the TV... Although it could be disturbing because it's an audio (the noise of the conversation) you don't expect, but it is the same as a local conversation at the table.”

The importance of bringing people together physically at least once throughout the project has also emerged as an action to improve social interactions. I24 comments “... if the company is able to offer a trip for the team to get together, it helps to create empathy with the other team members”. I25 comments:

“We look for close partners ... so we can have the maximum personal interaction. So every fortnight we try to get together. Either I go there or they come here and we do the Planning in person or the Review in person. Therefore, we try to narrow the barriers of distance in planning meetings.”

As the size of the project increases, more formal coordination strategies are needed, such as centralization, vertical communication, personal communication, and formal control, while original agile practices are applicable to each team that remains small or medium (Xu, 2009). The promotion of social interaction in DSD environments requires the use of both mechanistic and organic and cognitive coordination strategies being aligned with the coordination strategies in large agile projects presented by Scheerer et al. (2014).

#### 4.2.3 Interaction Influencers

The field research brought to light such social interaction influencers as trust, barriers, and enablers for interactions to happen. We had twenty-two mentions for trust in the analyses performed in NVIVO from twelve different interviewees. For interaction barriers, we got thirty-two mentions from nine different interviewees. For interaction enablers, there were fifty-eight mentions from twelve different interviewees. Due to page limits constraint, we structured this section in three tables to better present the analysis of the results on interaction influencers. Table 1 shows the main barriers to social interaction in distributed agile teams that emerged from the field illustrated by the interview extracts.



**Table 1 - Barriers to Social Interaction**

Barrier	Interview extracts	# of mentions
Communication challenge	“I think communication gets affected because you do not know how much the person is paying attention to what you are talking about. You don’t know what a person's interpretation of what you are saying is.” I28	8
Time zone differences	“It's hard to get everyone together at the same time, so meetings focus on a specific part of the day. It becomes kind of unproductive and I feel that communication becomes very based on documentation.” I24	4
Differing experiences causing team friction	“The older guy sometimes has some technical disagreement with the younger ones who are full of new ideas in their heads... and that creates situations of pet peeve.” I31	3
The number of Scrum teams and geographies increasing the complexity	“There were fifteen teams with people in Brazil, USA, and India. Therefore, it had a complexity because you had three different geographies, which made it difficult for everyone to be in the same place. The PO brought the requirements and didn't interact with the team, and so we ended up delivering requirements that weren't exactly what they would like.” I26	2
Over scheduling out-of-work interactions	“I've seen situations where people felt uncomfortable. They did not want that kind of relationship and approach. For example, you would take the visitors to their hotel, pick them up from their hotel, take them to dinner ... people felt suffocated because they didn't have much time to do their things.” I26	2
Lack of PO active participation in meetings	“She attended the Daily, but she never said anything. She did not contribute to the Daily, except answering questions. She was very reactive. A reactive PO.” I23	2

Lack of feeling of belonging to the group on the part of the PO, PO focus on technical definitions, lack of team maturity, and different native languages avoiding questions are also barriers that emerged with two mentions each. Some barriers received only one mention, for example, authoritarianism and lack of PO availability, PO behavior perceived as rude by the Dev Team, and avoiding dealing with sensitive topics in Retrospectives.

Table 2 shows the main enablers of social interaction in distributed agile teams that emerged from the field. Openness to listening to different

opinions, grouping each distributed team into rooms, actively seeking interaction in phone meetings, using the Retrospective meeting to get the team closer, and the importance of the SM’s role in capturing team attention are enablers that emerged with two mentions each. Two enablers received only one mention: Symmetry of conditions among teams in meetings (everybody attending virtual) and PO and Dev team writing user stories together. Trust was manifested in the field as a component for both promoting and inhibiting social interactions.

**Table 2 - Enablers of social interaction**

Enabler	Interview extracts	# of mentions
Bringing people closer through face-to-face meetings	“When you personally meet the person you are interacting with daily on the phone, the level of relationship changes... it's no exaggeration to say that it's like going from water to wine, for a number of issues such as empathy, sympathy, nonverbal communication, which doesn't happen when you're just on the phone.” I31	9
Communication tools	“It's pretty easy to find tools that replace the activities you would do in the localized team in the distributed team. ..., there are Plan Poker tools to run with distributed teams. The Skype for Business itself already has a White Board that helps in the Retrospective, people put improvement points, good points, It's very interactive. Each person can put it like a post-it.” I24	5
Follow-up meetings between the SM and each team member, including the PO	“I have 1: 1 where I work on things like: How are you relating to your PO? - Ah, he's not participating much ... so what's going on ... let's see ... when the team is distributed, the role of the Scrum Master gets much heavier.” I30	3
People meeting in different contexts	“When you go to dinner because it is in a different environment, then it changes, people talk more, find out what they like, what they don't like.” I26	3
Openness to listening different opinions	“I try to bring them more and more into the decision while worrying about getting them out of development to participate in it. But I think it's just to avoid coming up with a ready-made decision. So they can help me, even if I know it, but doing it with them to build this bridge.” I28	2
Group each distributed team into rooms	“Sometimes we make a war room where the whole team is together and the other distributed team is in another room and we have the channel open all day as if they were working side by side.” I25	2
Actively seek interaction in phone meetings	“So always paying attention to whether people on the phone are active at the meeting, encouraging them to participate. Seeking interaction is very important.” I24	2
The Retrospective meeting to get the team closer	“The Retrospective today has been our main point of approach. We go through the Review to formalize the delivery of Sprint, but the Retrospective is indeed our time to equalize feelings, perceptions.” I22	2
The importance of the SM's role in capturing team attention	“It's harder to keep people engaged, so the Scrum Master has to be always tuned in as to how to get people's attention because as people are via conference, it's hard to stay engaged.” I24	2

Table 3 shows the main concerns related to trust affecting social interaction in distributed agile teams. Badly defined processes, asking questions to specific individuals only, and different geographies emerged with two mentions each. Other concerns

related to trust, like deliverables not matching expectations, a lot of formality in monitoring activities, and keeping the Retrospective as a safe environment to expose opinions appeared only once.

**Table 3 - Concerns of trust in Social Interaction**

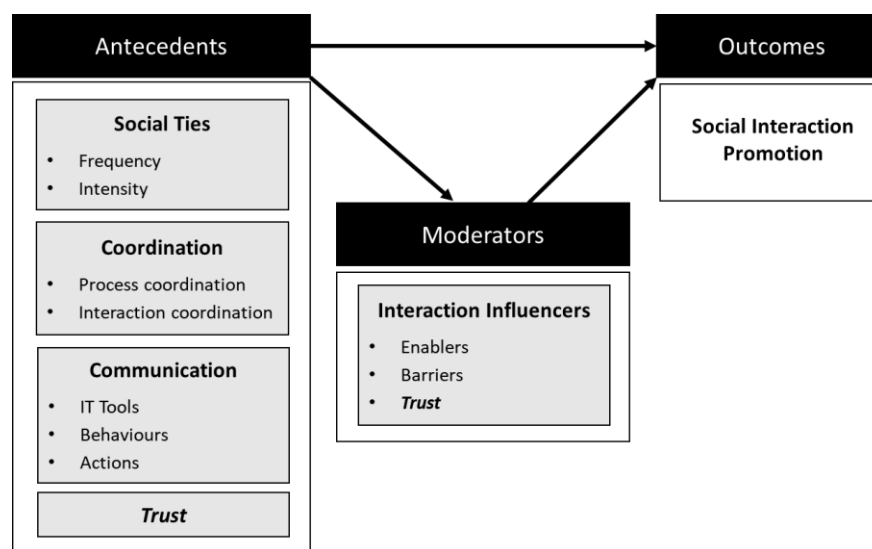
Concern	Interview extracts	# of mentions
Perception as to whether peers are competent	“Trust based on competence... I see people ignoring people they think don't have the same knowledge as them.” I30	4
The behavioral side	“The person is one of the most spectacular people in terms of technical knowledge, but others avoid talking to him. They will only ask him a question if they can't do it with anyone else. There are people who seek knowledge through research, spending more energy to find out something than simply asking because of behavior.” I21	2
Less challenging tasks	“We had very frequent meetings because it was so new. We didn't know how it worked. Each one used to research and then we saw that everyone was coming up with information and we ended up trusting each other because of it.” I32	2
Well-defined processes	“Trust, I think, increases when you have well-structured teams and well-established roles, well-established processes, continuous integration, unit testing.” I26	2

Concern	Interview extracts	# of mentions
Avoid directing questions to specific individuals only	“I always used to look for people with whom I had a stronger emotional trust. But I realized that this wasn't helping me much, so I started always to ask a group. So when I ask a question, I ask a group of people on the Slack channel. I ask an open question: 'Anybody guys?', and whoever can, answers me.” I23	2
Different geographies	“You build trust through a relationship. You end up making friends with the co-worker who is by your side and not just having the professional relationship. You are going to lunch, you are going to have a coffee, you talk bullshit. You do a bunch of things that make you open up and gain that confidence. Technically, it is also important to gain confidence, but it gets difficult due the distance.” I21	2

From the analysis of the interviews and the literature, we generated a model to help promote social interactions in agile DSD settings. The PASI model stands for Promoting Agile DSD Social Interaction and is shown in Figure 2. We used abduction to build the model in a cycle of both deduction, based on theoretical ideas, and

induction, through the interview analysis. The PASI model shows that the promotion of social interactions in agile DSD environments must consider at least social ties, coordination, and communication. The influencers of social interaction can moderate the direction and the strength of the antecedents to achieve the outcome.

**Figure 2 - PASI – A model for Promoting Agile DSD Social Interaction**



The interaction influencers are still debated in the literature. Some authors consider trust as an antecedent for social interactions (Chung and Jackson, 2011), while others consider it as a moderator (Khvatova and Block, 2017). Therefore, Figure 2 represents trust both as an antecedent and as a moderator, being an opportunity for future research to clarify where it fits best. Based on the experiences of practitioners, we noticed the importance of coordinating the social interactions in agile DSD projects. Therefore, we added interaction coordination to PASI as an antecedent to promote social interactions, although it has not been found in the literature.

## 5 Final remarks

This paper contributes to the project management field by providing the practical experiences of the internal stakeholders of agile DSD projects in communication and social interactions. We have not seen social interaction promotion in the literature with mature and defined constructs, although it is useful for practitioners to improve the dynamics of agile IT teams, mainly in DSD settings. This paper answered the research question by generating a model that identifies the

constructs for promoting social interaction in agile DSD environments.

The paper contributes to the theory by delivering the PASI model for the promotion of social interactions in distributed agile projects. The model presents interaction coordination as an important variable that emerged from interviews conducted in the field, not having been found in the literature.

The results can be extended to organizations by raising awareness of the importance of promoting social interactions for activities that require cooperation between individuals to achieve their results. Professionals like Project Managers and Scrum Masters should consider the coordination of agile processes and social interactions as a relevant action for project success. The frequency and intensity of social ties should be carefully considered in the relationships between team members, as well as communication behaviors and actions aligned with the good practices mentioned in this work using appropriate IT tools. In this context, practitioners should also consider the enablers, barriers, and trust among team members.

Further works could observe whether barriers and enablers that appeared only once in the data analyzed also appear in other studies. The promotion of social interactions presented in this model may have its constructs evaluated through a survey. Further research could also apply the PASI model with an interventionist approach (e.g. action-research) in agile DSD settings. Furthermore, the influence of promoting social interactions in the engagement of internal stakeholders in agile DSD projects should be researched in the future.

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**Appendix A - Semi-structured interview protocol - Phase 1**

<b>Interviewee profile</b>	
How old are you? How many years have you been working with projects? How many years have you been working with project management? How many years have you been a member of project teams? Have you ever worked on software development projects with distributed teams? Were the teams distributed globally or in the country itself? What is the biggest project you have worked on in terms of project budget?	
<b>Research questions</b>	<b>Source</b>
Does the company apply any project management methodology, such as that of PMI? Make a brief comment on this question.	Carneiro (2017)
What is your opinion on project management methodologies? To what extent do they assist project managers?	Carneiro (2017)
Do you have any project management certification? (PMI, IPMA, PRINCE2, Australian - AIPM, etc.)?	Molena & Rovai (2016)
What is your highest training in terms of hours in Project Management?	
In your opinion, is there a relationship between performance in managing project communication and project success? How can communication influence the success of project management? Comment.	Chen (2015); Carneiro (2017)
How do you control project communication? What is most important at this stage?	The authors
Report on the importance of communication in a distributed software development Project.	Farias Junior (2014); Carneiro (2017)
Please list the communication problems throughout the distributed software development projects. Now, for each of the problems listed, suggest mitigation or resolution actions for those problems.	Chen (2015); Farias Junior (2014)
What is your opinion about the spatial (geographical) dimension as a communication barrier in the management of a distributed software project? How can it be minimized?	Carneiro (2017)
What is your opinion about the time dimension (time zone) as a communication barrier in the management of a distributed software project? How can it be minimized?	Carneiro (2017)



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What is your opinion about the socio-cultural dimension as a communication barrier in the management of a distributed software project? How can it be minimized?	Carneiro (2017)
What is your opinion about the linguistic dimension (languages) as a communication barrier in the management of a distributed software project? How can it be minimized?	Carneiro (2017)
In your opinion, what is the relevance of communication (interaction between the project team) in a project?	Carneiro (2017)
What type of direct/passive communication does your team use when developing a project (daily meeting, pair programming, training material, source code documents, test documents), for example?	Carvalho & Mirandola (2007)
How do you compare the effort spent on communication compared to other activities (for example, planning, artifact development at each stage)?	Chen (2015)
How can communication drive a project to success or failure?	Ziek & Anderson (2015)
In your opinion, what is the main objective of good communication in projects?	Ziek & Anderson (2015)
In your opinion, what is the key to being a successful communicator?	Ziek & Anderson (2015)
What type of formal/informal communication does your team use in developing a project?	Carneiro (2017)
In addition to the formal and informal communication tools, are there any others used among the members of the distributed teams? (Skype, Whatsapp)?	Gupta (2015); Carvalho & Mirandola (2007)

**Appendix B - Semi-structured interview protocol - Phase 2**

<b>Interviewee profile</b>	
<p>How old are you?</p> <p>What roles have you played in agile DSD projects (Client, PO, GP, Development Team)? Were the teams distributed globally or in the same country?</p> <p>How many years have you been working with projects?</p> <p>How many years have you been working with agile DSD projects?</p> <p>Do you have any training or certification in agile methods?</p> <p>What is the biggest project you have worked on in terms of the number of Agile teams?</p> <p>What is the biggest project you have worked on in terms of project budget?</p> <p>Does the company apply an agile framework like LeSS or SAFe? Comment on this question.</p>	
<b>Research questions</b>	<b>Source</b>
How are the aspects of social interaction present in agile projects impacted when there are teams that are distributed? Comment on these aspects.	The authors
How can you adopt the positive aspects of team interactions in agile projects to agile DSD projects?	McLeod e MacDonell (2011)
What is your opinion about your ability to influence the behavior of other members of the distributed team and vice versa?	Turner (1988)
Are there any initiatives to improve social interactions among the members of the agile teams? How could social interactions improve?	Iden & Bygstad (2018)
How does the frequency with which you interact with the team influence the project? At what stages of the development cycle are interactions most frequent?	Qureshi et al. (2018)
How does the intensity of relationships represented by how close an individual feels in association with another - for example, emotional ties, influence the project?	
How does background homogeneity - characterized by shared similarities, like experience and appearance influence social interactions?	
How does the multiplicity of contexts in which individuals interact (for example, attending the same club or having participated in previous projects) influence the project?	
Do members of DSD agile teams inform each other about issues of major importance? How?	Iden & Bygstad (2018)
Do teams use similar terms, do they have a common language?	
How are meetings managed with distributed teams?	

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Do DSD teams participate in planning activities together? How?	
Is knowledge spontaneously shared between teams? How does this sharing happen?	Basir & Salam (2015)
How does the execution of tasks that are uncertain and unknown influence trust relationships between team members?	Khvatova & Block (2017)
What communication tools are used between team members?	Gupta (2015)
How does IT mediation influence trust relationships between participants in social interactions?	Qureshi et al. (2018)