Globally Distributed System Developers: Their Trust Expectations and Processes

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ABSTRACT

Trust remains a challenge in globally distributed development teams. In order to investigate how trust plays out in this context, we conducted a qualitative study of 5 multi-national IT organizations. We interviewed 58 individuals across 10 countries and made two principal findings. First, study participants described trust in terms of their expectations of their colleagues. These expectations fell into one of three dimensions: that socially correct behavior will persist, that team members possess technical competency, and that individuals will demonstrate concern for others. Second, our study participants described trust as a dynamic process, with phases including formation, dissolution, adjustment and restoration. We provide new insights into these dimensions and phases of trust within distributed teams which extend existing literature. Our study also provides guidelines on effective practices within distributed teams in addition to providing implications for the extension of software engineering and collaboration tools.

Author Keywords

Trust; Trust expectations; Trust processes; Systems development; Globally distributed teams; Multi-national organizations; Empirical study.

ACM Classification Keywords

H5.3 Group and Organization Interface: Computer-supported cooperative work; K.4.3 Computers and Society: Organizational Impacts: Computer-supported collaborative work.

INTRODUCTION

Globally distributed system development (DSD) faces a

number of sociotechnical challenges [11]; trust is just one challenge that must be overcome for effective and efficient collaboration in this area [1]. One of the most prevalent definitions sees trust as a belief that the trustee (individual, team and/or organization) will meet the positive expectations of the trustor (individual, team and/or organization) [1]. While we take this understanding of trust in terms of expectations as a starting point, we seek to gain a deeper understanding of what these expectations are and the processes that influence trust in DSD teams. Specifically, our guiding research question is: *How does trust play out among globally distributed development team members?* By contributing to a better understanding of trust *in this specific context*, we hope to inform the organization and management of these teams as well as the design of communication and collaboration tools to support this work.

To achieve our goal, we interviewed individuals working in DSD teams within 5 multi-national organizations. We specifically sought to investigate three aspects based on our understanding of trust as a dynamic process which involves expectations. First, we sought to understand what individuals within DSD teams expect from others during their collaboration. Second, we are interested in gaining insights into how individuals experience trust during their collaboration. Finally we wanted to identify the factors that influence the trust development process. This deeper understanding of trust can guide the development of future collaborative tools and extend existing tools to better support DSD teams.

We found our participants' expectations of others fell within one of three dimensions: *moral social order*, *concern for others,* and *technical competency*. We also found that the study participants described various phases of trust *processes*. We discuss these findings in the context of DSD, thus we extend existing literature. These findings are discussed in subsequent sections following our review of relevant literature to present an understanding of trust. The paper concludes with a discussion of our findings and directions for future work.

AN UNDERSTANDING OF TRUST

Trust has long been considered an important aspect of all social relationships [4]. It is a fundamental part of effective collaborations, as collaborators are more likely to collaborate, share knowledge and accept others' contributions when trusted [1].

We derive our understanding of trust from our previous work and from the literature. Furst et al. [9], for example, conclude that an individual's trust in their team refers to the likelihood that team members will live up to expectations, whereas Sabherwal [19] considers trust a "state involving confident positive expectations about another's motives with respect to oneself in situations entailing risk." In other words, trust can be considered one individual's expectations of another, and the former's willingness to be vulnerable based on those expectations [2]. These definitions of trust suggest that expectations, and consequently a sense of trust, can form and possibly change over time as an individual interacts with others. Trust formation and change over time in turn suggests that trust is a *dynamic process*.

We found two expectations frameworks particularly useful in analyzing our data: Barber's categories of expectations [4] and Fulmer et al.'s process model [8]. Barber [4] posits that all social interactions are acting upon expectations, which are part cognition, part emotional and part moral. He found that people's expectations develop into various *structures* and *processes*. Structures are often used to refer to people's expectations like referring to a person in their team as a manager, programmer, or tester. Although our discussions of trust are generally presented as positive expectations; we also consider changes in expectations from positive to negative, e.g. the expectation that an individual will fail to meet a deadline. This expectation of failure may lead to negative trust [1]. We therefore do not consider trust a static relationship but rather a complex dynamic *process* influenced by many factors that evolve and adapt in harmony with individuals' perceptions and changing expectations. Fulmer et al [8], consider this dynamic process as a series of three phases: trust formation, dissolution and restoration which denote met expectations, failure to meet expectations and instances in which individuals' trust is restored, respectively.

Barber [4] goes on to outline three different categories of expectations, namely: expectations of persistence of the natural and moral social orders, technical competency, and finally the expectation that the trustee will meet fiduciary obligations and responsibility in certain situations. Based on our review of his work, we understand these expectations to be as follows:

1. Social order: The expectations of the persistence of the natural and moral social orders refer to the internalized expectations that life will continue as usual. Such expectations within the context of systems development can be used to refer to the predictability of behavior e.g. people will behave as expected in a given situation.

2. Technical competency: The expectations of technically competent role performance within a given role may be dependent on knowledge, skill or other factors that enable an individual to perform the tasks within their roles. In this context, expectations are typically based on perceptions of what a certain role entails and the anticipated level of knowledge and technical facility.

3. Concern for others: What Barber refers to as "fiduciary" expectations include the expectations of obligations and responsibility that go beyond technical competence, such that an individual demonstrates concern for others' interest above their own. This includes team members fulfilling their role within the team regardless of their own agenda.

A breach of one or more of any of these expectations can have a negative impact on trust. Barber uses these dimensions of trust to frame his discussions of individuals' trust within the context of family, foundations, politics, and modern institutions (business and professions). We will use his dimensions to frame our research findings as we sought to understand what globally DSD team members expect from others, how they experience trust and the factors that influence this dynamic process.

METHOD

We conducted an empirical study across five Fortune 500 organizations that share the common characteristics of being multi-national and a leader in the development of computer-based systems worldwide. We recruited 58 subjects through a combination of email sent through a cross section of the organizations' mailing list and word of mouth (snowball sampling).

We interviewed 17 female and 41 male employees who were assigned to a wide range of projects within their organizations. The one-on-one semi-structured interviews lasted for an average of one hour and consisted of two main sections. The first section focused on the participant's demographics, role in the organization, and current project. For example, we asked the participant to choose a current or recent project (completed in the last year) in which one or more of the team members were geographically distributed. Each participant was a member of a team that was globally distributed across temporal and spatial locations. Participants described the project and discussed their trust in their team members.

The second section of the interview was designed to elicit deeper discussions about trust in the context of the participants' work. We began this section with a discussion of the meaning of trust; the interviewer asked the participant "*what do you mean when you say you trust John or Jane?*" A discussion ensued and typically concluded with a shared understanding that trust is about *expectations*, *reliance* and *risk*. Subsequent discussions typically included these key concepts associated with trust. We then presented participants with hypothetical scenarios, for example, "If you were forming a team to work on the next version of

your current project, who would you choose for that team and why?" We then followed such questions with a discussion of their response. We also asked participants to tell us stories of instances when trust became an issue in their current project and others they have been involved in.

One of two researchers conducted each interview either face-to-face (F2F), over the telephone or through VOIP. Participants were drawn from 10 different countries of the world: the United States (33), Brazil (16), Mexico (2), Costa Rica (1), Ireland (1), Israel (1), Poland (1), China (1), Taiwan (1), and Malaysia (1). It was common for a participant to be working on the same project with team members located at different sites. Participants had an average of 11 years' experience working in distributed teams and 12 years' experience in the organization. Overall, participants had an average of 21 years of work experience. The participants' roles in the distributed team fell into one of three broad categories: managers - 20 (e.g. project manager), developers - 33 (e.g. systems architect), and support staff - 5 (e.g. lawyer). We refer to them collectively as developers as they are all members of a DSD team working toward developing an IT-related product.

Data Analysis
All interviews were transcribed, and transcriptions were prepared for analysis in the ATLAS.ti qualitative data analysis software [3]. Qualitative coding proceeded in stages. A team of five researchers were involved in the analysis and coding process. Due to issues of timing and site access, it was not possible to conduct simultaneous or iterative data collection and analysis. Instead, we treated the interviews as a fixed dataset, and analyzed them using techniques adapted, in part, from grounded theory approaches [6, 7].

Analysis began by dividing the interviews equally among the researchers. Each researcher conducted open-coding on a subset of transcripts, with the instructions to identify any statement in which the participant provided a definition of trust, an explanation of why they trust someone, or a rationale that drives a behavior or decision. The researchers then discussed the code lists each had generated, collapsing and unifying codes where there was commonality, and identifying unique codes that only one or two researchers had identified for further investigation. Each researcher then returned to her subset of the documents in order to unify the coding, look for instances of codes that had been identified by the other researchers, and generate new codes as needed. In the next phase of analysis, all of the documents were combined in a single ATLAS project file, and the researchers each took responsibility for a subset of the codes, writing descriptive memos about the emergent categories. Analysis continued in parallel, as the researchers wrote, shared and discussed memos, added to and refined the coding scheme, and analyzed the primary documents.

As the coding scheme was refined, we used a technique of comparison against findings and frameworks in the

literature to identify the extent to which our developing insights fit existing theoretical explanations. Trust research is a theoretically flooded area (e.g. [4, 12, 14]). Rather than add to the general confusion of trust models, our goal is to specifically identify how existing frameworks apply (or do not) to the specific site of DSD. As such, rather than adopt Glaser's call to avoid the research literature [10] we engage with it directly. We used existing theoretical frameworks in the literature as a way to interrogate and challenge our developing category scheme. We paid special attention to which of our categories matched easily, which were struggles to fit, and those categories that did not fit a given framework. For example, when comparing our categories to a decision-theory framework [15], we found that the language of constraints could be useful for thinking about issues of organizational and geographical distance, but that the distinction between internal and external mental processes was less salient in our data. This process, repeated against several different trust frameworks from our literature review, then generated and informed further coding, memoing, and group discussion.

In the sections that follow, we discuss our findings, using two theoretical frameworks that we found to be most consistent with our data: Barber's model of expectations [4] and Fulmer's model of trust stages [8], both of which are outlined in the previous section.

FINDINGS
The context for this study is globally distributed systems development (DSD), and it is important to understand the ways that certain characteristics of the organizational and task context shape our findings. First, all of our participants are employed by large, multi-national firms engaged in systems engineering. These organizations typically have central headquarters and many satellite offices around the world (operating as separate divisions, wholly-owned subsidiaries, or sub-contractors). Second, almost all of our participants work in matrix organizations where they are members of a specific functional unit and are assigned to one or more product/project teams. For example, someone may be a test engineer (unit) working on a piece of accounting software (product). These large organizations work to promote strong corporate cultures through various organizational procedures, policies, and training events. Employees often have relatively long tenures within these organizations: the average among our participants is 12 years, with several of our participants reporting more than 30 years with the same firm. Global collaboration is becoming the dominant mode of work in these organizations, and it is typically supported through information technology infrastructure with specific tools for collaboration support including project management and communication tools.

Finally, risk plays an important role in many definitions of trust [1], and the organizational structure in which most of our participants live plays a significant role in shaping the risk preference. Systems development in other contexts,

even if it is globally distributed, is likely to look very different in terms of how trust plays out. Arenas like community-based open-source development or small start-up firms are likely to be higher-risk ventures, or at least will not have the same set of organizational resources available to manage the risks. This clearly places limits on the generalizability of our study.

Trust as Expectations

We found that most participants discussed trust in terms of their expectations of others and whether or not these expectations were met. For example, one female developer located in the US justified her trust towards others in her team stating: "*I can always rely on them to meet my expectations.*" (P7)

Expectations have been identified frequently as an important aspect of trust e.g. [2, 4, 16]. In this section, we adapt the framework proposed by Barber to structure our discussion, and to highlight the specific ways that expectations play out in global systems engineering context.

Barber's model, outlined in our discussion of trust, suggests that trust relies on meeting three kinds of expectations: *social order*, *concern for others,* and *technical competency*. In the rest of this section, we discuss how each of these plays out in our data.

Maintaining the Social Order

In Barber's framework [4], trust relies on expectations that others will act in a way that is consistent with the social order. In other words, we expect that others will act in a way that is consistent with cultural, organizational, and other social norms. We found that our study participants typically discussed aspects of professionalism, and our analysis led us to conclude that maintaining a certain level of professionalism is essential to the persistence of social order. The primary concerns discussed include: honesty, politeness, and meeting commitments.

Honesty is a common form of moral social order. Many of our participants have an expectation that others tell the truth and think that honesty is "*one factor*" that is important to establishing trust. It is especially prized in difficult situations, for example, when giving critical feedback. Many participants emphasized the importance of not withholding *negative* feedback especially, and providing such feedback in a timely and appropriate manner. As one female manager located in the US, explained: "*They were absolutely honest with me. So, if things were not going right, instead of - they would let me know, but they'd let me know in an appropriate manner.*" (P6)

Here, we find that the participant describes an implied social order where she expects others to be honest. Many other participants emphasized that it is expected that others would freely (but appropriately) share information, outcomes, and opinions. P6's statement exemplifies others who valued negative feedback.

Appropriate professional conduct was also frequently cited as contributing to trust. One male manager, located in the US, explained an incident which led to the dissolution of trust: "*This man started swearing at people. And immediately that broke quite a good bit of trust with certain individuals who personally found that offensive.*" (P18).

Our participants also frequently cited a particular aspect of expectation of professionalism that was very important: whether or not others met their commitments. It is not surprising that meeting commitments plays such a large role in distributed development. The work tends to be deadline driven, and cooperative work is often managed through a divide-and-conquer strategy, in which distributed individuals and subgroups are assigned portions of the task that will be their responsibility. However, if someone does not complete their portion of the work on time and to specification, it can cause delays and other problems across the whole project. Monitoring others' activities from a distance is difficult. A clear sign of lack of trust is how much monitoring and follow-up is required. One male manager located in the US explained that his trust in someone depended on "*how many times I have to go back and keep asking them, or even worse, call them on the phone and walk through it.*" (P40)

Response to emails is also considered by many participants as a basis of trust and a characteristic of professionalism. One participant, a male developer located in Brazil, explained his expectations of others to respond to his queries as follows: "*if these people takes more than three or five hours to answer you back, it's hard to trust in other things.*"(P33). Another stated that "*trust is really shook up*" if a response is not received "*within a week*" (*P36*). Others recalled instances in which a non-response led them to assume that their remote team members may have a public holiday and created negative trust when the team member claimed the email was not received (e.g. *P33*). Some participants stated that they would appreciate some form of acknowledgement, even if only it is an email to inform them it would take a few days to provide an answer (e.g. P35).

Expectations about meeting one's commitments are an important aspect of trust and a complicated one. In global development, the teams typically include people from a number of different cultural backgrounds. What it means to make a commitment, and the behaviors associated with making that commitment, tend to vary across cultures. As one male manager, located in the US, explains his experiences with others of different cultures: "*Certainly different cultures have different ways of saying yes and no or they'll say it and they don't mean or it's difficult… People are very willing to say yes when they're not committed, especially in other cultures. They just don't want to disappoint you, but they're not really committed and I was surprised by that a few times.*" (P3)

In international and cross-cultural interactions, expectations about maintaining the social order become particularly fraught. The meanings of a "yes," appropriate modes of expressing conflict, expectations about working in the evenings or on weekends, and many other aspects of organizational life, are all part of culturally-specific social orders. If the social order varies depending on the location of the team member, trust can suffer, not because of a personal failing, but as a result of differences in understandings of the social order [2].

Demonstrating Concern for Others
Barber [4] refers to "expectations of fiduciary obligations," or expectations that others will demonstrate concern and interests that extend beyond their own personal needs and gains. We take a broad view of this category that includes a consideration of others' needs and also one's dedication to the team and organization, sometimes including an "*element of self-sacrifice*" (P17).

We found that our participants typically discussed their sense of commonality as being important to their sense of trust towards others. This could involve shared goals, meanings, styles of working, or morality. This commonality led our participants to feel that they could predict others' performance. We found instances where participants stated that they could predict others' behavior because they shared emotion (e.g. passion for the project), ideals (e.g. conviction), culture or shared goals and agendas.

One way this category emerged in the data is that participants are more likely to trust others who share their emotions about the project or product. One male software engineer located in Costa Rica described how he picked collaborators: "*The idea is if you can include people that have an excitement about it either as part of the idea or can be excited about executing it, then we try to assign those folks.*" (P3)

Similarly, a female lawyer located in the US, said: "*I think it would be dependent upon whether or not they were passionate about the idea as well. So I think it would be more knowledge and passion.*" (P7)

Being passionate about the project also demonstrates a commitment to something outside of ones' own self-interest, and our respondents both tended to trust and want to work with enthusiastic and passionate people more.

Participants' trust also relied on their sense that others shared their ideals and work ethic, implying that this commonality engenders trust. One participant, a male manager located in the US, stated: "*I felt that we were all working towards common goals, I felt that they demonstrated technical credibility and that they had the respect of their peers and I have several personal experiences with them in difficult situations that showed that they could deliver.*" (P10)

In this statement, we find that the participant uses his experience of others on his team to predict future behavior.

First, we find that he has determined that others shared his goals and those of the team, therefore they will collaborate and commit as he does. Second, he was able to determine a certain level of technical competence and assumes this will continue. Finally, he uses the insights gained from his peer network and his sense that those peers respect team members to conclude that others have found them reliable and predictable. Ideals such as confidentiality and loyalty are also important traits that participants listed amongst their expectations of others' moral correctness. We observed that loyalty to the team is a core expectation whereas loyalty to the individual is often considered an additional bonus.

Other participants demonstrated an awareness of the role that culture, *shared culture* in particular, plays in determining others' understanding of moral obligations. They acknowledge that people from different cultural backgrounds may vary on moral obligation. One developer located in Brazil, for example, typically sought others born in Brazil as their contact in remote locations i.e. (P33).

These findings suggest that there is a degree of overlap between expectations of *social order* and *demonstrating concern for others*. We observe that some participants expect team members to collaborate within the norms of their ideals and we therefore treated these expectations as part of the *natural social order*, whereas other participants regard others sharing such ideals to be beyond the norm and we therefore considered them showing *a concern for others* which extends beyond their own personal needs and gains.

Demonstrating Technical Competency
In general, system development requires a high degree of technical skill. We made four overarching observations regarding our data. First, we observed that study participants generally expected that all team members would possess the requisite technical competence to do their job. Participants believe that specific organizational structures, processes and practices make it possible to simply assume a certain level of skill from their team members. In other words, our participants expect that team members will have the required technical abilities because their organization's stringent performance reviews and intensive internal training maintain a universally high level of expertise among all employees. For example, when asked about technical competence, a male developer located in the US stated: "*... there's also something to be said for the fact that they are [org_name] employees and one of the criteria for getting in the group is that you've been with [org_name] for a while. And so, absolutely, I'm not saying that just having an [org_name] badge makes you a trustworthy person, but it certainly is one factor.*" (P49)

Second, we found that participants were generally confident in their understandings of the roles that each team member and remote site played within the context of their project. For example, a male developer located in China felt it was important to understand the role of each location during the

collaboration: *"… and [we know] what kind of role the Shanghai team will be playing, what kind of role in Malaysia team will be playing, what kind of role the U.S. team will be playing.*" (P46)

This understanding of roles allowed participants to appreciate when their team members went beyond the confinement of their role to support others working on the project. The following statement, made by a male support staff member located in Malaysia, illustrates that he has often encountered team members that fulfill their role and go beyond his expectations thereby giving him a sense of team cohesion: "*…today I look at that team as one that has a very teamwork and lots of positive surprises where people would go the second and third mile to accommodate some of the needs that I'm facing over here in Penang.*" (P5)

Finally, we found that participants valued other competencies that impacted *how* they carried out the tasks associated with their role. One key form of competency was an organizational or process competency, e.g. people who could successfully navigate corporate bureaucracy or evaluate ideas for their organizational as well as technical acceptability. Study participants often implied that they trusted others who could provide insight into the dynamics of their team interactions. It was important that decisions be clearly communicated, but also that the rationales (especially if non-technical) should be clear. When rationales weren't explained, trust could be hurt e.g. (P35).

Interestingly we found instances where participants stated that they valued moral correctness more highly than technical knowledge. In such instances, participants acknowledged the importance of being able to rely on fellow team members and not need to second-guess their actions or tasks once these had been discussed.

In sum, Barber's framework of trust is a lens through which we can categorize our results into 3 categories of expectation: *social order*, *concern for others,* and *technical competency*. We found that professionalism, honesty, politeness, and meeting commitments are values that form expectations about social order.

In addition, we found that participants were more likely to trust others who share their emotions about the project or product. Demonstrating this passion to others and being aware of shared culture allowed participants to predict each other's behavior which in turn resulted in more trust. Additionally, participants trusted those who demonstrated competency in technical and organizational areas, as well as team interactions. Thus, our results indicate that these expectations form the foundation upon which trust rests.

Trust as a Process
While our findings about the types of expectations are consistent with Barber's model, we also found that, for our study participants, trust is a *dynamic process* that cannot be fully explained by Barber's model. To understand this aspect of trust, we engage the work of Fulmer et al [8],

which describes trust as evolving through three stages: trust *formation*, *dissolution*, and *restoration*. *Trust formation* is the phase in which individuals develop trust over time, whereas *trust dissolution* occurs when trust erodes as a result of others failing to meet an individual's expectations. *Trust restoration* can occur when trust stops declining after violation and eventually reaches some relatively stable state. We observed these stages in our study, and also observed an additional phase - that of *trust adjustment.* Trust *adjustment* occurs when individuals adjust their expectations so that they can be met by others and it therefore enables *trust restoration*. While we identify these phases with distinct names, we recognize that they do not necessarily occur in distinct phases. We found that these phases intertwine and overlap; moreover, the sequence of these phases can also change.

In the next sections, we describe each of these stages in more detail in relation to our participants' experiences.

Trust Formation
Our participants typically discussed *trust formation* as occurring over an extended period of time as a result of interpersonal interactions. They discussed the formation of trust as being contagious, an emotional process which involves developing empathy with others in the distributed team and an awareness of different cultures (work styles, language, etc.). Their statements also suggest that while many felt that they had a baseline level of trust that exists because of their trust in the organization's hiring process, they also recognized that different forms of trust developed based on the roles of the trustor and the trustee within the team (e.g. peer-peer vs. team member-manager). Finally, we found that many relied on others' previous performance to initiate the trust formation phase; conversely, we also found instances where participants stated they preferred providing their team mates with an opportunity for a "*fresh start"* (P54).

Our study supports findings that trust is built over time [1]. We found many instances in which our study participants referred to trust developing either through a planned strategy to test others' trustworthiness or through the opportunities afforded to demonstrate their own trustworthiness. For example, the following general quote from a male developer located in Brazil illustrates the need to form trust gradually over time: "*... trust is something that you need to build, it's not something that you're gonna get on your first meeting. You don't know that person, you don't know the skills that uh she or he has, and things like that.*" (P13)

Similarly, another participant located in the US considers trust formation as process that is forged from shared experiences and *"common battles together"*. These statements exemplify many participants' perception that their trust in others has developed over an extended period of time through a series of interactions. This perception of participant's trust towards others is extended by an

awareness that others trust' towards them must be gained by meeting others' expectations to "*build up that bank account with them*", as one male manager located in the US explained (P18).

Our participants had mixed thoughts about whether trust could successfully be built without face-to-face (F2F) interaction. For some, F2F meetings were crucial to gain insights into others' concerns and understand where they were coming from. Others felt that they acclimatized to non-F2F interactions and focused more on the nature of their interactions rather than the medium. There is, however, a general agreement that *frequent* contact is important, and that, if given the choice, F2F is preferable to non-F2F, and that richer mediating technologies (e.g. video- and audio-conferencing) are better for trust development than leaner (e.g. e-mail).

Personal networks are also very important in trust formation. Participants are more likely to trust others who have been introduced or referred by someone they trust. Our analysis of such statements suggests that people who have long-term experience in the organization could play an important role in supporting the development of trust. For example, a US-located manager was confident that he could form trust with most people he needed to collaborate with: "*… I've been at [org_name] for 18 years. I know a lot of people inside [org_name]. And never do I go to a meeting where there isn't somebody there that I know who can introduce me to somebody else.*" (P21)

Participants reported that frequent interactions promoted an understanding of other cultures in terms of diverse working styles, humor, use of language, and shared knowledge. Frequent interactions also helped participants read the "tone" of someone's communications. Tone is often implicitly implied in written communications or explicitly heard in spoken communications. Such cues are often the only clues team members have when interacting with others in remote locations. For example, one manager located in Brazil described why he liked to meet with his French colleagues: "*I think talk is really important… when I come and go to talk about that with people they take it easier. Okay, he's like that. He's not angry at me; he's just like that.*" (P17)

His statement suggests that he feels that the French team members are better calibrated to his way of expressing emotion and tone because he spent time with them and they met F2F.

The formation phase of the trust process is considered by some as an emotional process in which the role within the team determines the level of involvement and the degree of empathy which can be felt by the participant. For example, a manager located in the US (*P3*) explained how his sense of trust is formed within the boundaries of team members' roles and determines the nature of the collaboration. Another participant, a developer located in Brazil (*P34*),

describes the emotional aspect of trust formation as developing an *empathy* towards trusted others.

Trust Dissolution
Trust formation and growth do not always continue unchecked, but rather can undergo *dissolution*. Others have found that trust breaks down in electronic contexts [18], but our findings suggest that there are a variety of reasons for trust dissolution. Participants often reported instances in which their trust towards others declined as a result of others failure to meet their expectations. Participant's trust in others also declined if they sensed that others did not trust them (e.g. questioned the truthfulness of participant's statements). *Trust dissolution* is also often precipitated by fear of job loss, negative reputation or differences in culture coming to the fore.

Previous work has led us to conclude that the dissolution of trust in distributed development teams can lead to individuals working in isolation or re-doing others' work, which leads to the erosion of team cohesiveness [2]. In previous sections, where we discussed trust expectations, we discussed instances in which others failed to meet study participants' expectations and the participants' attempts to cope with such failure. The following statement, given by a male manager located in Malaysia, exemplifies the general sentiment that some basic level of baseline trust can exist and grow, unless the participant finds that such trust is unfounded: "*I'm a person that I would trust you until - unless you give me reason not to.*" (P5)

We conclude from statements similar to these that failure to meet expectations, regardless of which category these expectations fall under, can lead to the decline of trust.

Our analysis of coded data led us to observe that the dissolution of trust typically occurs when a change of context arises. Changes in context occur as a result of the participant working with others on a new project, or when others employment status changes from an employee of the organization to a consultant or contractor. In such instances, while participant's expectations remain the same the new context may mean that team member fails to meet those expectations. The following statement, for example, made by a male developer located in Brazil illustrates the influence of roles within the team (i.e. business team): "*People who are the [business unit] are having difficulty to get the trust from the business partners because…. those guys, they are not always open to share.*" (P13)

Other instances of trust dissolution were a result of fear of job loss or failure to meet the participant's expectations regarding communication, in terms of timeliness, truthfulness, or honesty. The dissolution of trust because of the fear of job loss is closely associated with poor communications and a perceived lack of transparency. For example, one manager located in the US explains others' experience of fear of job loss as leading to dissolution of trust: "*Every time you tell them, no, look at how this is*

structured. They don't believe you because everybody is so d--n (expletive) scared about getting shut down." (P21)

Participants also discussed less positive encounters with agendas of some of the remote locations that competed for project ownership. Such statements often include the participants' description of their coping strategies e.g. the need for extra control by attending meetings, checking up on others to make sure they followed through or enforcing a reporting hierarchy.

Others experienced the dissolution of trust as a result of communication breakdown caused by the relatively large team size. The benchmark for the optimum team size varied greatly. This may imply that it is not so much the size of the team in some instances, but rather the mismatched expectations of the team members.

Other mismatches could be caused by cultural traits of the distributed team members. The awareness of differences in culture often leads to participants anticipating differences during interactions and arousal of suspicion between diverse collaborators. Participants described how they had to bridge between two or more mismatched cultures that caused trust dissolution within the team as a whole, e.g. (P6).

Trust Adjustment
While Fulmer [8] claims that trust restoration occurs when "trust stops declining after violation and starts to rebound, eventually being relatively stable", we found that this transition from dissolution to restoration requires an adjustment of expectations. Participants generally discussed their need to make adjustment to other cultures which they determined was the cause of the dissolution. The period of adjustment phase allowed many of our study participants to transition into the next phase of the trust process - trust restoration.

A failure to meet expectations often leads to a decline in trust or trust dissolution. Our analysis of the phases as experienced by study participants and within the trust process proposed by Fulmer [8], led us to identify a phase that has not been widely reported. Practitioners assigned to a project cannot typically leave the project if negative trust has developed towards one or more of their team members. We found that participants typically attempted to *adjust* their expectation when they were not met - such that they can be met by others.

We found many instances in which participants chose to continue working with others who had not met their expectations when presented with a hypothetical scenario where they could choose team members to work with. They acknowledged the existence of negative trust towards some of the current team members but rationalized their choice by stating that they now knew what to expect and had learned to cope. As such, *trust adjustment* refers to the phase in which individuals reflect on their expectations of others, why these expectations were not met, and how they

need to revise their expectations during interactions to *restore* some level of trust.

One participant, an experienced lead developer located in Brazil, described the adjustment of her expectations regarding her PM. This adjustment took some time because they both expected different work styles, as she explains: "*And about the PM. Uh, now because we are working for some time I would say we can, we have a high trust. But at the, at the beginning you don't have, we didn't have because she has a totally different way of working. I've never worked with a PM like her before.*" (P52)

We found that participants typically reflected on their experiences with others to identify the cause of the discord and guide them through the adjustment phase of the trust process. One software engineer located in Brazil described what led him to adjust his expectations as follows: "*...by my interaction with them. By experience. By situation where I was trusting them, there was a certain action item. I figured out that wasn't exactly the product; it wasn't exactly what happened. So it's based on experience.*" (P17)

One senior US manager discussed the dissolution of trust in his team, and acknowledged that his failure to nurture the team affected the level of trust. His statement suggests that he did not expect team members to need guidance and his reflections imply he has revised his expectations to more closely reflect the team members' ability to perform and work together: "*And that's the part that I think I could have made a difference in the overall trust of the team had I been able to spend the time working with that team in a more one on one guidance, leadership type basis; take the politics out of the discussions.*" (P21)

Participants predominantly reported that they needed to adjust to others because the cause of the dissolution was cultural; some reporting that their exposure to other cultures and travel has enabled them to gain a better understanding of others and revise their expectations. Such cultural adjustments are not limited to interaction among team members from different countries; they also include adjustment to different regions within the same country as highlighted by a manager in Mexico (P32).

Trust Restoration
Trust restoration typically occurs when individuals attempt to rebuild their sense of trust towards others. We found that many participants discussed instances in which trust *restoration* can occur as a result of the *adjustment* of expectations. Once individuals have reflected on and revised their expectations, they can then begin to rebuild trust using expectations that more closely reflect the reality of their collaborations with others. While restoration is possible, it is not an easy phase or necessarily one that can be taken for granted. A portfolio manager in Brazil made the following comment: "*I mean, if you break that [trust], the work required to regain trust is very high.*" (P12). Other participants explicitly stated that they were never able to

restore trust towards their team members and this typically led to a breakdown in their collaboration.

Participants also recalled working in teams and having to restore trust amongst disparate cultures of two geographically isolated sites. An experienced female manager in US found that previous negative experiences among team members or units led to ineffective collaboration: "*There was a lot of historical bad feeling, as I said earlier. So, part of my job was to bring this into a cohesive team to deliver the capability in the most efficient manner for [org_name]. My recommendation towards the end of the program was actually an org change. That we [re]org these people so that they could work better together.*" (P6)

She further illustrated her points with an example of differences in working styles between the participant located in the US and team members located in Israel: "*It absolutely, it was my learning that I needed, for these people-we're talking engineers, we're talking technical people-is that it will - in fact it has helped me with the Israel folks. I deal with them now, and I know how to do it so much better than I did before. And it's different than I do in the US. It's very different…Although it was painful, it was really - it was good.*"

As in the formation phase of trust development, we found that participants reported trust restoration can be more readily restored when they have an opportunity to meet F2F. A female project manager (P10) in the US described how F2F interaction helped the restoration phase and went on to explain how she continues to rely on and trust the team members she met in her first visit.

In sum, our results corroborate previous research that indicates that trust is a dynamic process that occurs in multiple stages: trust formation, trust dissolution, and trust restoration. However, while we found support for this model, our data indicates that there is an additional phase in the process: *trust adjustment*. Trust *adjustment* occurs when individuals adjust their expectations so that other individuals can meet them. The adjustment phase enables *trust restoration*.

DISCUSSION
Trust is an important element of most interactions and allows individuals to work together effectively and share information openly. It must be developed over an extended period of time. We have also extended other work in reporting that trust is experienced through a series of phases, trust *formation*, *dissolution* and *restoration*. We identify a phase discussed by many of our study participants that of *adjustment*. In reporting the activities within each of these phases we have extended our understanding of the trust process and provided new insights into how individuals in DSD teams refer to trust in such contexts. Our analysis of participants' adjustments implies that trust is a dynamic process which evolves over time in response to elements in the environment and is

similar to other conceptual constructs that have been defined by researchers.

Researchers, for example [17], discuss people's continuous management and negotiation of expectations and behaviors within the context of privacy, and we find this is echoed in our data. Their description of a dynamic process in which individuals continuously respond to circumstance is similar to the process of adjusting and recalibrating the expectations which form the basis of trust. People act in a variety of capacities simultaneously: as individuals (e.g., team members, project managers, developers) and as representatives of work units or of a specific team. Trust judgments are not isolated to single events, but rather evolve based on the outcome of a sequence of previous collaborations and adjustments. Based on their past experiences, some participants sought to "understand" one another and adjust.

We adapted Barber's [4] constructs to structure the understanding of developers' expectations, reported in this paper. It allows us to provide information that can be used to more accurately reflect what individuals expect of others in their globally DSD team. For example, our findings suggest that not only is communication clarity important but also the timeliness and appropriateness of communications are additional factors that can influence trust. Such an understanding of expectations, which many of our study participants discussed during our interviews, can be used to further extend existing tools adopted by development teams. Indeed, existing qualitative studies of e-mail responsiveness suggest that a reply within the same work day or within 24 hours of receiving a message is a reasonable expectation [21]. The authors cite contextual cues such as e-mail, shared calendars, and job role that can be integrated into existing applications such as e-mail clients where they can help developers form expectations about their colleagues' response times.

For instance, a new feature to an existing email application can include deriving the average response time for individuals on the team. Consider a scenario where a developer "John" sends an e-mail to another team member "Jenna". Our results suggest that extending John's e-mail application such that it informs him that Jenna typically needs 3 working days to respond to any e-mail can help him know when to expect a reply. Providing such information (with respect for appropriate privacy considerations) can help developers set their expectations at a level in line with a team member's typical response time.

Truly globally distributed software developers can especially benefit from contextual cues they might otherwise miss. Yet responsiveness is but one indicator of trustworthiness, and other relevant cues will likely depend on the task at hand. For example, when assembling new teams for especially *innovative* software projects, managers may value expertise over responsiveness, despite the fact that that expertise may be distributed throughout many time

zones. Cues such as personnel profiles and org. chart information will be more appropriate than emails and calendars. On the other hand, new developers who are being "onboarded" to such a project will likely need to quickly learn the inner-workings of the system as well as who to go to for help. This requires knowing about their colleagues' expertise. As such, cues like source-code and work items may be more meaningful because these are the artifacts that demonstrate said expertise.

The findings reported in this paper have informed the construction of a "design space" for DSD tools that gives guidance on what contextual cues can be used in the design of tools to maximize factors that influence trust among globally distributed software developers. Using the example of responsiveness as a trust factor, the design space suggests that cues such as one's e-mail reply time, time zone overlap, the number and priority of work items assigned to them, and their working hours overlap can help set expectations [20]. Our findings provide guidance for designers about what kinds of expectations are important and the role they play in the process of building and maintaining trust.

We found our study participants' expectations remarkably consistent across sites and organizations. We also found, however, that many of our participants had encountered many instances in which others had failed to meet these expectations. This suggests that while these expectations are widespread there is a certain level of ignorance of how to effectively collaborate with others in DSD teams. We conclude that the expectations we report in this paper can be used to develop a more substantial set of expectations which can serve as guidelines for effective practices in DSD teams and can be used for training purposes.

Finally, it is worth pointing out a kind of "meta-finding" that arose from our analysis process. We worked to compare our emergent categories to frameworks proposed in the literature, but we found no single framework that could explain the richness of our data. Here we draw on the two frameworks that fit our data the best, but both were incomplete. Barber discusses expectations, but does not shed light on how they come to be or change over time. Fulmer allows us to see dynamic processes, but does not help us to understand which expectations are important. Like these two frameworks, models of trust tend to be either static models that emphasize particular determinant factors or dynamic models with a process focus. We found this dichotomy to be inconsistent with our data. For our participants, trust in someone is always a matter of both who that person is and what kinds of experiences they had shared together.

STUDY LIMITATIONS

We had a rare opportunity to conduct an empirical study *in situ*, to discuss trust with individuals working in globally distributed systems development (DSD) teams. We strove to off-set the limits that may have been introduced in the

recruitment process (self-selection and snowball sampling) by increasing the sample size, and diversity of sites included in our participant pool to increase our confidence regarding our insights into trust within DSD teams. Our study is one of a few which gains insights from practitioners through an open discussion of current projects rather than laboratory studies involving students (e.g. [5,14]) or a survey targeting off-shore developers (e.g. [19]). Furthermore, the interviewees are not limited to software engineers, but range from very technical jobs (e.g., developers) to support staff (e.g., lawyers). This inclusion is also not typical of studies of trust in distributed teams. The researchers have no conflicts of interests with the interviewees.

As with any interview study, certain aspects of trust may have been invisible to our method. For example, while in-group/out-group effects are likely to affect trust in global collaborations, social stigma and the human tendency for post-hoc rationalization make it difficult to uncover issues like cultural prejudice through interview data.

Given the aims of this study, we believe the method was appropriate. As we have discussed, our goal was to explore the applicability of existing trust frameworks in this particular context. However, we caution against simplistic generalizations to other contexts that do not share similar organizational structures, forms of expertise, and task constraints.

CONCLUDING REMARKS

In conclusion, we report several key contributions in this paper. These include:

- A description of what people expect from others when collaborating: We demonstrate that these expectations cut across gender, roles and geography and consequently cultures. We adopted Barber's [4] construct to frame our findings and provide structure to expectations discussed by our study participants. These expectations give insights on *what* engenders trust.

- An extension of existing theory based on practitioners' accounts of their experiences of the trust process: We extended the phases identified by Fulmer [8], based on our analysis of these accounts, to include an *adjustment* phase. The *adjustment* phase explains how individual transition from trust *dissolution* to *restoration*, which will allows them to continue to collaborate with others more effectively.

- Integration of existing frameworks for understanding trust: We found that to adequately explain our findings, we needed to draw on two kinds of theories: one that described categories of expectations, and another that dealt with trust as a dynamic process.

- Suggestions on how to extend existing collaboration tools: Our findings provide new insight into both the factors that engender trust and the phases that are part of the trust process. These can be utilized to both extend existing tools

and to help develop effective collaboration practices that are key to improving future collaborations among DSD team members.

We have three specific goals for our future work on this project. First, we continue to explore our data in different ways, including investigating the existence of any correlations between the findings reported in this paper and other characteristics of the individuals (e.g. demographics) or collaborative projects (e.g. team structure, cultural distribution, etc.). We also have introduced here an extension of the grounded theory method that, rather than focusing on generating new theory, takes as its goal the assessment of theoretical validity and fit within a particular context. We are working to refine and extend this method as we use it to explore this and other data. Finally, as mentioned above, we have already begun to utilize our current findings to extend existing tools such that they can support the development of trust in distributed teams by helping the team members build proper expectations, and we expect to pursue this work further.

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