

2009

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Linda Plotnick

Jacksonville State University, linda.plotnick@gmail.com

Starr Roxanne Hiltz

New Jersey Institute of Technology, roxanne.hiltz@gmail.com

Rosalie J. Ocker

Pennsylvania State University, rocker@ist.psu.edu

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Recommended Citation

Plotnick, Linda; Hiltz, Starr Roxanne; and Ocker, Rosalie J., "Trust in Partially Distributed Teams" (2009). *ICIS 2009 Proceedings*. 25.
<http://aisel.aisnet.org/icis2009/25>

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TRUST IN PARTIALLY DISTRIBUTED TEAMS

Linda Plotnick

Jacksonville State University
Jacksonville, AL
linda.plotnick@gmail.com

Starr Roxanne Hiltz

New Jersey Institute of Technology
Newark, NJ
hiltz@njit.edu

Rosalie J. Ocker

Pennsylvania State University
University Park, PA
rocker@ist.psu.edu

Abstract

Partially Distributed Teams (PDTs) are increasingly utilized as a means for inter-organizational collaboration. In a PDT, members within a subteam are collocated and communicate face-to-face and electronically, but communication between two or more geographically separated subteams occurs primarily through electronic media. A PDT has characteristics and issues unique to its hybrid structure, such as increased likelihood of in-group/out-group dynamics. Trust has been shown to be important for effectiveness. Through a quasi-experimental field study, we examine dimensions of trust and their effects on performance and satisfaction in PDTs. Results indicate that trust in PDTs has multiple dimensions which have different effects on outcomes and that early trust is distinguishable from longer term trust. This research contributes by offering a more articulated understanding of trust at different phases of a PDT's life cycle and by identifying three distinct types of trust that play a role in the effective functioning of PDTs.

Keywords: Partially Distributed Teams (PDT), trust, performance, satisfaction, in-group/out-group effects

Introduction

Distributed teams, and their variant globally distributed teams, are an increasingly common means of accomplishing work in corporate, government and NGO arenas that depend more and more on international interactions and exchanges (Connaughton and Shuffler, 2007; Cramton and Hinds, 2007). Inter-organizational collaboration is widespread in a variety of domains, ranging from global software development including off-shoring, outsourcing, and insourcing practices (Barcus and Montibeller, 2008; Carmel and Abbot, 2007; Herbsleb and Grinter, 1999) to global emergency response, such as in the case of the 2004 Asian tsunami (Plotnick et al., 2008b).

Distributed teams can vary structurally according to spatial, temporal, and configurational characteristics (O'Leary and Cummings, 2007). Inter-organizational teams are often configured with subteams located across two or more sites. These *partially distributed teams* (PDTs) share characteristics of fully dispersed teams as well as collocated (traditional) teams. For example, members *within* a subteam share the same physical work context and communicate with one another face-to-face and electronically. However, members in different subteams have distinct physical work contexts; communication *between* subteams occurs primarily through electronic media. A PDT has characteristics and issues associated with its hybrid structure (Huang and Ocker, 2006; Polzer et al., 2006). Particularly when there are two subteams, as in this study, "faultlines" (Lau and Murningham, 2005) may develop, with strong in-group/out-group divides.

Trust has been shown to have important effects on team outcomes for virtual teams, such as satisfaction and performance (Coppola et al., 2004; Jarvenpaa and Leidner, 1999). The focus of this paper is on the dynamic nature of trust in PDTs and the importance of trust within and between subteams in a PDT in terms of outcomes. Kanawattanachai et al. (2002) looked at the dynamic, changing nature of trust in virtual teams and its relation to high and low performing teams. Trust is likely to be especially problematical in PDTs with two distant subteams; for instance, Polzer et al. (2006) found that virtual team members experience more conflict with and less trust in distant teammates than collocated teammates. Moreover, they observed that teams composed of two subteams experience more conflict and less trust than fully dispersed teams or teams with three subteams. We posit that in PDTs, changes in the nature of trust will occur over time, and that the degree of trust will be related to both satisfaction of team members and the perceived performance of the team. Trust, therefore, is a critical issue for PDTs but has been under-studied.

In this paper, we describe a quasi-experimental field study of global PDTs engaged in a four week project to establish the requirements for a software system for emergency management. While traditional trust and swift trust have been identified in traditionally collocated and fully distributed teams, one cannot assume that the dynamics of a PDT give rise to the same kinds of trust. Therefore, our first research question is:

RQ1: What are the dimensions of trust for PDTs and are there different "kinds" of trust that occur early or later?

Trust has been shown to affect outcomes. If there are different types of trust in PDTs, it is of interest to determine how they may differ in association with outcomes such as perceived performance and satisfaction. Therefore, our second research question is:

RQ2: How is trust related to perceived performance and satisfaction with the subteams and whole team in PDTs?

After a literature review, we return to these research questions and discuss our hypotheses and research methods. Our measures of trust, satisfaction and perceived performance of PDTs are presented, along with results for reliability measures. We identify three dimensions of early trust in PDTs, which condense to two dimensions after teams have experience working together (later in the project). The results of hypotheses testing are presented and discussed, along with limitations of this research, a synthesis of our contributions, and plans for future research.

Literature Review

Trust Defined

A commonly used definition of trust, and the one that we adopt in this research, is that of Mayer et al. who define trust as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that

other party” (Mayer et al., 1995, p. 712). Trust is put forth as rooted in the ability, benevolence and integrity of team members (Jarvenpaa et al., 1998; Mayer et al., 1995; Picolli and Ives, 2003). Mayer et al., (1995) contend that cooperation under risk is not necessarily a result of trust. One might cooperate with someone whom they do not trust because, for example, there might be a punishment for not cooperating; what is important is willingness to take a risk (Mayer et al., 1995).

Trust in Virtual Teams

Virtual teams differ from traditional teams in ways that may impact the development of trust. For example, virtual teams are often formed with members who have no history together and may never meet face-to-face. The supervision of team members may be difficult because the members are distributed. In the context of self-directed teams, Mayer et al. (1995) note that because it is not possible to closely supervise members of such teams, trust must substitute for such supervision. Trusting relationships provide benefits to the team. They can reduce transaction costs, increase sociability (which increases cooperation), and promote a respect for authority that enables management to manage without constantly having to explain themselves (Kramer, 1999). However, there may also be barriers to the formation of trust. If perceived obligations are not fulfilled, then trust is breached and may be diminished or even destroyed (Kramer, 1999). In a virtual team (or a PDT), distance can impede communication and resulting misunderstandings may create the impression that obligations are not fulfilled. Thus, trust may be especially fragile when there is distance between collaborators.

For any virtual team that is comprised of members who have no prior history together yet must perform quickly, the development of trust is an important issue. Often the trust occurs as “swift trust” which is trust not based on experience with the trustee, but rather other cues such as the trustee’s role, category, or the presumption that someone else has already vetted the trustee and found him/her to be trustworthy (Meyerson et al., 1996). Swift trust can promote future trust by setting off “a familiar cycle in which trust becomes mutual and reinforcing” (Myerson et al., 1996, p. 188).

Although the concept of swift trust was developed in the context of temporary face-to-face teams, researchers have also used this concept to explain trust in virtual teams (Coppola et al., 2004; Iacono and Weisband, 1997; Jarvenpaa and Leidner, 1999). As with temporary face-to-face teams, members of a virtual team often begin with no prior history upon which to base assessments of trustworthiness. An additional complication is that virtual teams lack the personal and rich social cues used by members of traditional permanent teams to learn about trustworthiness. Connaughton and Daly (2004) suggest that trust develops differently in virtual teams than it does in collocated teams. This trust must develop quickly and be based on cues other than experience and is an example of swift trust (Connaughton and Daly, 2004). With members both collocated and distant, then, one might expect to see aspects of both swift trust and traditional trust in PDTs.

In-Group/Out-Group Effects

Social categorization theory (Tajfel, 1981) and Social Identity Theory (SIT) (Tajfel, 1978; Tajfel and Turner, 1986) suggest that individuals derive social identity primarily from membership in groups. Demographic differences spawn differences of opinion and divergent viewpoints which result in people categorizing themselves into “us vs. them” groupings. These subgroups develop separate identities and exhibit *in-group dynamics*, defined as increased interaction with and preferential behavior towards members of one’s subgroup; reduced trust and team cohesiveness, and increased conflict between subgroups. In-group dynamics impair team effectiveness and performance (Chatman et al., 1998; Cohen and Bailey, 1997; Jehn, 1997; Lott and Lott, 1965).

A faultline (Lau and Murnighan, 1998) divides a team’s members according to one or more attributes. The limited research on PDTs indicates that distance creates a faultline and that PDTs are especially vulnerable to in-group team dynamics (Armstrong and Cole, 2002; Bos et al., 2004; Huang and Ocker, 2006; Panteli and Davison, 2005; Polzer et al., 2006). In-group effects have been shown to impede whole team communication (Bos, 2004), and decrease trust and increase conflict between subteams (Huang and Ocker, 2006). Identification with the subteam, rather than with the whole team, can be so strong as to impede trust, communication, and collaboration with distant subteam members (Armstrong and Cole, 2002; Huang and Ocker, 2006).

Research Questions and Hypotheses

RQ1: What are the dimensions of trust for PDTs and are there different “kinds” of trust that occur early or later?

Trust has been conceptualized as a multi-dimensional construct (e.g., Cummings and Bromily 1996, Kanawattanachai et al. 2002). As prior research has not examined dimensions of trust in PDTs, we sought to identify the dimensions of trust in PDTs. However, because this is a first set of studies on trust in PDT's, we did not start with formal hypotheses. But, reflecting the concepts of “swift” vs. long term trust, as well as previous studies of trust in virtual teams (e.g. Kanawattanachai et al. 2002) we posited that the salient dimensions of trust in PDT's would probably change over time. Therefore, we measured trust at two points (early and later) in the interactions of the subteams, as described below. Besides looking for changes over time, we are also interested in how measures of trust may differ within subteams vs. between subteams, and in identifying aspects of trust that are especially problematical for PDTs.

RQ2: How is trust related to perceived performance and satisfaction with the subteams and whole team in PDTs?

In a PDT, the collocated members of a subteam may have experience working together, but no prior experience working with their distant team members. In such a case, traditional trust may already exist among subteam members, while between subteams, members may have to rely on swift trust which is based on cues other than experience with the trustee (Meyerson et al., 1996). PDTs may be especially prone to in-group/out-group effects (“us” vs. “them” thinking) because each member is collocated with some team members and yet distant from others (Armstrong and Cole, 2002; Bos et al., 2004; Huang and Ocker, 2006; Panteli and Davison, 2005; Polzer et al., 2006). That is, a strong subteam identity may form (“us”) that impedes the development of whole team identity (“we”) and of trust in the whole team.

High trust has been shown to lead to better outcomes (Hung et al., 2004; Coppola et al, 2004, Dirks and Ferrin, 2001). In a PDT there are multiple trust relationships, due to the team's configuration. Stemming from in-group/out-group effects tied to the faultline between subteams, a member can trust his/her subteam members while not trusting (or trusting less) members of the distant subteam. Yet, if a member experiences trust within and between subteams, these studies suggest that there will also be higher perceptions of team performance than if there were not such trust. Thus, we hypothesize:

H1: Trust of members within a subteam will be positively associated with the member's perceptions of *subteam* performance.

H2: Trust of members in the distant subteam will be positively associated with *team* performance.

Trust may also be associated with satisfaction with a group. Trust is a positive affect that is hypothesized in PDTs to be associated with perceptions of positive outcomes and is an expression of a belief that the trustee will perform important actions without being monitored (Mayer et al., 1995). If someone does not trust members of his/her subteam or the distant subteam, then it is unlikely that s/he will be satisfied with the interactions with the team. Trust for an organization has been shown to predict overall satisfaction with that organization (Driscoll, 1978). Therefore, at the micro level, one might posit that trust for a subteam will predict satisfaction with that subteam. Therefore, it is hypothesized that:

H3: Trust of within-subteam members will be positively associated with the member's satisfaction with the collocated (“my”) subteam.

H4: Trust of members in the distant subteam will be positively associated with the member's satisfaction with the distant (“other”) subteam.

Method

Subjects

A total of 208 undergraduate students from five universities in four countries participated in this study; we received usable data from 204 students in 21 teams. Regarding structural characteristics (O'Leary and Cummings, 2007), each team was configured across two sites, such that subteams within a given team were balanced with four-six members each. Each team consisted of one subteam from the U.S. and one from Spain, the UK, or China. Thus, all

teams had an east-west temporal dispersion (O'Leary & Cummings, 2007). Members of a given subteam were drawn from the same class; these "within" subteam members were collocated and had a degree of prior acquaintance and interaction.

Communication Media

An open source web-based communication and content management system was implemented (based on Drupal 4.7, see drupal.org), enhanced with additional functionality via third-party plug-ins needed for team activities. The system (PDT System) provides a threaded discussion board; a file sharing repository; shared document creation and editing; and a project calendar. Each team was provided with private space on the PDT System. Subteams also had the capability to create private spaces that their remote team members could not access. Communication was not restricted to the PDT System although all instructions and deliverables were posted there.

Project Task and Procedures

Teams worked over a four-week period to determine the high-level functional requirements and design for an emergency management information system (EMIS). The purpose of the system, detailed in a Request for Proposal (RFP), was to support resource management and detection of bioterrorist threats to Zurich, Switzerland. The primary deliverable was a written proposal for a Bioterrorism Management and Planning System (BTMAPS) and was to include a description of system functionalities, intended users, the policies needed to manage the system, and the next steps needed to carry the project forward. The teams were given a template to help them organize the content of their proposal. The project counted as a significant portion of the participants' course grade, generally about 20%, to assure strong motivation.

Intermediate deliverables were designed to help participants work effectively in a PDT and guide them in the process of preparing the final proposal. During the first three weeks, participants completed weekly training modules. In the first week participants introduced themselves to each other using the PDT System, completed an online training module to learn to use the PDT System, and read scenarios and answered questions about issues associated with working in PDTs. Teams also completed a team contract which included identifying leaders and formulating agreements on how often and through which media they would communicate.

In the second week, when work on the task began, participants also completed training activities designed to help move them from "us vs. them" (in-group) behavior to a single team identity. Participants interviewed distant subteam members and then each team, as a whole, completed a web page with information from the interviews.

The goal of training in the third week was to establish or maintain a positive team trajectory. Teams assessed their strengths and weaknesses and prepared an action plan to address problem areas. They continued to work on BTMAPS by creating a detailed outline of the functional requirements needed. The fourth and final week was devoted to writing the proposal and completing the user interface design (mock-up).

Data Sources

Prior to the start of the project, participants completed a background survey. At the end of each of the four weeks, participants completed a survey that included a "personal reflection" about their experiences during the week as well as survey items pertaining to variables of interest (e.g., trust). At the conclusion of the project, participants completed a post experiment survey. Participation in the surveys and personal reflections was voluntary for U.S. students because of IRB requirements. Students from the UK, Spain, and China all completed the surveys and personal reflections. All members of the participating classes worked on the task (BTMAPS proposal).

Measures

Ten scale items for **trust** within a subteam (with the same ten items repeated for trust between subteams) were included in both the first personal reflection survey (Week 1, which we refer to as "early trust") and the post survey (referred to as the "longer term trust" measure). The ten 7-point semantic differential items to measure trust had four questions (8 in all) adapted from Jarvenpaa et al. (1998) and six questions (12 in all) adapted from Cummings and Bromily (1996). Tables 3 to 6 below show the items measuring trust.

Perceived performance of the subteam and team were each measured by six 7-point semantic differential scale items in the post survey. Scale items were adapted from Mortensen and Hinds (2001). Each question asked about one of six dimensions of performance: efficiency, quality, creativity, adherence to schedule, coordination of member efforts, and communication between members. Perceived performance was measured as the sum of the responses to the six questions

Objective performance was measured by the grades given to the final deliverable by designees of the researchers, using a grading rubric designed by the researchers. Also, two experts experienced in software development evaluated the final reports using the same rubric as the grader. The average of the three grades was used to measure objective performance. While objective performance and perceived performance are both measures of group performance, they differ in a significant way. Objective performance is measured as the quality of the output while perceived performance is measured as the perceptions of dimensions in the processes of the team/subteam functioning.

Satisfaction with a group (collocated or remote subteam) was measured on the post survey with three 7-point semantic differential scale items adapted from Fuller et al. (2006-7). That is, each question was answered with reference to both the collocated subteam (“my” subteam) and the remote subteam (the “other” subteam). Satisfaction was measured as the sum of the responses.

Distributions, Reliability and Validity for Dependent Variables

On all dimensions of Perceived Performance, ratings were skewed toward the positive side. Note however that for all items, the means for the local subteam are higher than for the team as a whole, demonstrating ingroup effects.

Reliability measures (Cronbach’s alpha) were calculated for all multi-item scales. In cases where Cronbach’s alpha was inadequate and the number of scale items was small, composite reliability measures were taken because Cronbach’s alpha is sensitive to the number of items in a scale while composite reliability is not (Cortina, 1993; Hair et al., 2006; Ocker et al., 2009a). Factor analysis (principal components with Varimax rotation) was also performed. The statistical package SAS® was used to measure Cronbach’s alpha and perform factor analysis. SmartPLS (Ringle et al., 2005) was used to compute composite reliability. Tables 1 to 6 below show the factor analysis loadings. They also show means and standard deviations for the items and for the construct. Means and standard deviations are calculated based upon the average of the items measuring the construct. All items were measured using Semantic Differential response scales ranging from 1 to 7. Note that negatively worded items are reverse coded when combined with other items for factor analysis or a scale. To show individual item means and standard deviations, they are not reverse coded.

Perceptions of team/subteam performance

Reliability measures were calculated for perceived subteam and team performance. Reliability was high for both the items measuring subteam and those measuring team performance ($\alpha = .9188$ for subteam performance; $\alpha = .9369$ for team performance). Factor analysis offered a consistent view, with items loading on one factor each for perceptions of subteam and team performance. Bernard (2000) suggests .60 as a cutoff for unambiguous loading on a factor. All loadings were above .80 with the exception of one variable that loaded above .75. Thus, in each case we can conclude that there is a single factor underlying the data. For each variable, the communalities generated by the factor analysis were adequate with values above .7, well above the .5 recommended by Hair et al. (2006). Table 1 shows the factor analyses loadings for Perceived Performance. Note that when asked about performance of the subteam, the members were asked about coordination of member efforts and communication among members of the subteam. On the other hand, when asked about performance of the team, they were asked about coordination between subteams and communication between subteams.

1=low; 7=high	Of the Local Subteam N=149		Of the Team N=149	
	Loadings	Mean SD	Loading	Mean SD
Efficiency	.8601	5.67 1.23	.8881	5.29 1.32
Quality	.8871	5.54 1.22	.8886	5.38 1.38
Creativity	.7785	5.23 1.44	.8259	5.12 1.33
Adherence to Schedule	.8448	5.58 1.40	.8754	5.30 1.42
Coordination	.8491	5.51 1.39	.8950	4.99 1.62
Communication	.8407	5.57 1.42	.8585	4.91 1.70
PERCEIVED PERFORMANCE		5.52 1.14		5.17 1.28

Satisfaction with a Group

The means for all of the group satisfaction items are skewed towards the positive side, especially for the local subteam; however, particularly for the remote subteam, there is substantial variation. Reliability was high with Cronbach's alphas of .9590 for satisfaction with "my" subteam and .9798 for satisfaction with the "other" subteam. Factor analyses resulted in loadings on a single factor for each group. All loadings were above .90 which is well above the .60 cut-off suggested by Bernard (2000). Communalities were also adequate with values of over .90 for each variable (not shown). The factor analysis loadings are shown in Table 2.

1=strongly disagree; 7=strongly agree	For the Local Subteam N=131		For the Remote Subteam N=131	
	Loadings	Mean SD	Loading	Mean SD
I was satisfied with members of my subteam/ the other subteam	.9572	6.05 1.24	.9825	5.37 1.78
I was pleased with the way the members of my subteam/ the other subteam and I worked together	.9663	6.08 1.17	.9832	5.37 1.68
I was satisfied working with my subteam/ the other subteam	.9706	6.05 1.22	.9854	5.35 1.67
SATISFACTION		6.06 1.16		5.37 1.68

Results: Early and Longer Term Trust

Factor analysis was performed for the four trust scales (early trust for “my” subteam, early trust for the “other” subteam, longer term trust for “my” subteam, and longer term trust for the “other” subteam). The results, which relate to RQ1, are shown in Tables 3 to 6, along with the means and standard deviations for each item. Although the means generally indicate trust rather than distrust, there are some problematical areas. For instance, particularly for the remote subteam, a substantial number of participants would have preferred to be able to monitor the work of others more closely, and there was ambivalence about feeling comfortable with giving them critical tasks.

For early trust, measured at the end of the first week, the factor analyses produced three factors for both trust for “my” subteam and trust for the “other” subteam. Communalities were all adequate. The results of the factor analyses are shown in Tables 3 and 4. For early trust, the first factor is identified as Personal Trust which is, as with longer term trust, based on member interactions during the first week of the project. This is a traditional type of trust, based on observed behavior of the individual trustees. The second factor is Process Trust; as with longer term trust, it is a traditional type of trust, based on inferences made from the process of members working together. Finally, we identify the third factor as Expertise Trust. This can be seen as a form of swift trust (Mayer et al., 1995) based on a trustor’s judgment about the trustee’s expertise. Recall that in the first week the participants do not work on the proposal but only engage in team building exercises. Trusting expertise, then, is a generalized concern in that the trustor doesn’t know if s/he can trust the other members’ expertise. So, trusting the others’ expertise is not based on observed behaviors but on other cues, such as perhaps what the other person says about his/her expertise. By the time the post survey is administered, trusting expertise is no longer a swift trust but can be evaluated based upon actual experience and so those items become part of the traditional Personal Trust.

N=146	Loadings			Means and SD		
1-strongly disagree; 7-strongly agree	Personal Trust	Process Trust	Expertise Trust	Personal Trust	Process Trust	Expertise Trust
1. I would have preferred if some members had less influence over important aspects of the project in my subteam.	.3696	.6688	.1548		2.13 1.38	
2. I wanted to more closely monitor the work of members in my subteam.	.2866	.7789	.1809		2.72 1.70	
3. I was comfortable when other members worked on a critical task or problem in my subteam.	.2788	.0167	.8228			4.75 1.77
4. Even if I could not monitor them, I was comfortable giving a critical task or problem to other members in my subteam.	.2343	.1990	.8570			4.80 1.80
5. I felt the members tried to get out of their commitments in my subteam.	.2914	.6268	-.1914		2.51 1.65	
6. I felt that members kept their word in my subteam.	.8184	.1670	.1984	5.39 1.64		
7. I felt that members were honest with me in my subteam.	.8179	.1810	.2474	5.81 1.39		
8. I felt that members negotiated joint expectations fairly in my subteam.	.8195	.2088	.1109	5.46 1.41		
9. I felt that members tried to get the upper hand in my subteam.	-.1729	.6881	.4688		2.68 1.73	
10. I felt confident that members would not exploit me in my subteam.	.5502	.4229	.1379	5.34 1.76		

EARLY TRUST FOR THE LOCAL SUBTEAM				5.50	5.49	4.78
				1.26	1.19	1.64

Table 4. Factor Analysis, Means and Standard Deviations for Early Trust for the Remote Subteam

N=146	Loadings			Means and SD		
1=strongly disagree; 7=strongly agree	Personal Trust	Process Trust	Expertise Trust	Personal Trust	Process Trust	Expertise Trust
1. I would have preferred if some members had less influence over important aspects of the project in the other subteam.	.4954	.6221	.1566		2.19 1.42	
2. I wanted to more closely monitor the work of members in the other subteam.	.1090	.7272	.2463		2.98 1.82	
3. I was comfortable when other members worked on a critical task or problem in the other subteam.	.1872	.0618	.9094			4.44 1.79
4. Even if I could not monitor them, I was comfortable giving a critical task or problem to other members in the other subteam.	.2006	.2191	.8856			4.37 1.76
5. I felt that members tried to get out of their commitments in the other subteam.	.5517	.3699	-.1101		2.19 1.43	
6. I felt that members kept their word in the other subteam.	.8018	.0048	.2403	5.36 1.66		
7. I felt that members were honest with me in the other subteam.	.8430	.0763	.2263	5.68 1.47		
8. I felt that members negotiated joint expectations fairly in the other subteam.	.7896	.1615	.1532	5.40 1.43		
9. I felt that members tried to get the upper hand in the other subteam.	.0234	.7990	-.0084		2.68 1.71	
10. I felt confident that members would not exploit me in the other subteam.	.4738	.4288	.2599	5.27 1.76		
EARLY TRUST FOR THE REMOTE SUBTEAM				5.43 1.25	5.49 1.14	4.04 1.62

For longer term trust, communalities (not shown) indicated that questions 5 and 10, with communalities of less than 4.5 should be removed. Hair et al. (2006) suggest that variables with communalities of less than 5.0 be removed but that value is not to be used as a strict threshold. Because the present work is exploratory in nature, we have elected to use a communality of 4.5 as the cut-off for removing variables.

Factor analysis was then run again for longer term trust with questions 5 and 10 removed. The results are shown in Tables 5 and 6 below. One factor (Questions 3,4,6,7, and 8) we identify as "Personal Trust," namely trust that is based on interactions the participants have had with each other. The other factor (Questions 1, 2, and 9) we label "Process Trust," because it is based on inferences made from the process of the team working together. That there are three factors for early trust and two for longer term trust suggests that early trust is different from longer term trust. That is, participants make judgments differently early in the life cycle of the team than they do longer term, indicating that the underlying concepts are different.

Table 5. Factor Analysis, Means and Standard Deviations for Longer Term Trust for the Local Subteam				
N=149	Loadings		Means and SD	
1=strongly disagree; 7=strongly agree	Personal Trust	Process Trust	Personal Trust	Process Trust
1. I would have preferred if some members had less influence over important aspects of the project in my subteam.	.1032	.8324		2.48 1.65
2. I wanted to more closely monitor the work of members in my subteam.	.2831	.7374		2.92 1.77
3. I was comfortable when other members worked on a critical task or problem in my subteam.	.7524	.2851	5.36 1.50	
4. Even if I could not monitor them, I was comfortable giving a critical task or problem to other members in my subteam.	.7872	.1990	5.33 1.50	
5. I felt that members tried to get out of their commitments in my subteam.	-----	-----	-----	-----
6. I felt that members kept their word in my subteam.	.8086	.1567	5.53 1.51	
7. I felt that members were honest with me in my subteam.	.8117	.2156	5.99 1.23	
8. I felt that members negotiated joint expectations fairly in my subteam.	.8045	.0828	5.54 1.47	
9. I felt that members tried to get the upper hand in my subteam.	.1416	.6652		2.48 1.67
10. I felt confident that members would not exploit me in my subteam.	-----	-----	-----	-----
LONGER TERM TRUST FOR THE LOCAL SUBTEAM			5.55 1.18	5.37 1.30

Table 6. Factor Analysis, Means and Standard Deviations for Longer Term Trust for the Remote Subteam				
N=149	Loadings		Means and SD	
1=strongly disagree; 7=strongly agree	Personal Trust	Process Trust	Personal Trust	Process Trust
1. I would have preferred if some members had less influence over important aspects of the project in the other subteam.	.1356	.7700		2.54 1.57
2. I wanted to more closely monitor the work of members in the other subteam.	.3681	.5576		3.38 1.90
3. I was comfortable when other members worked on a critical task or problem in the other subteam..	.8189	.1965	4.94 1.67	
4. Even if I could not monitor them, I was comfortable giving a critical task or problem to other members in the other subteam.	.8514	.1689	4.74 1.74	
5. I felt that members tried to get out of their commitments in the other subteam	-----	-----	-----	-----
6. I felt that members kept their word in the other subteam.	.7973	.2653	5.19	

			1.66	
7. I felt that members were honest with me in the other subteam.	.8097	.2281	5.56 1.60	
8. I felt that members negotiated joint expectations fairly in the other subteam.	.7965	.0460	5.23 1.53	
9. I felt that members tried to get the upper hand in the other subteam.	.0621	.7080		2.57 1.73
10. I felt confident that members would not exploit me in the other subteam.	-----	-----	-----	-----
LONGER TERM TRUST FOR THE REMOTE SUBTEAM			5.13 1.37	5.17 1.23

One might speculate as to why Questions 5 and 10 have inadequate communalities for longer term trust, but adequate for early trust. We suggest that laziness (Question 5) and exploitation (Question 10) become less of a concern for longer term trust. Also, although in early trust, Question 5 loads on Personal Trust for “my” subteam and Process Trust for the “other” subteam, upon examination of the question, it is logical to group it in Process Trust. Similarly, for early trust for the “other” subteam, Question 10 does not clearly load on Personal Trust. However, it loads clearly on Personal Trust for “my” subteam and it is logical, upon examination, to group it with Personal Trust. Therefore, for consistency and based upon our judgment, in this research it is assumed to be an item measuring Personal Trust.

Note that trust was not measured at the start of the project. If it had been, there might have been yet another pattern, for example, suggesting that all of the team members’ initial feelings of trust are based on swift trust. Rather, trust is measured at the end of the first week when the participants have been working together for that week intensely on non-task related activities. Thus, the feelings of trust at that time (end of Week 1) are likely to be a mix of traditional trust (Personal Trust, Process Trust) and swift trust (Expertise Trust). Then, after the four weeks of the study, what is measured is only traditional trust (Personal Trust and Process Trust). Additionally, that the communalities suggested pruning the scale for longer term trust and not for early trust gives additional evidence that the two (early and longer term trust) are essentially different.

Reliability was assessed for each dimension of trust for each data set. Cronbach’s alphas were not adequate in some cases but, as noted in the literature (Cortina, 1993; Hair et al., 2006, Ocker et al., 2009a), Cronbach’s is sensitive to the number of items in the scale. Each dimension of trust has few items (e.g., Expertise Trust has only 2 items). Composite reliability, however, is not sensitive to the number of items in the scale (Ocker et al., 2009a) and so composite reliability was computed for each dimension of trust. Also computed was the average variance explained (AVE) which Chin (1998) indicates can be interpreted as a measure of reliability and should be over .5. According to Hair et al. (2006), composite reliability should be .7 or higher although between .6 and .7 may be acceptable if there are other indicators of a model’s good construct validity. The results of reliability tests are shown below in Table 7.

Data Set	Type of Trust	Composite Reliability	AVE
Early Trust for “my” subteam	Expert Trust	.9052	.8274
	Personal Trust	.8928	.6768
	Process Trust	.8244	.5471
Early Trust for the “other” subteam	Expert Trust	.9413	.8890
	Personal Trust	.8682	.6286
	Process Trust	.6972	.4059
Longer term trust for “my” subteam	Personal Trust	.9082	.6645
	Process Trust	.8043	.5843

Longer term trust for the “other” subteam	Personal Trust	.9211	.7004
	Process Trust	.7012	.4693

All reliability measures are adequate except two. For early Process Trust for the “other” subteam, composite reliability at .6972 is slightly under .7 and the AVE at .4059 is less than .5. However, we argue that because good reliability is shown for Process Trust for “my” subteam, and the composite reliability is almost .7, thus indicating construct reliability in other ways, the reliability is acceptable and the measures are retained. Also, longer term Process Trust for the “other” subteam has adequate composite reliability but the AVE is .4693 which is just under .5. AVE is more conservative than composite reliability (Chin, 1998), but because the AVE is barely under .5 and composite reliability is adequate, the items are retained for this analysis.

Therefore, for analysis of trust for longer term trust measured in the post survey there are two dimensions of trust: Personal Trust and Process Trust. For early trust measured at the end of Week 1, three dimensions of trust are used in the analyses: Expertise Trust, Personal Trust, and Process Trust.

With respect to Research Question 1, the factor analysis results suggest that there may be three dimensions for early trust but only two for longer term trust. This is a significant finding as the efforts to build and maintain trust may need to be tailored to the longevity of the team in recognition of these variations in dimensions of trust.

Analysis and Results of Hypotheses Testing

The variables of interest were not normally distributed and attempts at achieving normality through transformations (e.g., Box Cox, exponents, roots, log, exp) failed. Since normality is lacking, we used Spearman’s rank correlation coefficient test (a nonparametric test) for hypothesis testing (Kutner et al., 2005). Analysis was conducted at the individual level except when testing the relationship between trust and objective performance, which was measured at the team level. Therefore, correlations were performed for trust vs. objective performance at the team level. Team measures for the trust variables were determined by finding the means, for each team, of the trust scores of the dimensions of trust for the remote subteam. All variables were normally distributed in this case, and so Pearson’s r was calculated.

Below in Table 8 are the results of Hypotheses testing. Discussion of the results follows.

H	Variable 1	Variable 2	r	p	N
1	Perceived subteam performance	Early Personal Trust	.300	.0006*	127
	Perceived subteam performance	Early Process Trust	.270	.0021*	127
	Perceived subteam performance	Early Expertise Trust	.150	.0930	127
	Perceived subteam performance	Longer term Personal Trust	.553	<.0001*	149
	Perceived subteam performance	Longer term Process Trust	.389	<.0001*	149
2	Perceived team performance	Early Personal Trust	.279	.0015*	127
	Perceived team performance	Early Process Trust	.072	.4222	127
	Perceived team performance	Early Expertise Trust	.286	.0033*	127
	Perceived team performance	Longer term Personal Trust	.668	<.0001*	149
	Perceived team performance	Longer term Process Trust	.320	<.0001*	149
	Objective Performance	Early Personal Trust	.138	.5507	21
	Objective Performance	Early Process Trust	.236	.3034	21
	Objective Performance	Early Expertise Trust	.229	.3176	21
	Objective Performance	Longer term Personal Trust	.207	.3685	21
	Objective Performance	Longer term Process Trust	.567	.0073*	21
3	Satisfaction with “my” subteam	Early Personal Trust	.403	<.0001*	113
	Satisfaction with “my” subteam	Early Process Trust	.173	.0668	113

	Satisfaction with “my” subteam	Early Expertise Trust	.181	.0549	113
	Satisfaction with the “my” subteam	Longer term Personal Trust	.567	<.0001*	126
	Satisfaction with the “my” subteam	Longer term Process Trust	.400	<.0001*	126
4	Satisfaction with the “other” subteam	Early Personal Trust	.500	<.0001*	113
	Satisfaction with the “other” subteam	Early Process Trust	.180	.0561	113
	Satisfaction with the “other” subteam	Early Expertise Trust	.293	.0017*	113
	Satisfaction with the “other” subteam	Longer term Personal Trust	.730	<.0001*	126
	Satisfaction with the “other” subteam	Longer term Process Trust	.300	.0006*	126

* denote significance

H1: Trust of members within a subteam will be positively associated with the member’s perceptions of subteam performance

The results of correlations of early trust within subteam (“my” subteam) with perceptions of subteam performance were mixed. The correlation of perceived subteam performance with early Personal Trust was significant as was the correlation of subteam performance with early Process Trust. However, the correlation of subteam performance with early Expertise Trust did not reach significance at the .05 level. It is of interest that perceived performance, measured at the end of the project, is associated with traditional trust measured early in the project, but not with the Expertise Trust that is based on more normative cues. It must be noted that perceptions of performance were not measured at the early trust (Week 1) time. Recall that work on the task itself did not start until Week 2. However, it would be of interest to, in the future, measure perceptions of potential for performance at the same time that early trust is measured. It may be that perceptions of performance change over time. Nonetheless, it is interesting that traditional trust (Personal and Process Trust) measured at the end of the first week can predict perceptions of performance measured at the end of the project, while early swift trust (Expertise Trust) cannot.

For longer term trust for “my” subteam, the results of correlations of perceived subteam performance with longer term Personal Trust and perceived subteam performance with longer term Process Trust were both highly significant.

Therefore, Hypothesis 1 is partially supported for early trust and strongly supported for longer term trust.

H2: Trust of members in the distant subteam will be positively associated with team performance

The results of hypothesis testing for H2 in the context of early trust vs. perceptions of performance were mixed. The correlation of perceived team performance and early Personal Trust for the “other” subteam was significant as was the correlation of perceived team performance and early Expertise Trust for the “other” subteam. However, the correlation of perceived team performance and early Process Trust for the “other” subteam was not significant at the .05 level. These results are different than the results found for correlations of early trust for “my” subteam and perceived subteam performance (H1).

For longer term trust, correlations of perceived team performance with Personal Trust and with Process Trust were both highly significant.

Therefore, Hypothesis 2, for perceived performance, is partially supported for early trust and strongly supported for longer term trust.

For objective performance, only the relationship between longer term Process Trust and objective performance was significant. The results may differ from those for perceived performance because, as noted above, the two measures of performance measure different dimensions of performance. The direction of the relationships is not hypothesized in this research.. Ability is shown by Jarvenpaa et al. (1998) to influence trust. Therefore, if students perceive the performance as being high, they may be more likely to trust the team members because they will have greater faith in the skill of the team members, no matter the level of objective performance.

H3: Trust of within-subteam members will be positively associated with the member's satisfaction with the collocated ("my") subteam.

For early trust, measured at the end of the first week in the first personal reflection, the results of the correlations were mixed. Early Personal Trust for "my" subteam was significantly and positively associated with satisfaction with "my" subteam. However, the correlations of satisfaction with "my" subteam and early Process Trust and with early Expertise Trust were insignificant. Thus Hypothesis 3 is partially supported for early trust.

For longer term trust, measured in the post survey, Hypothesis 3 was strongly supported for both Personal Trust for "my" subteam and for Process Trust for "my" subteam.

Therefore, Hypothesis 3 is partially supported for early trust and strongly supported for longer term trust.

H4: Trust of members in the distant subteam will be positively associated with the member's satisfaction with the distant ("other") subteam.

For early trust, measured at the end of the first week, correlations were made between early Personal trust and satisfaction with the "other" subteam; between early Process Trust and satisfaction with the "other" subteam; and between early Expertise Trust and satisfaction with the "other" subteam. Hypothesis 4 is supported for the correlations with Personal Trust and with Expertise Trust but not supported for the correlation with Process Trust.

For longer term trust, measured in the post survey, Hypothesis 4 was supported. The correlations of longer term Personal Trust and satisfaction with the "other" subteam and between longer term Process Trust and satisfaction with the "other" subteam were both positive and significant at the .05 level.

Discussion

The results of the factor analyses of the trust scales suggest that in the early phases of project work, the trust among PDT members may involve three different dimensions: Expertise Trust, Personal Trust, and Process Trust. Personal and Process trust are familiar constructs from research on trust and are evident in both early and longer term trust measures. However, Expertise Trust has been conceptualized as an aspect of swift trust, and as such appears to play a role in early perceptions of trust in PDT teams (in this case measured at the end of the first week before participants have task-related experiences with their teammates). The results indicate that trust early in the life of the team is different than that which has developed and is maintained later in the lifecycle. This suggests that as trust develops in a PDT, the effects of trust may change. The results of hypotheses testing support this conclusion.

The hypotheses were strongly supported for longer term trust. That is, longer term Personal Trust and Process Trust are significantly associated with perceived satisfaction and performance with "my" subteam and with the "other" subteam. However, only partial support was found for our expectations about early trust. That is, the trust that develops over the longer term seems to be a better predictor of team members' satisfaction and perceptions of performance than early trust. This supports the observation that trust in PDTs takes a variety of forms and changes over time. There are implications for practitioners forming and managing PDTs. To understand the types of trust and effects they might have over time gives insight into what focus needs to be taken to promote and engender trust, so critical to team effectiveness. For example, that there is a distinction between Process and Personal Trust suggests that attention needs to be given to building strong personal relationships as well as task related ones.

We are particularly interested in the trajectory of evolution from early trust to longer term trust. For instance, if PDT members rely on expertise inferences as part of their initial trust assessment, how might we enhance this process? We might simplify access to general expertise indicators, perhaps by asking team members to identify their skill sets or disciplinary tendencies. We might also emphasize early on that even though team members know little about one another's personal knowledge or skills, they make attributions based on general expertise beliefs, and that part of coming together as a team is to recognize, probe, and adjust these perceptions as relevant. At the same time, we can search for ways to produce information relevant to Process and Personal Trust perceptions as early as possible in team activities, as these constructs appear to be the most important predictors of satisfaction and performance in the longer term.

Limitations

The subjects of this study were students, and this may limit the generalizability of our findings. However, this limitation is partially ameliorated by the fact that their work on the project contributed significantly to the course grade, thus providing incentive to work diligently. Additionally, as perceptions of the students of performance were measured, they were skewed in favor of high performance, resulting in the non-normality of the data.

This research only examined teams with two subteams each. In practice, PDTs may be comprised of many more subteams and even include isolates as well. Also, the study was four weeks in duration. In practice, tasks could be shorter or much longer than four weeks and the task itself may be more complex. Thus, generalizability to industry or other settings with different types of tasks and longevity may be compromised.

Early trust was measured after one week. Although work on the task had not yet started, results might be different if trust were to be measured earlier in the project (e.g., at the inception). Also, analysis was done at the individual level. It would be interesting to analyze the data at the group level, using hierarchical/ nested analysis.

Contributions

This research contributes to the literature offering a more articulated understanding of trust at different phases of a team's life cycle, as well as the relationships of trust with satisfaction and perceived performance in PDTs. As part of this effort, we adapted and further validated scales that have been used to measure trust in traditional and fully virtual teams (Cummings and Bromily, 1996; Jarvenpaa et al., 1998), extending their applicability to the study of PDTs.

Perhaps most significantly, this research has described three distinct types of trust (Expertise Trust, Personal Trust, and Process Trust) that seem to play a role in the formation and functioning of PDTs in the early stages of their work. The research results suggest that early trust is different than longer term trust. For example, while Expertise trust is evident in early trust, in longer term trust, after the participants have an opportunity to have experience with each other, it is subsumed by Personal Trust.

Future Research

We have extended the study to additional semesters and universities and plan to use the larger data set, with increased statistical power, to replicate the factor analysis and to build and test a model of trust in PDTs. Although the language of the project was English, for many of the subjects English was a second language. In the Background survey the participants rated how proficient they are in English. It would be of interest to see if language proficiency affected trust and the relationships of trust with other variables. Also of interest is whether cultural and temporal distances have an effect on trust, as well as possibly other variables such as gender.

Replication of this study to include students from a wider variety of countries would not only increase the power of our statistical tests, but would also allow an examination of the relationship between cultural distance and trust.

Additional studies of PDTs are also envisioned. One such study could compare the relationships with trust in PDTs as compared to those of face-to-face groups and/or fully distributed teams. It is also planned to expand the study of PDTs. In this research, trust was measured after one week of the project (early trust) and after the four week project concluded (longer term trust). It would prove interesting to measure initial swift trust at the inception of the project as well. Studies of professionals in the field would also add to the understanding of trust in PDTs.

Acknowledgments

This research is based upon work supported by the National Science Foundation under Grant Nos. NSF DHB 0623047 and DUE 0736961. We are grateful to Mary Beth Rosson for her collaboration on this project.

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