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By

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Abstract

Increased competition, globalization, and greater availability of communication technologies have lead to an increase in the number of geographically distributed teams. The distribution of these teams creates new contexts for team members that may make trust simultaneously more difficult and more important. In this chapter, we used data from 108 dyads on 12 globally distributed student project teams to compare the development of trust in collocated and distributed dyads. We find evidence that trust is more stable in distributed dyads – it increases less, but it also decreases less than in collocated dyads. Members of distributed dyads appear to retain stable perceptions of their team members' trustworthiness that, in turn, affect their perceptions of their team members' performance. In contrast, collocated dyads appear to update their perceptions of trustworthiness based on their perceptions of their team members' performance. We conclude that the context in which people are working may have a significant impact on the way that trust is developed.

With the help of Internet technologies, such as email and computer-based collaboration tools, the number of geographically distributed, cross-functional teams (Parker, 1994), the number of sites at which team members work (Armstrong & Cole, 2002) and the interdependence of the tasks undertaking by distributed teams are increasing. Globalization of organizations through mergers and growth makes distributed teams important for international coordination and valuable in tying together resources from different geographic regions (Carmel, 1999). Although remote workgroups have existed throughout history (see King & Frost, 2002), remote operations historically undertook more independent activities, such as the sourcing and transportation of goods (O'Leary, Orlikowski, & Yates, 2000). Today's distributed teams perform highly interdependent tasks such as creative design and problem solving. However, such strong interdependence requires trust (Shepard & Sherman, 1998; Shapiro, 1987).

In this chapter, we explore the relationship between geographic distribution and trust among distributed and collocated members of global teams. We examine the development of trust between members of these teams as well as the effect of trust on individual performance.

Trust has been defined as "a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behavior of another" (Rouseeau, Sitkin, Burt, & Camerer 1998: p. 395; see also Mayer, Davis & Schoorman, 1995). However, trust is only meaningful within a particular context or situation (see Gambetta, 1988). Hardin (2000) offers the trust equation, "A trusts B about X." The trustor, person A, trusts the trustee, person B, about X, the object of trust, which is the task or behavior that the trustor expects. We add "Z" to the equation to create "A trusts B about X when Z", where Z is the context of trust or the situation in which the trustor and trustee are embedded. We believe that examining the

object and context of trust are particularly important in the work environment where trust may be narrowly construed to encompass performance of a particular task and one's ability to act may be largely determined by the characteristics of the context in which one works.

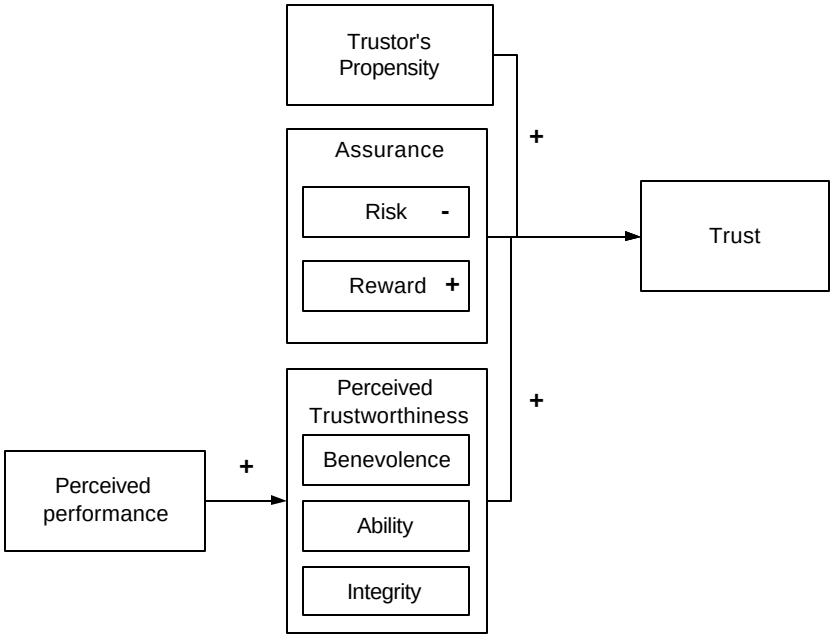
Trust Development

In their model of organizational trust, Mayer, Davis, and Schoorman (1995) argue that trust develops based on the trustor's propensity to trust, the extent to which the trustee perceives the trustor as trustworthy, and the trustor's perception of situational risk. They argue that perceived trustworthiness is a function of how capable (ability), how benevolent (caring), and how honorable (integrity) the trustor perceives the trustee to be. They add that risk will moderate the relationship between the trustor's attitude and their willingness to act in a trusting way such that higher levels of trust will be required when higher levels of risk are present. Zolin and colleagues (Zolin, Hinds, Fruchter, and Levitt, 2001) add several components to the Mayer, Davis, and Schoorman (1995) model. They argue that the trustor's assessment of the rewards possible from the situation also come into play in determining the trustor's behavior suggesting that "assurance," which combines risk and reward, more completely captures the situational determinants of trust. Yamagishi and Yamagishi (1994: p. 129) define assurance as "a perception of the incentive that leads the interaction partner to act cooperatively". We argue that assurance is a combination of both risk and reward such that lower levels of risk and higher levels of reward increase the extent to which the trustor can expect to receive value from the interaction and trust a team member.

Mayer et al also add the trustor's perception of the trustee's performance, arguing that perceived trustworthiness will be updated based on the extent to which trustees are perceived as

following through on commitments. The resulting model of trust development is presented in Figure 1.

Figure 1. Model of Trust Development



The model of trust development presented above, however, may not obtain for all situations. In particular, we consider the situation in which team members are geographically distant from one another and must rely more heavily on technology to mediate their interaction. In these situations, trust may be particularly important because monitoring is more difficult. Ironically, trust also may be more difficult to develop because team members have fewer opportunities to interact face-to-face, have less unplanned interaction, rely more heavily on technology to mediate their interactions, and often are more heterogeneous because they inhabit different cultural contexts.

Trust in Geographically Distributed Teams

The trend toward distributed teams is growing (Armstrong & Cole, 2002). In a recent study, respondent firms reported that 63% of their new product development teams would be

geographically distributed within the next few years, with 22% globally distributed (McDonough, Kahn, & Barczak, 2001). Nine percent of the firms responding indicated that they expected to rely exclusively on geographically distributed teams. Although distributed teams are becoming increasingly prevalent, little is known about the social dynamics that result for team members (see Maznevski & Chudoba, 2000) or the extent to which our current understanding of team dynamics will apply (Hinds & Bailey, 2000). For the purposes of this paper, we define a geographically distributed team as one in which some team members are located in different cities or countries and geographically distributed dyads as dyads in which the team members are located in two different cities or countries.

Working on a geographically distributed team means that team members spend less time in the presence of others, often have different physical and cultural contexts, and rely more heavily on technology to mediate their interactions – technologies such as telephone, video and teleconferencing, Internet chat, and facsimile. Because members of distributed teams generally spend less time in the presence of one another, they are less likely to develop rapport and trust (Kiesler & Cummings, 2002). With distance, spontaneous interaction is more difficult thus reducing information sharing and interpersonal attraction between members (Kiesler & Cummings, 2002). Simply being co-present with others also increases feelings of familiarity (Zajonc, 1968), which has been linked to the development of trust on work teams (Wilson, 2001).

In addition to reduced physical proximity, distributed team members often inhabit different physical, organizational, and cultural contexts. Members in different locations may use different technologies, have different work processes, conform to different interaction norms, be paid based on different reward and compensation systems, have different vacation schedules,

confront different stressors (i.e., economic or political issues), and have different cultural perspectives (e.g., see Armstrong & Cole, 2002). For example, Armstrong and Cole (2002) describe a situation in which "…the two sites had different definitions of completed product quality and tested their work with different procedures. These differences caused unexpected conflicts and delays and were taken by either side as signs of bad faith and political maneuvering" (p. 200). In addition to creating or fueling conflict, occupying different contexts can detract from mutual understanding (Clark & Brennan, 1996; Fussell & Kreuz, 1992; Olson & Olson, 2000). Cramton (2001) describes five problems that result from differences in context; 1) failure to communicate contextual information, 2) unevenly distributed information, 3) differences in speed of access to information, 4) difficulty in communicating and understanding the salience of information, and 5) difficulty in interpreting the meaning of silence. Because the development of trust is, in part, based upon information about the trustee and the situation, reduced or inaccurate information about the trustee is likely to negatively affect the development of trust. Burt and Knez (1996) also offer evidence that the probability of trust will increase with indirect connections that are likely to provide gossip and rumor. When embedded in different social contexts, indirect connections are less prevalent and thus, trust may be inhibited.

Members of distributed teams also must rely more heavily on technology to mediate their interaction. Reliance on communication technologies has been associated with less social interaction (Sproull & Kiesler, 1991; see also Olson & Olson, 2000), more time pressure, less information sharing (Hollingshead, 1996), more misunderstandings (Armstrong & Cole, 2002; Cramton, 2001), and more conflict (Mannix, Griffith, & Neale, 2002). Communication technologies, in comparison to face-to-face interaction, do not offer as many of the social cues

(touch, gestures, voice-intonation, facial expressions, etc.) that are helpful for interpreting feedback and negotiating understanding.

We believe that gathering the information required to assess the extent to which someone is a caring and honorable person, and to assess their competence vis a vis the task that must be accomplished will be difficult when distant, in a different context, and reliant upon technologies for interaction. Because the development of trust is based largely upon information that the trustor has about the trustee and the situation, such a reduction in information is likely to inhibit the development of trust. For example, Grinter, Herbsleb and Perry (1999: 312) reported that team members on distributed teams had more difficulty assessing the competence of others – they did not trust that those at remote sites could "handle the work assigned to them." We propose that

H1: Trust will be lower in distributed dyads than in collocated dyads.

There is evidence that trust changes over time as people gather more information and update their perceptions (Kramer, 1999; Rousseau et al, 1998; Lewicki & Bunker, 1996). In our model (Figure 1), we assume that trust will be updated as team members observe the performance of their colleagues and evaluate the extent to which they followed through on commitments. However, individuals rarely seek disconfirming information and may actually try to avoid it (Good, 2000). Therefore, trust may be resistant to change once established and thus more stable over time than predicted (see Ring & Van de Ven, 1994). This may be particularly true on distributed teams because disconfirming information may be less visible (see Cramton, 2002). Thus, members of these teams may be able to avoid disconfirming information and sustain their initial (and perhaps inaccurate) impressions for an extended period of time. This is

consistent with the findings of Jarvenpaa and Leidner (1999) that distributed teams that establish trust from the beginning are more likely to sustain high levels of trust.

We do, however, expect some development of trust over time in distributed teams. Although distance and reliance on mediating technologies may prove challenging, there is evidence that teams adapt to media (e.g. Markus, 1994; Orlikowski, 2000; Zack & McKenney, 1995) and develop close interpersonal relationships over time (Walther, 1997). We posit that *H2: Members of distributed teams will modify their trust of one another over time, but less so than will members of collocated teams.*

In their model, Mayer, Davis, and Schoorman (1995) propose that risk will moderate the relationship between trust and trust behavior. Zolin et al. (2001) extend and modify this aspect of Mayer and colleague's model by adding perceived reward – the extent to which the trustor stands to benefit from the interaction. For example, if the task has the potential to result in great value and reliance on the trustee is the best way to attain that value, then the potential reward is great.

Normally, one would suppose that high levels of risk would make trust more difficult whereas generous rewards would motivate team members to trust one another so that the reward could be achieved. However, in geographically distributed teams, we posit that risk will loom larger and may suppress the development of trust. We expect this effect for two reasons. First, we anticipate that team members will experience work with distributed team members as inherently more risky. Regardless of the reality of the situation, people enjoy distributed work less and report that they find success more elusive in distributed situations (e.g. McDonough, Kahn, & Barczak, 2001). Thus, additional situational risk may prove intolerable. Second, we anticipate that members of distributed teams will have more difficulty managing the risks

inherent in the situation. For example, additional risk is incurred when teams work with an uncertain, untested technology. When distributed, it may be even more difficult to develop a common understanding of the new technology and manage this risk as team members proceed with different perceptions of how the technology works and should be harnessed for the project. *H3: In distributed dyads, team members' trust will be predicted by perceived risk more so than in collocated dyads.*

Trust and Performance

Trust between team members can have a positive effect on performance (see Hughes, Rosenbach, & Clover, 1983; Klimoski & Karol, 1976), although this effect may be moderated by motivation (Dirks, 1999). In geographically distributed settings, we expect the trust-performance relationship to be even stronger. As discussed earlier, distributed teams have more opportunities for miscommunications and misinterpretations. They also have less opportunity to talk through issues, gain clarification, and resolve misunderstandings. Thus, members of distributed teams may be called upon more frequently to give other team members "the benefit of the doubt" when the others' actions are not visible and are subject to misinterpretation. Distributed team members may need to rely on trust to avoid a downward cycle of blame and faulty attributions, which may result in withholding of information, competition between group members, and an unwillingness to coordinate work together. In a recent study of firms with new product development teams, behavioral challenges were reported to have a significant effect on the performance of distributed teams and "generating trust between team members" was seen as one of the top three behavioral challenges for these teams (McDonough et al, 2001). Thus, we predict that trust will have a greater impact on performance in distributed as compared with collocated dyads.

H4: Trust will be more important to performance in distributed dyads as compared with collocated dyads.

Method

To evaluate the development of trust in geographically distributed dyads, we studied student construction design teams that each included an architect, a structural engineer, and a construction manager. Students, on average, reported 8 months of full-time work experience in their field and 12 academic courses in the relevant disciplines. We observed the teams over three consecutive years and present survey data collected the last year.

Over a period of three years, we used student teams to develop and modify a model of interpersonal trust in geographically distributed, cross-functional teams. Student teams were chosen for three main reasons. First, student teams replicate a work environment more closely than other forms of research methodology, such as a laboratory experiment. Second, compared with industry teams, student teams can be studied more closely using surveys and interviews. Student teams provide higher response rates to questionnaires and allow the more frequent surveys required for longitudinal studies. Third, student teams all start at the same time, work on the same task and operate in the same organizational environment. This greatly simplifies the number of variables that must be measured by holding constant these factors.

A number of issues make the study of trust in a working environment complex and the development of a model problematic. First is the dynamic nature of trust. Trust builds over time and, thus, there is a need for longitudinal studies of trust. Second, trust is a social psychological construct that is experienced across many levels of social structure. In our natural language use of the word trust, we speak not only of trusting an individual, but also of team trust, organizational trust, industry trust, trust in society and trust in government. Somehow, some or

all of these factors interact to influence an individual, in the design and execution of his or her behavior. In this study, we chose to study trust at the interpersonal level, rather than at the team or organizational levels. Trust as an attitude or a behavior operates at the individual level and influences individual behavior. Studying interpersonal trust keeps the analysis on the individual level, rather than spanning levels as described by Coleman (1990).

Participants

As described in Zolin et al. (2001),

> The participants for this study were students in the seventh and eighth generation of a Computer Integrated Architecture-Engineering-Construction (A/E/C) class organized by a West Coast University in the United States (Fruchter, 1999). Masters students drawn from United States, European and Asian universities in three disciplines—architecture (A), engineering (E), and construction management (C)—worked in globally distributed teams for four months to design a five-million dollar building according to a client's specifications. The graduate students were assisted by undergraduate 'apprentices' and mentored by globally distributed professionals working in each discipline.
>
> To facilitate assignment to groups, students were randomly assigned a skill profile during an initial face-to-face meeting attended by all students. Each project had specific requirements, such as being located in an earthquake zone. In an icebreaking exercise, students identified and joined the project that best suited their assigned skill profile (e.g., those with experience working in earthquake zones were likely to join projects with a building to be located in an earthquake zone). Each team included at least one member who was not collocated. After the two-day project launch, teams did not meet again face-to-face until the final presentation four months later. Distributed team members

> communicated mainly through computer-based Internet applications. Internet meeting applications allowed audio and video communication and desktop file sharing. Internet message applications allowed synchronous message transfer between two or more parties. An Internet application developed for the course facilitated the posting and retrieval of messages and files. Collocated team members used face-to-face meetings as needed. (p. 12)

Data Collection

We provided online surveys and "conducted structured interviews with 12 teams composed of three to four team members each, distributed among 10 locations in six countries - the United States, Switzerland, Holland, Germany, Slovenia, and Japan" (Zolin et al., 2001: 13). All team members participated in the research. A survey during the first week of the project contained questions about the number of courses taken, work experience in each discipline, and the students' perceptions of their own risks and rewards associated with the project. Approximately one month later and three months later, we distributed dyadic surveys in which we asked each team member to rate each of his or her other team members on trustworthiness (care, ability, and integrity), perceived performance and to indicate the extent to which they checked on the work of each other team member (our measure of trust). This survey yielded 108 usable dyadic responses (e.g., responses from A about B). The interviews, which were recorded and the interviewer's notes transcribed, were used to enrich our understanding of what transpired in these teams.

Measures

Dependent Variables. Our primary dependent variables of interest are trust and performance. Zolin et al. (2001) describe a measure that taps into the behavioral aspects of trust

– monitoring or checking on the work of the trustee. This measure is consistent with the argument that in investigating trust, one must take into account the situation, thus A trusts B about X (see Hardin, 2000). To create a measure of checking, we averaged across four items from the dyadic survey (see figure 2). The scale reliability for the four items was high (alpha=.77). Each item was rated on a 5-point scale with 5 equating to high levels of checking. By reverse coding our checking variable, we created a measure of trust.

To create a measure of performance, we used the student's final grade. A portion of the grade was determined based on the student's contribution to the project in their own disciplinary area (e.g., architecture, engineering, or construction management), which they presented at the end of the project. Another significant portion of the grade was based on the overall team project. A multi-disciplinary team of faculty and industry experts assessed the individual and team presentations. Thus, we considered the grade to be a reasonable measure of the team member's performance on the project.

Figure 2. Survey items. (* These items were reverse coded)

Trust Behavior – Checking
1. How often have you needed to check/ask to see if this team member had completed her/his commitments?
2. How often have you counted or compared to see if this team member was contributing to the group?
3. How often have you worried about this team member's performance?
4. How often have you checked on this team member's progress on the deliverables promised?

Propensity (General trust)
1. Most people are basically good and kind
2. Most people are trustworthy
3. Most people are basically honest.
4. I am trustful.
5. Most people are trustful of others.
6. Most people will respond in kind when they are trusted by others.
7. People are always interested only in their own welfare.*
8. No matter what they say, most people inwardly dislike putting themselves out to help others.*
9. One can avoid falling into trouble by assuming that all people have a vicious streak.*
10. In this society, one does not need to be constantly afraid of being cheated.*
11. People usually do not trust others as much as they say they do.*
12. In this society, one has to be alert or someone is likely to take advantage of you.*

Risk (Year 1)
Do you feel that you are at risk if your team mates do not perform?
What is at stake for you if your team mates do not do their job?
What would happen if a team mate just refused to perform?

Reward (Year 1)
1. What reasons did you have for taking on the project?
2. How important were those reasons?

Risk (Year 2)
1. To what extent do you feel at risk if one team member does not perform?
2. How much is at stake for you (what do you have to loose) if one team member does not do their job?
3. How serious will it be if one team member refuses to perform through most of the project?

Reward (Year 2)
What goals do you do you hope to achieve with this project? (Not directly used)
2. How important are those goals?

Perceived Trustworthiness: Benevolence
1. How often has this team member made an extra effort to make your job easier?
2. How often has this team member listened carefully to hear your problems or concerns?
3. How often has this team member notified you when she could not meet a commitment?
4. How often has this team member passed on new information or ideas that may be helpful to you or the group?
5. How often does this team member check to make sure that communication was received or understood?

Ability
1. How often has this team member exhibited technical or project competence?
2. How often have you noticed that team member exhibit professional behavior?

Integrity
1. To what extent is this team member Honest/Dishonest?*
2. To what extent is this team member Virtuous/Sinful?*

Perceived performance
1. How often did this team member follow-through on work commitments?
2. How often did this team member complete work commitments on time?
3. How often did this team member fail to follow-through on work commitments? *
4. How often did this team member fail to complete work commitments on time? *

Independent Variables. The primary independent variables of interest in this study are geographic distribution, perceived trustworthiness (care, ability, and integrity), trustor risk and reward, and perceived performance.

Geographic distribution is a dichotomous variable in which dyads are either located on the same campus (collocated = 0) or split between two distant campuses (distributed = 1). Distributed dyads could be as close together as 50 miles or as far apart as different continents. We examined the effect of time zone, but saw little difference, so collapsed distribution into a single dichotomous variable.

Perceived trustworthiness was measured by the care, ability, and integrity reported by the trustor about the trustee in the dyadic surveys. Each of the items (see figure 2) was measured on a 5-point scale with 5 equal to higher levels of care, ability, or integrity. Care, ability, and integrity were summed and divided by 3 to create a scale of perceived trustworthiness with 5 equal to high and 1 equal to low perceived trustworthiness.

Perceived risk and reward were assessed from questions included in our demographic survey (see figure 2) so that we could assess perceptions of risk and reward as early in the project as possible. The scale for these items was 1 to 3 where 3 was equal to high levels of risk or reward.

Perceived performance was a measure of the trustor's perception of the extent to which the trustee followed-through on commitments and delivered work on schedule (see figure 2). We used a 4-item scale (scale reliability = .87) with each of the items measured on a 5-point scale with 5 equivalent to high levels of perceived performance. To create a measure of perceived performance, we averaged across the 4 items. Measures for perceived trustworthiness and perceived performance were taken from the dyadic surveys.

Analysis

We tested our hypotheses using linear regression models and structural equation modeling. Because our data were dyadic, we were concerned about autocorrelation between the trust reported by members of the same dyad (e.g. reciprocal trust). However, the Durbon-Watson (Hamilton, 1992) test statistic was higher than the upper limit (d=2.14) suggesting that reciprocation of trust was not strong in the dyads we studied.

We conducted structural equation modeling using the estimation procedure of AMOS (Hoyle, 1995; Byrne, 2001) to observe the effects of variables over time. Our goal was to test our hypotheses about trust development in distributed dyads as compared with collocated dyads. Hence, we adopted a strictly comparative analysis approach. We also used Bollen-Stine bootstrapping to adjust for the small sample size and non-normal distributions of variables (which can overestimate the $?^2$ statistic and lead to rejection of acceptable models) thus improving our ability to assess model fit (Byrne, 2001).

Results

We collected data at three points in time to enable us to conduct longitudinal analyses, examining trust development over time. The descriptive statistics for and correlations between our variables are provided in Table 1. On the whole, participants reported a moderate level of checking with the average being 2.51 (SD = .88) on a 5-point scale at month one and 2.42 (SD=.70) at month three. As expected, the correlation between checking at month one and checking at month three ($r=.32$, $p<.001$) was positive and significant suggesting that initial trust predicted later trust. Perceived trustworthiness at month one also predicted checking at month three ($r=-.44$, $p<.001$) indicating that perceived trustworthiness may have contributed to later trust.

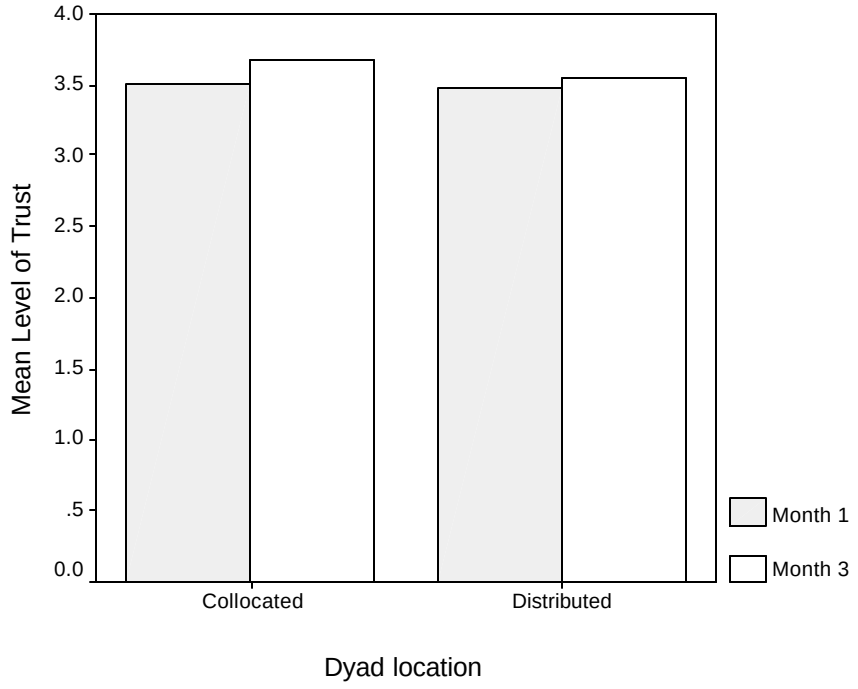
Table 1. Descriptive Statistics and Correlations for Variables. (N= 108).

Variable	Mean	Std Dev.	1.	2.	3.	4.	5.	6.	7.	8.
1. Checking (month 1)	2.51	.87	1.00							
2. Checking (month 3)	2.42	.70	.32***	1.00						
3. Trustor's performance	3.80	.46	.07	-.03	1.00					
4. Distribution	.71	.45	.02	.08	-.11	1.00				
5. Perceived trustworthiness	3.58	.75	-.22*	-.44***	-.12	-.14	1.00			
6. Trustor risk	2.10	.43	.17+	.30**	-.13	.06	-.16+	1.00		
7. Trustor reward	2.47	.55	-.11	-.18*	-.17+	.21*	.06	.03	1.00	
8. Perceived performance	3.94	.82	-.47***	-.43***	-.01	-.12	.58***	-.20*	.25**	1.00
9. Courses	11.49	5.40	.22*	-.15	.18+	-.05	.26**	-.12	-.14	.10

+ p < .10 * p < .05, ** p < .01, *** p < .001

In hypothesis 1, we argued that trustors in distributed dyads as compared with those in collocated dyads would trust their team members less. We therefore expected a negative relationship between geographic distribution and trust. We compared the mean level of trust by distributed and collocated dyads in month one and month three (see Figure 3). In an ANOVA analysis, comparing distributed and collocated dyads, we found no significant difference at month one ($F[1, 106] = 0.04$, $p<.85$) or at month three ($F[1, 106] = .69$, $p<.41$). These data provide no support for hypothesis 1, instead suggesting that distributed and collocated dyads experienced the same amount of trust.

Figure 3. Comparisons of mean levels of trust for distributed and collocated dyads for months 1 and 3. (N = 108).



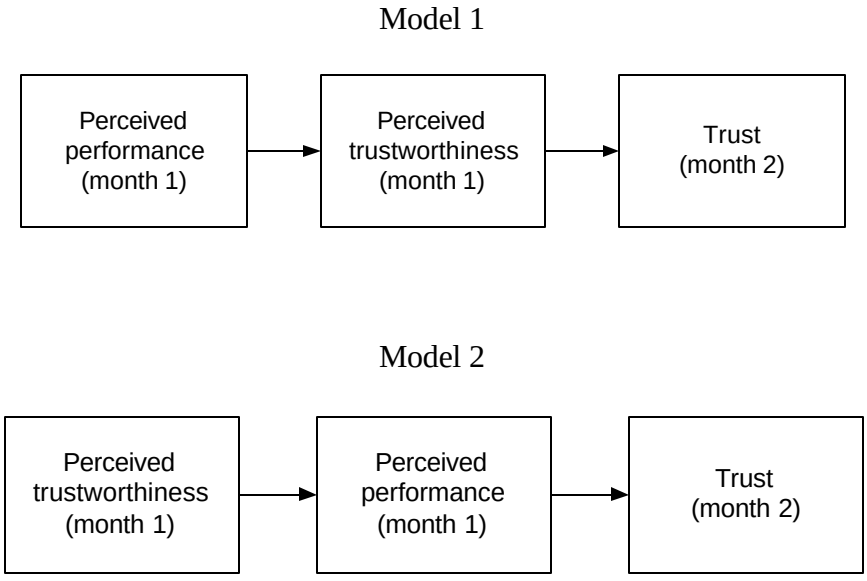
We also argued (H2) that distributed dyads would update their trust less over time than would collocated dyads. A quick look at Figure 3 indicates that members of collocated dyads did not change their level of trust from month one to month three any more than did those in

distributed dyads. A one-way ANOVA confirms no significant difference between distributed and collocated dyads in the change in trust between month one and month three ($F[1,106] = .20$, $p < .66$). However, these analyses merely suggest that average levels of trust did not change. It is possible that trust changed more in collocated teams, but that the averages obscure increases and decreases in trust. We therefore examined more closely the changes in trust. An examination of absolute difference in trust between month one and month three indicates that distributed dyads exhibited significantly less change than did collocated dyads ($F[1,107]=4.09$, $p<.05$). Over 19% of the collocated dyads decreased the extent to which they checked on their team members (suggesting increased trust) whereas only 9% of distributed dyads decreased checking from month one to month three. Further, over 16% of the collocated dyads increased the extent to which they checked on their team members (suggesting reduced trust) whereas only 10% of distributed dyads increased checking from month one to month three. These analyses provide some support for hypothesis 2, indicating that trust may increase more, but that it also may deteriorate more in collocated than in distributed teams.

In our logic leading up to hypothesis 2, we argued that participants would use performance information – perceived performance – to update their trust in their team members. To the extent that team members delivered on commitments, trust should increase. To the extent that team members did not deliver on commitments, trust should decrease. However, we expected this effect to be stronger in collocated teams because they are able to more easily gather performance data. To investigate this, we created a structural equation model (AMOS) that reflected the predicted relationship (see model 1, figure 4). In model 1, perceived performance is used to predict perceived trustworthiness. When using the data from collocated dyads, this model fit reasonably well ($?^2$ [1, N = 31] = .23, $p<.90$). However, when testing the same model

with data from the distributed dyads, the model fit poorly ($?^2$ [1, N = 77] = 8.92, p<.003), providing additional support for our arguments that distributed teams would use performance data less to update their perceptions than would collocated teams. In fact, a better fit with the data from distributed dyads is a model (see model 2, Figure 4) in which perceived performance mediates the relationship between perceived trustworthiness at month one and trust at month three ($?^2$ [1, N = 77] = .3.30, p<.07). To determine model fit, we used several standard fit indexes to compare model 1 with model 2. Byrne (2001) reports that a value above .95 in the RFI index indicates superior fit. The RFI of model 1 for distributed dyads is below .95 (.931) whereas the RFI of model 2 is above .95 (.974), indicating that model 2 has a more acceptable fit than model 1 for our sample of distributed dyads.

Figure 4. Structural Equation Models 1 and 2.

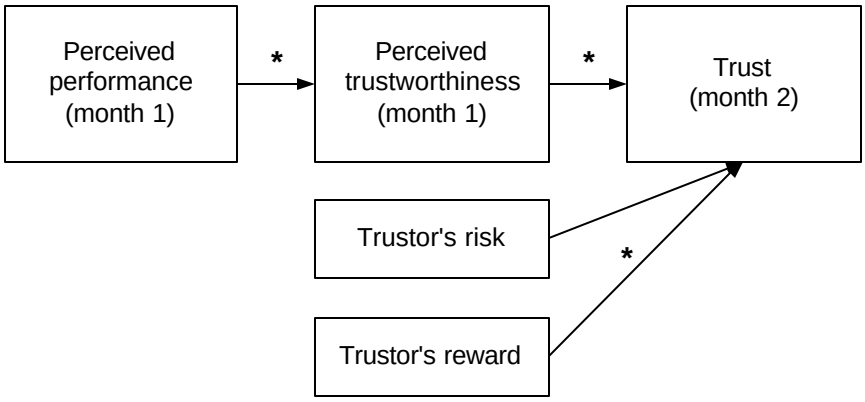


In our third hypotheses, we argued that team members in distributed dyads would use risk as a basis of trust more so than those in collocated dyads. Because model 1 fit better for

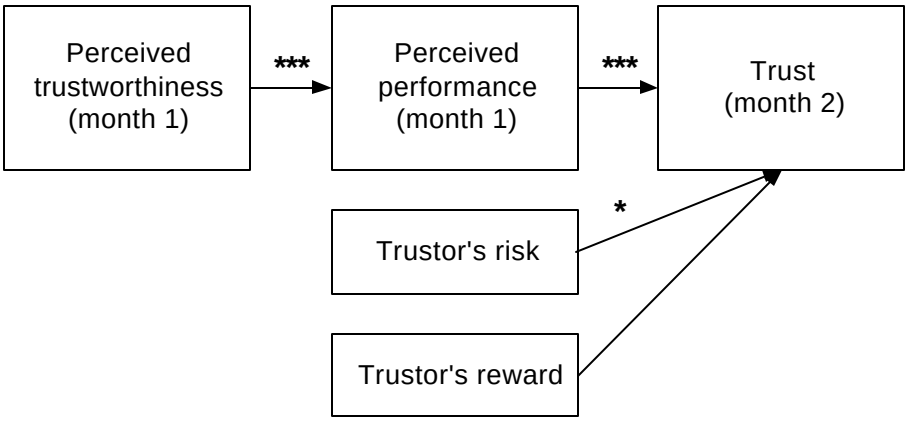
collocated dyads, we added risk and reward to model 1 and used it to estimate for collocated dyads (see model 3, Figure 5). Similarly, we added risk and reward to model 2 and used it for the distributed dyads (see model 4, see Figure 5). Model 3 had a reasonable level of fit for the collocated dyads ($?^2$ [6, N = 31] = 4.89, p<.56) Bootstrapping indicated a higher probability of fit (p < .61). However, model 4 did not fit as well for the distributed dyads ($?^2$ [6, N = 77] = 14.24.65, p<.03), (with bootstrapping p < .10) although all of the relationships were significant except the relationship between reward and trust (ß=.05, p<.62). As predicted, risk was significant in predicting trust for distributed dyads (ß=-.22, p < .05), but not so for collocated dyads (ß=-.25, p < .11). Consistent with hypothesis 3, these analyses indicate that high levels of perceived risk may have had a more detrimental effect on trust in distributed as compared with collocated dyads. However, contrary to our expectations, distributed dyads did not report higher levels of perceived risk than their collocated colleagues (F[1,106]= .32, p<.57).

Figure 5. Structural Equation Models 3 and 4.

Model 3 (Collocated Dyads)



Model 4 (Distributed Dyads)



* p < .05, ** p < .01, *** p < .001

We also argued that trust would be more important to individual performance in distributed dyads (H4). To evaluate this hypothesis, we conducted OLS regression (see Table 2). In model A, we include the set of control variables that we expected might have a direct effect on performance. We included the number of relevant courses (the sum of courses that participants had taken in architecture, structural engineering, and construction management) with the expectation that students who had completed more relevant coursework would perform better. We also added risk, reward, and the interaction between risk and reward to the model with the assumption that perceived risk would indicate the perceived difficulty of the project and reward would be a proxy for motivation. That is, if the reward is perceived to be high, then the participant may be more motivated to perform well. The relationship between risk and reward

was expected to affect motivation as well – to the extent that risk was perceived as low[1] and reward was high, then motivation should have been high and better performance should have resulted. From model A, none of the control variables were significant although risk (reverse scored) was suggestive ($\beta = .61$, $p < .07$) indicating that lower levels of perceived risk may lead to more successful performance.

[1] If participants perceived this course as having no challenge, then that could also have a negative effect on motivation. However, the quality of work expected in this course is generally considered quite challenging and we assume that all students were at least somewhat challenged by the project.

Table 2. OLS estimation of trustor's performance (N=104).

	Model A	Model B	Model C	Model D	Model E
Intercept	**	**	**	**	**
Number of relevant courses	.15	.15	.17 +	.14	.18
Geographic distribution[a]	-.07	-.07	-.76	-.07	-.09
Risk (reverse scored)	.61 +	.61 +	.63 +	.61 +	.64 +
Reward	.48	.48	.53	.48	.53
Risk (reverse) X Reward	-.78	-.77	-.83	-.78	-.85 +
Trust (month 3)		-.01	-.23		
Distribution X Trust			.71		
Increase in trust				.01	-.15
Distribution X Increase in trust					.22 +
Adj. R-squared	.05	.04	.05	.04	.06
Model F	2.06 +	1.60	1.71	1.70	1.88 +
Degrees of freedom	5, 99	6,98	7,97	6.96	7,97

[a] Geographic distribution was coded as 0, 1 where 1=distributed and 0=collocated.

[b] Checking at month 1 minus checking at month 3.

+ p <.10 * p < .05 ** p < .01 *** p < .001

In model B, we add trust to the model. We used trust (the reverse score of checking) rather than checking in these models so that the interaction terms were more interpretable. However, we found no significant relationship between trust and performance (β = -.01 , p<.93). Although the interaction between distribution and trust when predicting performance was in the

expected direction (β = .71 , p <.20) – with an increase in trust in distributed dyads having a positive effect on performance – the results were not significant. We then replaced trust with increase in trust from month one to month three with the expectation that building trust over time would improve performance, particularly in geographically distributed teams. Surprisingly, we found a negative (but non-significant) relationship between increase in trust and performance although the interaction between distribution and an increase in trust was in the expected direction (β = .22 , p <.10). These results provide only weak support for the idea that trust will be more important to performance on distributed as compared with collocated teams.

In the previous analyses, we predicted the performance of the trustor with the assumption that the extent to which the trustor is able to trust his/her team members will influence his/her ability to perform well. We also reason that the extent to which someone is trusted may affect his/her performance. However, in analyses similar to those reported above, we found no evidence that trust predicted trustee performance on these teams.

Discussion

In this chapter, we examined the affect of geographic distribution on the development of trust. Although we expected to find less trust between team members who were geographically distant, we found no evidence of this. We did, however, find that trust was more stable and may develop differently in geographically distributed dyads. In collocated dyads, trust was more volatile – both increasing and decreasing more over time than in distributed dyads. We also found that although collocated team members updated trust based on their perceptions of their team members' performance on commitments, distributed team members appeared to use their initial perceptions of trustworthiness to evaluate performance. These data suggest that first impressions are particularly powerful and enduring on geographically distributed teams.

Our data also provide some support for the argument that distributed teams will invoke "swift trust"– trust that is conferred based on the role the trustee occupies (Meyerson, Weick & Kramer, 1996; Jarvenpaa & Leidner, 1999). "Swift trust" can provide the basis for impersonal trust when trust is necessary and there is not adequate time to develop it. Jarvenpaa and Leidner (1999) reported that some distributed teams they studied developed "swift trust" – establishing trust early on and maintaining it throughout a 6-week project – but that others had difficulty developing trust if it was not established from the beginning. Our results also indicate that trust in distributed teams was relatively stable over time. If it started out high, then it tended to remain high throughout the project. These findings suggest that trust may be difficult to develop in distributed teams, but that "swift trust" may be a desirable alternative.

It is, however, important to consider that the teams in our sample met at the beginning of the project for at least two days of icebreaking exercises and project planning. This allowed the partners in distributed dyads to form rich first impressions of each other. Many distributed team members do not have this opportunity and, in fact, may never meet face-to-face. We believe that team members who do not meet face-to-face early in the project will not establish such high levels of trust and may not be able to maintain high levels of trust over an extended project. Therefore, it is important that future research examine the development of trust in distributed teams that do not have the opportunity to meet face-to-face or meet for the first time later in the project.

It is also important to note that trust *did* change over time in distributed dyads even though it did not change as much as it did in collocated dyads. There is ample evidence that distributed team members adapt to distance and to the technologies they are required to use (e.g. Zack & McKenney, 1995) and learn to develop strong interpersonal relationships with distant

colleagues (see Walther, 1997). Distributed team members in our sample increased trust (9%) as nearly much as they decreased it (10%) although collocated team members increase trust (19%) more than they decreased it (16%). These data suggest that trust may be more difficult to create and may deteriorate more at a distance, but more research is needed to evaluate this claim.

We also found that trust between members of distributed dyads is more susceptible to perceptions of risk. Distributed team members who perceived the situational risk to be high were less inclined to trust their distant colleagues, checking more frequently on their behavior. We predicted this effect based on the argument that managing risk would be more difficult in distributed situations because managing risk calls for more information sharing and more negotiation, which are difficult on distributed teams. However, in risky situations, too much trust may be detrimental to performance. Our measure of trust – checking – suggests that distributed team members who perceived the situation to be risky checked more frequently on the work of their distant team members. In these situations, checking may be beneficial as checking may spur information sharing and avoid the potential for miscommunications. However, in our evaluations of performance, we have no evidence that trust is more or less important on distributed as compared with collocated teams. We did, however, find that increasing trust might be more important in distributed than in collocated teams. We speculate that this may be the result of increased cooperation and information sharing between team members. Unfortunately, we do not have the data to evaluate this proposition, but hope that future research will more deeply explore the complex relationship between trust and performance in distributed teams.

As predicted in the model, collocated team members used their evaluation of performance as information upon which to update perceived trustworthiness. In contrast,

distributed team members used their assessment of perceived trustworthiness to evaluate performance. In addition to affecting the development of trust in distributed teams, this could have implications for the ability of distributed team members to accurately assess the quality of work produced by other team members. However, in regression analyses, perceived performance predicted performance better in distributed (β=.25, $p<.03$) than in collocated dyads (β=-.09, $p<.65$) suggesting that the information used to update impressions of collocated team members may not have been sound. It is possible that distributed team members are less biased by factors (e.g. attractiveness, friendliness, ethnicity, etc.) unrelated to performance than are collocated team members. Closer examination of the relationship between interpersonal impressions and performance in distributed teams seems a fruitful direction for future research.

There are several serious limitations to the study we presented here. First, all of the teams that we studied were distributed teams. Our comparisons were not between collocated and distributed teams, but between collocated and distributed members of distributed teams. Although, this is not necessarily an issue when examining interpersonal trust, it does weaken our ability to generalize the results to collocated teams or to collocated dyads that are members of collocated teams. We believe it is important that future research compare the experience of members of collocated teams with the experience of members of distributed teams. The unit of analysis in this study was the dyad. Our sample of teams was small (n=12), so it was not possible to conduct analyses to understand the dynamics of team-level trust on distributed teams. We also believe that this is an important avenue for future research. Our sample of collocated dyads also was small. Such a small sample may have obscured differences that existed. Therefore, we caution the reader to look at the patterns that we uncovered and not at the differences we neglected to find.

Another limitation of this work is that it was conducted with student teams. Although this enabled us to examine teams that were similar on many dimensions, better isolate the factors in which we were interested, and conduct longitudinal research with a reasonably high response rate (and minimal turnover), we assume that trust and the development of trust between members of cross-functional, distributed teams in an industry setting are more complex than we were able to observe. With a better understanding of how trust may develop differently on distributed teams, we are armed to conduct future research in teams that are embedded in a more complex organizational environment.

Although we strove in this study to examine performance, our performance measure was not ideal. The grade was a single indicator and did not distinguish between timeliness, innovativeness, quality, and so forth, so we are unable to determine the extent to which trust differentially improved speed, innovativeness, and quality. Also, although we have a measure of final project performance, we do not know the extent to which team members helped one another or contributed to the project in ways that did not accrue to their individual grade. To understand the relationship between trust, geographic distribution, and performance, it is important to conduct field studies that examine performance using multiple measures and multiple methods. We leave this for future research.

With the caveats above, we offer several recommendations for members and managers of distributed teams. First, it appears from this and other work that first impressions are particularly important for distributed teams. It therefore may be important that teams meet face-to-face early in the life of the team to get to know one another and discuss project goals (Armstrong & Cole, 2002; Kraut, Galegher, Fish, and Chalfonte, 1992). Our study also suggests that distributed teams may have difficulty observing other's performance and gathering performance

information. Facilitating the sharing of this information is an important role for leaders of distributed teams (see also Weisband, 2002). Finally, our examination of perceptions of risk suggests that perceived risk (if not risk itself) could be problematic for the development of trust on distributed teams. To the extent that risk or the perception of risk can be mitigated, distributed team members may be able to focus better on their own work and avoid the need to check frequently on the work of their distant team members. Alternatively, formal procedures (reports, meetings, and so forth) may alleviate the need to monitor the work of distant colleagues (see O'Leary et al, 2002). Early face-to-face meetings, sharing performance information between team members, and reducing perceived risk might facilitate the development of trust on the geographically distributed teams that are proliferating in organizations.

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