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Abstract

With Internet technology and globalization, companies are rapidly adopting cross-functional, global teams, but little is known about the challenging new social environment created for team members. One challenge is the development of trust. To develop and test a model of interpersonal trust, we observed and surveyed 167 dyads across nineteen globally distributed student teams. Teams containing an architect, engineer and construction manager with entry-level education and work experience designed, analyzed and planned a $5 million construction project. We found that perceived trustworthiness (benevolence, ability and integrity) was associated with higher levels of trust but perceived performance mediated the relationship between perceived trustworthiness and trust. Our longitudinal analyses indicated general stability in perceived trustworthiness, perceived performance and trust, but there were some changes over time.

Trust In Cross-Functional, Global Teams

Imagine a construction firm with offices worldwide that has won a competition to build a prestigious hotel facility in Singapore worth over $100 million. They assign a world famous architect based in their London office to team up with a senior structural engineer from their design group in the San Francisco office, and they engage a general contractor based in Singapore to construct the hotel.

Such scenarios are commonplace today in the construction industry and are becoming increasingly common in other industries. These cross-functional, global teams provide great advantages by bringing the diverse skills of scarce specialists to bear on problems or projects that span traditional organizational boundaries, in such diverse areas as software development (Carmel, 1999), engineering (Hauptman and Hirji, 1999, Levinthal and Warglien, 1999), nursing (Ireson and McGillis, 1998), purchasing, and new product development (Brunelli, 1999). They are popular for change-orientated projects such as introducing "total quality" practices, business process reengineering, new product development and improvements to product or service quality (Bishop, 1999). Although companies are rapidly adopting the model of cross-functional, global teams (Jasswalla and Sashittal, 1999), little is known about the challenging new social environment that such teams create for team members (Maznevski and Chudoba, 2000).

One of the major challenges for members of cross-functional, global teams is the development of trust (e.g. Bishop, 1999). Trust develops on the basis of the trustor's personality, the history of the relationship, third-party information, shared category membership, role expectations, and rule-based expectations (see Kramer, 1999). However, the process of

developing trust on cross-functional, global teams may be hindered by the characteristics that define these teams (e.g. O'Hara-Devereaux and Johansen, 1994). Cross-functional, global teams are populated with members who have different training and may have conflicting priorities. They also are likely to interact primarily over mediating technologies rather than face-to-face thus finding it more difficult to share information, observe others' personalities and behavior, and develop rapport.

The irony is that trust may be particularly important on cross-functional projects because many sub-tasks are interdependent, with team members relying on the functional expertise of other team members. Trust is central to teamwork, leadership and organizational culture (Fairholm, 1994, Nicholas, 1993, Ryan, 1999). But, trust may be more difficult to establish in cross-functional, global teams because team members are less familiar with the goals, world-views, problem solving approaches, and methods of team members from other disciplines and other regional or national cultures. Geographic distance makes it even more challenging to create shared understanding (Cramton, 2001) and develop rapport (e.g. Kiesler and Cummings 2002).

Consistent with Rousseau and colleagues (Rousseau, Sitkin, Burt and Camerer, 1998: p. 395, see also Mayer, Davis and Schoorman, 1995), we define trust as "a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behavior of another." However, along with others, we assume that trust can only exist within a particular situation or action (see Gambetta, 1988, Bhattacharya, Devinney, & Pittultia, 1998). As Bigley and Pearce (1998) have argued, it is not a question of "What is trust?" but rather "What trust and when?" Thus, we assume that the expectations of the intentions or behavior of another must be embedded in a particular situation.

In this paper, we synthesize the extant literature to develop a model of trust in cross-functional global teams and empirically test our model in 169 dyads across nineteen teams.

Cross-Functional Teams

A cross-functional team is a group of people with complementary skills who are chosen to achieve a common goal and are mutually accountable for the team's success (Katzenback and Smith, 1993). For example, each line of Harley-Davidson motorcycle is created by a team consisting of a program manager from the design community, a manufacturing lead, a purchasing lead and a marketing lead who work together to bring the product to market (Brunelli, 1999). Such mutual accountability coupled with specialization suggests high levels of interdependence. For example, in design/build projects the architect, engineer and construction manager are reciprocally interdependent – the design and planning activities are performed more or less concurrently (Thompson, 1967). This structure potentially shortens the length of time spent in planning and creates opportunities for joint problem solving, presumably resulting in buildings that are more attractive, safer, cheaper and completed sooner. Such strong interdependence requires trust (Shepard and Sherman, 1998, Shapiro, 1987), particularly in a cross-functional team, because other team members do not have the necessary skills to perform in the breech created by non-performing team members. Sometimes, as is the case with structural engineering, cross-functional team members cannot legally substitute for each other.

Developing trust may be particularly difficult in cross-functional teams due to unshared goals and perceived differences in professional allegiance. Even though cross-functional team members work together to achieve shared project goals, people from different disciplines often have different functional objectives, priorities, and agendas (Jasswalla and Sashittal, 1999). For example, in a large construction project, the architect is responsible for the aesthetics of the

building, the structural engineer for its structural soundness, and the construction manager for ensuring that it can be built on time and within budget. These functional goals often are in conflict and require a "give and take" type of problem solving to arrive at a solution that will satisfy the project goals and the goals of each discipline.

The cross-disciplinary composition of a cross-functional team also means that team members are less likely to perceive themselves as belonging to the same group or category, one of the factors that promotes trust (Brewer, 1996). Kramer, Brewer and Hanna (1996) propose that the strength and salience of identification with a group influences trust of other members. Social categorization (Tajfel, 1969) can lead to in-group bias resulting in higher perceived trustworthiness and enhance perceived similarity that may reduce perceived risk. In cross-functional teams, disciplinary differences may be particularly salient because of the importance people place on their own specialization (e.g. Schunn, Crowley and Okada, 1998). Thus, whereas task interdependence requires more trust between team members, the multi-disciplinary nature of these teams may make the development of trust more difficult.

Global Teams

The challenges confronting cross-functional teams are compounded when team members are distributed around the globe. Trust can become increasingly difficult to develop when team members have few opportunities to interact face-to-face, rely heavily on technology to mediate their interactions, and face cultural and language barriers. Geographic distribution reduces the amount of time that team members spend in the presence of one another and therefore is likely to hinder the development of rapport and trust (see Kiesler and Cummings 2002). Physical proximity and face-to-face interaction may be crucial for developing and maintaining trust (see Nohria and Eccles, 1992). Collocation also can reinforce social similarity and highlight

obligations that individuals have to one another (Latane, Liu, Nowak, Bonevento, and Zheng, 1995). When teams are geographically distant and rely on mediating technologies to interact, information may flow less easily between team members (see Hollingshead, 1996), team members may not develop the same understanding of the information that is shared (e.g. Cramton, 2001), and team members may assume the worst of distant team members (Cramton 2002). For these reasons, when observing geographically distributed teams, Armstrong and Cole (2002) noted that distant team members had a more difficult time reconciling issues. These findings are consistent with media richness (Daft, Lengel, and Trevino, 1987) and social presence (Short, Williams, and Christie, 1976) theories which argue that mediating technologies will impoverish the communication process and result in less interpersonal affection and trust.

In addition to spanning geographic distances, global teams are likely to be composed of people from different cultures with different basic assumptions (Schein, 1991). The diversity of team members could make the development of trust difficult (Williams and O'Reilly, 1998) because others' perspectives and behaviors are more easily misinterpreted (see Olson and Olson, 2000). Thus, we expect that global teams will have difficulty reconciling issues that arise and developing and maintaining trust.

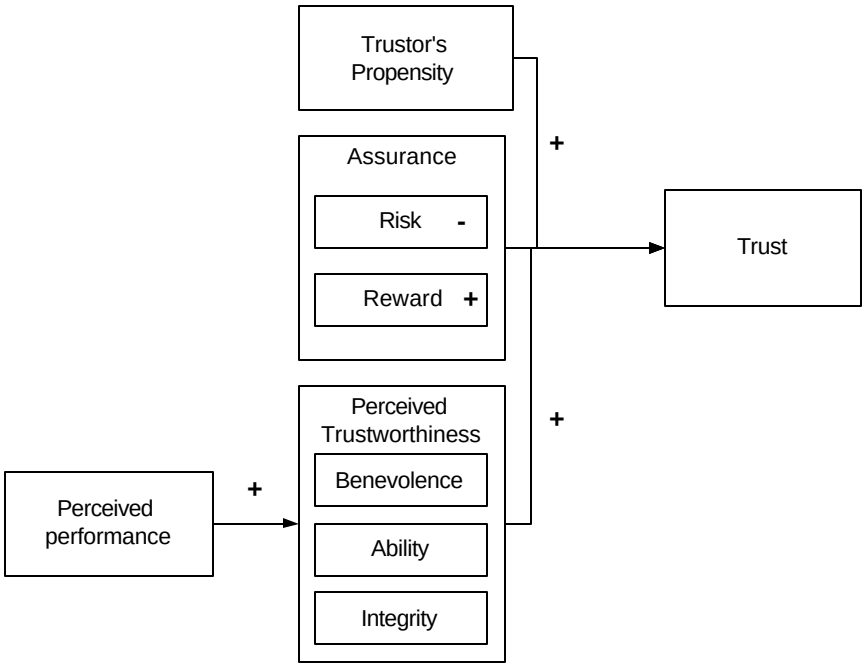
In an examination of trust development in globally distributed teams, Jarvenpaa and Leidner (1999) reported that teams developed "swift trust," but that it may have been fragile and temporary. Theories of "swift trust" argue that, due to roles, trust does not start at zero in new relationships (Meyerson, Weick & Kramer, 1996). In their temporary (6 week duration) teams, few teams were able to develop trust if trust was not established from the beginning. In summary, Jarvenpaa and Leidner argue that trust can be established in globally distributed teams, but it may be fragile and early interactions between team members are crucial.

Trust Development in Cross-Functional Global Teams

Although the process may be more difficult, we argue that trust in cross-functional, global teams can develop as it does in traditional teams. We therefore rely on existing models of trust development to generate our predictions. In particular, we have used the model built by Mayer et al (1995) as a point of departure. In their integrative model of organizational trust, Mayer and his colleagues argued that trust is a function of the trustor's propensity to trust and the trustor's perception of the trustworthiness of the trustee (composed of perceived ability, benevolence, and integrity). They further argue that the trustor's perception of risk will affect the extent to which the trustor is willing be vulnerable to the behaviors of the trustee. Finally, they propose that the outcomes of risk taking will affect the trustor's perception of the trustworthiness of the trustee in the future.

Our model also relies on the trustor's propensity to trust (general trust), the trustor's perception of the trustworthiness of the trustee, and the trustor's perception of risk. We, however, add several components to the model. First, we argue that perceived performance, which is more specific than outcomes, is an important behavioral measure on which people rely to determine trustworthiness. Second, in addition to considering their own risk, we argue that trustors take into account the potential rewards of trusting the trustee. Our model of trust development is pictured in figure 1 and described in detail below.

Figure 1. The proposed model of trust development in cross-functional global teams.



Trustor's propensity

Disposition-based trust theories propose that trust develops based on a person's general nature as a trusting or non-trusting person (Rotter, 1971). The trustor's propensity to trust (also referred to as general trust and dispositional trust) is a characteristic of the trustor, independent of the situation or characteristics of the trustee. The trustor's propensity totrust may be particularly important in global teams because people with different cultural backgrounds may vary in their propensity to trust others (e.g., Hofstede, 1980).

H1: The higher a trustor's propensity to trust, the more the trustor will trust members of his/her team.

Risk and Reward

Consistent with others, we posit that the situation faced by the trustor contributes to his or her willingness to trust. We argue that trust is partially determined by the potential risk and

reward faced by the trustor and the trustee. Many scholars have argued that risk is a necessary pre-condition for trust (Coleman, 1990, Rousseau et al, 1998). Several have considered risk so central to the trust decision that they have incorporated the concept of risk into their definition of trust (e.g. Shapiro, 1987, Sheppard and Sherman, 1998). For example, Coleman (1990: 91) defined trust as "an incorporation of risk into the decision of whether or not to engage in the action." The value at risk for the trustor equates to the value of what will be lost if the trusted person does not perform. Failure to perform by the trusted person may result in loss of overall project quality, time invested, or reputation if the failure interferes with the trustor's ability to meet obligations. Perceived risk may be mitigated by social controls such as binding contracts, procedural norms and so forth (Shapiro, 1987) or exacerbated by uncertainty and lack of information. Risk may be perceived as particularly high in cross-functional, global teams because of task interdependence, the inability of team members to perform the job of others, and the difficulty of getting information about team members' performance.

We also propose that the potential for reward is an important situational consideration for the trustor. Although Mayer et al (1995) do not represent reward in their model, potential rewards are built into their conceptualization of risk. If the task is highly valued and no one else can perform it, the trustor's reward from the interaction is large. If the task is not valued or there are many alternatives for accomplishing it, the reward is small. 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.

H2: To the extent that trustors perceive low levels of risk and high levels of reward for themselves, they will trust their team members more.

Perceived Trustworthiness

Although the word trust is sometimes used when describing perceived trustworthiness (Hardin, 2000), it is important to distinguish between perceptions of trustworthiness and trust because trust may be influenced by factors other than the trustworthiness of the trustee. Perceived trustworthiness is a multifaceted construct (Barber, 1983, Mishra, 1996, Rempel, Holmes and Zanna, 1985). Consistent with the Mayer et al (1995) model, we use three dimensions of perceived trustworthiness; benevolence, ability, and integrity.

Benevolence is described by Mayer and colleagues (Mayer et al, 1995: 719) as "the perception of a positive orientation of the trustee toward the trustor." Benevolence can be the outcome of goal alignment or "encapsulated interest" (Hardin, 2000) or the confidence derived from mutually compatible interests (Das and Teng, 1998). Benevolence is similar to McAllister's (1995) conception of affect-based trust – trust grounded in reciprocated concern from the other party.

Ability refers to the extent that the trustee has the skills and resources needed to perform the task and may be an essential element in determining trust (e.g. Butler 1991, Butler and Cantrell 1984, Sitkin and Roth, 1993). No matter how diligent a team member, if he or she does not have the ability to accomplish the goal then the likelihood of success is slim and trust not warranted. This dimension is similar to McAllister's (1995) conceptualization of peer reliability and dependability, which depend on the trustee's ability to deliver as promised (or expected). Consistent with Mayer and colleagues (Mayer et al, 1995), we have conceptualized ability as specific to the task and situation rather than as generalized expertise.

The third dimension, *integrity*, refers to the honesty and moral character of the trustee as perceived by the trustor. This is consistent with Mayer et al's (1995: 719) definition of integrity as "the trustor's perception that the trustee adheres to a set of principles that the trustor finds acceptable" and with Butler's (1991) dimension by the same name. Trustees who are perceived as having integrity are seen as more likely to behave in honorable ways toward team members. Thus, to the extent that trustors see teammates as high in integrity, they are more likely to perceive them as trustworthy.

We posit that benevolence, ability, and integrity compose perceived trustworthiness and lead to increased trust in cross-functional, global teams.

H3: To the extent that the trustor perceives his team members as caring, capable, and of high integrity, s/he will trust them more.

H4: Perceived trustworthiness composed of benevolence, ability, and integrity) will increase trust between team members.

Perceived Performance

Trust is often represented as a static, binary (trust exists or does not exist) variable but comparative histories give evidence that trust changes over time (Rousseau at al, 1998). One important basis for trust is the history dependent process in which "trust between two interdependent actors thickens or thins as a function of their cumulative interaction" (Kramer 1999, p 575). The process resulting in the change in trust over time begins when an individual's expectations about another party are confirmed or discredited by experience (Kramer, 1999). Thus, once a trustor is given the opportunity to observe a trustee's behavior, the trustor can evaluate the perceived performance of the trustee, the extent to which the trustee has followed

through on the commitments made. Our dimension of perceived performance is similar to the "outcomes" variable in Bhattacharya, Devinney, and Pittultia's (1998) dynamic model that describes trust in terms of actions, outcomes and consequences. It is also similar to the dimension Mayer et al (1995) refer to as "outcomes." In both of these models the variable outcomes refers to the positive or negative results of trusting. Mayer Davis and Schoorman also propose that outcomes will positively or negatively influence perceived trustworthiness. Expanding on these ideas, we argue that trustors will think their team members worthy of trust when the trustor perceives that his team members are performing as expected.

H5: When trustors perceive their team members as performing well in a given domain, perceived trustworthiness will increase.

Although there is evidence that trust changes over time, individuals rarely seek disconfirming information and may actually try to avoid it (Good, 2000) suggesting that trust, like first impressions (Chaiken & Eagley, 1998), may be resistant to change once established and thus stable over time (see Ring and Van de Ven, 1994). In cross-functional, global teams, disconfirming information may be less available and less visible (see Cramton 2002). Thus, members of these teams may form an opinion about the trustworthiness of their team members and be more resistant to changing their opinion. This is consistent with the finding of Jarvenpaa and Leider (1999) that global teams who develop trust in the formative stages of the team are more likely to sustain high levels of trust.

H6: Trustor's perceptions of team members' trustworthiness, perceptions of team members' performance, and trust of their team members will be stable over time.

Method

To evaluate the development of trust in cross-functional, global teams, we studied student construction design teams composed of an architect, a structural engineer, and a construction manager. On average, students had taken 12 courses in architecture, structural engineering, or construction and had 8 months of full-time work experience in the domain. We observed the teams over three consecutive years and collected survey data for the last two years.

The Architecture/Engineering/Construction Project

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 and from three different 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 (e.g. experience working in an earthquake zone) during an initial face-to-face meeting attended by all students. Each project had a specific characteristic, such as being located in an earthquake zone. In an icebreaking exercise, students identified and joined the project that best suited their randomly 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). By chance, each team included at least one member who was not collocated. By necessity, each team had to have at least one team member from each discipline, architecture, engineering and construction

management. 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.

Data Collection

Data were collected over three years. In year 0, we observed and videotaped (from a single location) the distributed team meetings and conducted group discussions with participants in each of the three disciplines to develop a general understanding of how trust developed and identify strategies for data collection. In year 1, we studied seven teams composed of three to four team members each, distributed across six locations in three countries – the United States, the United Kingdom, and Slovenia. All team members participated in the research. We observed and videotaped one side of the distributed team meetings, conducted structured interviews with individual team members, and collected survey data at two points in time. During the first 2 weeks of the project, we administered an online survey with questions about work experience, the number of courses taken in each discipline, and general trust. Three months into the project, we asked each team member to rate each of his or her other team members on trustworthiness (benevolence and ability) and to indicate the extent to which they checked on the work of each other team member (our measure of trust). From this survey, we received 61 usable dyadic (directional) responses (e.g. responses from A about B). Information on the trustor's perceived risk and reward and the trustor's perception of the trustee's risk and

reward were gathered from structured interviews conducted during the last month of the 4 month project. The interviews were video recorded and notes transcribed.

In year 2, we conducted online surveys and 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. Again all team members participated in the research. As in year 1, a survey during the first week of the project asked questions about the number of courses taken and work experience in each discipline. We also added questions about students' perceptions of their own risks and rewards associated with the project. Approximately one month later and three months later, we distributed dyadic surveys similar to that described in year 1 which yielded 108 dyadic responses. However, in year 2 for the survey at three months, we included several questions to measure each team member's assessment of their other team members' integrity.

Measures

Dependent Variables

Our primary dependent variable of interest is trust. I conceptualize trust as a property of the relationship between two actors that has a directional quality and an object of trust, as in A trusts B about X (Hardin, 2000). The need for questions that identified a specific person and the performance of a specific task made most existing trust scales unsuitable. In addition, it was necessary to differentiate our measure of trust from perceived trustworthiness and our measure of the dimensions of perceived trustworthiness, care, ability or integrity. For example, the question To what extent do you think that Person B is competent? is a better measure of perceived trustworthiness. Since perceived trustworthiness is an antecedent to trust in the model, asking

such questions would confound the measures. Our definition of trust is the willingness to accept the risk based upon the expectation that another will perform, irrespective of the ability to monitor or control that other party. Since one of the indicators of low trust is a higher level of checking or monitoring of work progress (e.g. Strickland, 1958), I used checking as a behavioral measure of the attitude trust. Therefore, I measured the extent to which the trustor reported checking on or verifying the work of the trustee, or feeling the need or desire to do so. To create a measure of checking, we averaged across four items in the dyadic survey (see figure 2) that were rated on a 5-point scale with high amounts of checking rated more highly. This resulted in a variable ranging from 1 to 5 with high scores indicating low levels of trust. The scale reliability for the four items was high (alpha=.82 in year 1 and alpha=.77 in year 2). These data were taken from the dyadic surveys administered three months into the project during year 1 and one and three months into the project during year 2.

Figure 2. Scale items for years 1 and 2. (* Indicates 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 propensity (general trust), trustor's risk and reward, perceived trustworthiness (benevolence, ability, and integrity) and perceived performance. Propensity to trust was measured using the Rotter scale for general trust (1971) modified by Yamagishi, Cook and Watabe (1998). Propensity was taken from the background survey administered during the first two weeks of the project in year 1. Because propensity resulted in low scale reliability (alpha=.47) and did not predict trust in year 1, it was not measured in year 2.

In year 1, perceived risk and reward were assessed from questions asked in the interviews (3 months into the project), but in year 2 similar questions were included in our demographic survey so that we could assess perceptions of risk and reward as early in the project as possible. Thus, in year 1, each participant's response to the risk and reward questions (see figure 2) were coded from the interview transcripts. The coder evaluated the respondent's perceived level of risk and reward as either low (1), medium (2), or high (3). To match the scale used in year 1, the 5-point risk and reward values in year 2 were rescaled as 1 or 2=1, 3=2, and 4 or 5=3.

Perceived trustworthiness was measured by perceived benevolence, ability, and integrity reported by the trustor about the trustee in the dyadic surveys. All items are listed in figure 2 and were measured using a 5-point scale with 5 equal to higher levels of benevolence, ability, or integrity. Benevolence was created by averaging across 5 items asking about the extent to which the trustee demonstrated sensitive and helpful behaviors that demonstrated concern for the trustee (alpha=.83 in year 1, alpha=.80 in year 2). Ability was created by averaging across 2 items asking about the extent to which the trustee had exhibited technical, professional, and project level competence (alpha=.77 in year 1, alpha=.73 in year 2). Our last dimension of

perceived trustworthiness, integrity, was only measured in year 2. Integrity has been conceptualized in many different ways including values congruence (e.g. Sitkin and Roth, 1993), consistency (e.g. Butler, 1991), and character (e.g. Gabarro, 1978). Consistent with Mayer et al (1995), we operationalized integrity as virtuosity and honesty as perceived by the trustor. This conceptualization was consistent with two questions from McCroskey's (1966) scales for source credibility. We therefore adopted these measures (see figure 2) with a resulting scale reliability of alpha=.67.

Perceived performance was measured based on the trustor's evaluation of the extent to which each team member followed through on commitments and completed work on schedule (see figure 2). Each of the items was measured on a 5-point scale where 5 equated to high levels of perceived performance. This 2-item scale resulted in a scale reliability of .87 in year 2. Perceived trustworthiness and perceived performance were taken from the dyadic surveys administered at one and three months into the project during year 2.

Analysis

We tested our hypotheses using linear regression models with ordinary least squares estimation (OLS). We anticipated a problem with autocorrelation – the correlation between values of the same variable across different cases. For example, my trust of you is related to your trust of me. Theories of trust based upon reciprocity (Creed and Miles, 1996: 19) suggest that the level of trust between two people is positively related, the more **A** trusts **B**, the higher is **B's** trust of **A**. That could cause a problem with first order autocorrelation of the data between dyads. In both year 1 and year 2, the Durbon-Watson (Hamilton, 1992) test statistic (d) for correlation between the value of checking of the trustor and the trustee was higher than the upper limit (d=1.88 in year 1 and d=2.14 in year 2) suggesting no positive first-order autocorrelation

among the errors. Thus, the reciprocal nature of trust does not appear to be significant in either year.

We also used the estimation procedure of AMOS (Hoyle, 1995, Byrne, 2001) to construct a structural equation model (SEM) to simultaneously observe the effects and changes of variables over time. The AMOS SEM is a test of goodness of fit between the data and the proposed model. The null hypothesis is that the model does not fit. Therefore, a low p value indicates that null hypotheses can be accepted, the model does not fit. A high p value indicates that the null hypotheses, that model does not fit, can be rejected. Our goal was to test hypotheses 6 that perceived trustworthiness, perceived performance and trust has some level of stability between month one and month three of the project in year 2. Hence we adopted a strictly confirmatory analysis approach (Joreskog, 1993). To maintain the same variables as in our multivariate regression models, we choose not to construct latent variables because isolating the measurement error in the indicator variables (Hoyle, 1995) was not our goal and could alter the values of the latent variables at the two points in time. Two potential problems with our data, a small sample size and non-normal distributions of variables, tend to overestimate the $?^2$ statistic and hence can lead to rejection of suitable models (Byrne, 2001). We therefore used bootstrapping to provide a greater degree of accuracy in assessment of model fit statistics (Byrne, 2001).

Results

Year 1

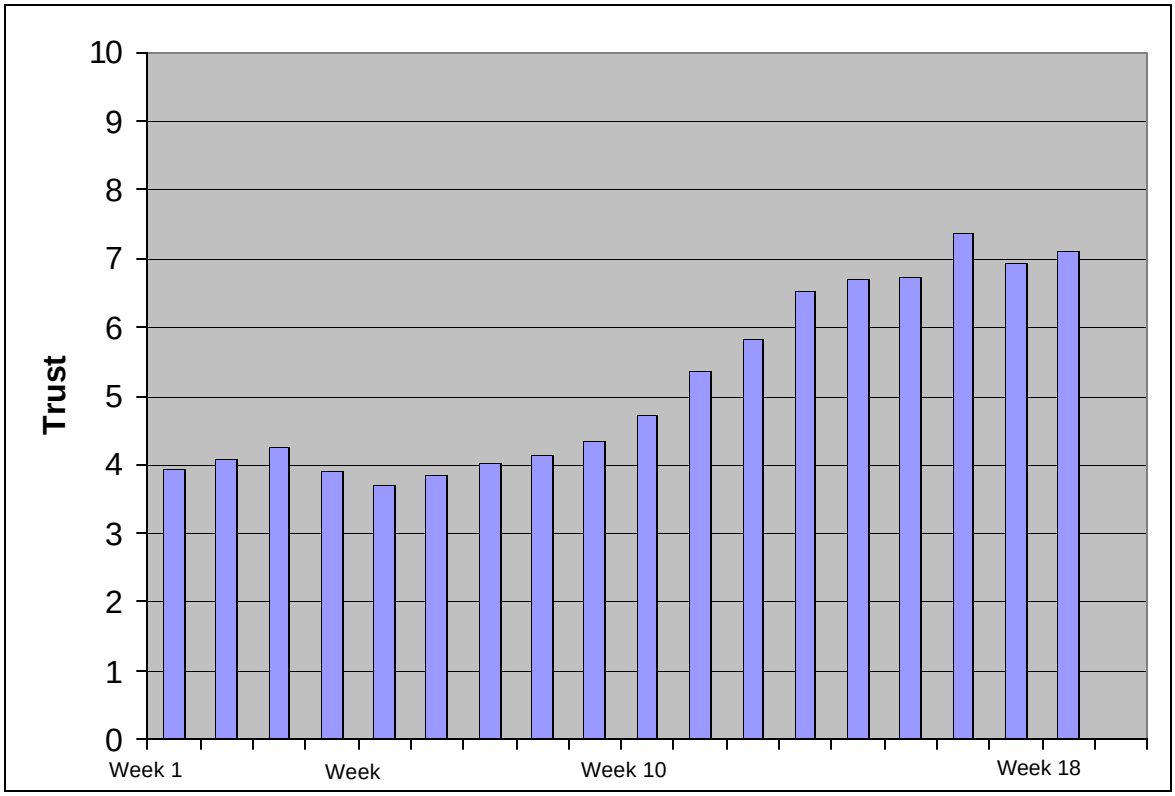
During discipline-based group discussions, members of each profession said that they would trust a member of their own profession more than one of the other professions, supporting

our assertion that developing trust may be more challenging in cross-functional teams. The architects felt that architects were "inherently more trustworthy" since the architect has to coordinate the design team. The structural engineers said that the structural engineer must be trustworthy or the building would fall down. One construction manager jokingly said, "architects are useless" but the construction managers all laughed at the joke. These comments supported our intuition that trust would be more difficult to develop in cross-functional teams.

One behavior that was reported to build trust was making "personal sacrifices for the good of the team." Interruptions to work caused by lack of discussion and "seeing someone do something to save himself" were described as severely damaging trust. International differences in holidays that were not discussed also caused problems. Several teams did not coordinate the spring break and left team members wondering where they were for two weeks. Overall, being physically and temporally distributed (e.g. being in different time zones) and relying on technology reportedly made trust more difficult. These stories can be seen as examples of benevolence, competence and integrity, which support hypothesis 3.

In the interviews, team members were asked to draw a graph of the trust relationships in the teams to show how the level of trust increased or decreased during the time of the project. Figure 3 shows the average of all teams in year 1 across the four-month project. As observed by Sheppard and Sherman (1998) and McKnight, Cummings and Chervany (1998) the level of trust does not start at zero. In fact, only one respondent began drawing the graph at zero and most graphs indicated an increase in trust suggesting that trust may develop over time.

Figure 3. Average level of perceived trust as drawn by participants in year 1.



The descriptive statistics for and correlations between quantitative variables for year 1 are reported in table 1. On the whole, participants reported moderate levels of general trust (M=3.03, SD=.55 on a 5-point scale), risk (M=1.92 on a 5-point scale) and reward (M=2.71 on a 5-point scale). Our dependent variable, checking, suggests that team members had relatively high levels of trust for their team members and did not spent much time checking on the work of others (M=1.35 on a 5-point scale). Higher levels of checking were significantly and negatively correlated with benevolence ($r=-.43$, $p<.001$), but not ability ($r=-.21$, n.s.) It is interesting to note that risk correlates with general trust ($r=.44$, $p<.01$), reward ($r=.31$, $p<.05$), and perceived trustworthiness ($r=.29$, $p<.01$).

Table 1. Descriptive Statistics and Correlations for Variables in Year 1 (N=61)

Variable	Mean	Std Dev.	1.	2.	3.	4.	5.	6.	7.
1. Checking	1.35	.60							
2. General trust	3.03	.55	.12						
3. Risk	1.92	.74	.16	.44**					
4. Reward	2.71	.67	.14	-.06	.31*				
5. Benevolence	3.32	.84	-.43***	.14	.25+	.06			
6. Ability	3.57	.95	-.21	.07	.27+	.24+	.26*		
7. Perceived trustworthiness	3.45	.71	-.39**	.12	.29*	.15*	.77***	.82***	
8. Perceived Performance	4.09	.65	-.70***	-.14	-.10	.07	.47***	.23+	.43***

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

In hypothesis 1, we argued that people with a propensity to trust others would trust their team members more. We therefore expected a negative relationship between general trust and checking. Our data provided little support for this hypothesis. General trust was negatively (though not significantly) related to checking (ß=-.10, n.s). Because of the low reliability of the measure we excluded general trust from analyses in year 2. We also hypothesized that the trustor's low level of perceived risk and high level of perceived reward would increase their trust of other team members (H2). The risk results were in the predicted direction (ß=.18, n.s.), but the reward results were not (ß=.08, n.s.), thus providing little support for hypothesis 2 (see table 2, model A).

Table 2. Comparison of OLS estimates (standardized beta values) of checking behavior for year 1, Month 3.

	Model A	Model B	Model C	Model D
Intercept	+	*	**	***
General trust	-.10	.03	.01	-.10
Risk	.18	.23	.23	.12
Reward	.08	.12	.14	.16
Benevolence		-.36 *		
Ability		-.10		
Perceived trustworthiness			-.41 **	-.08
Perceived performance				-.64 ***
Adj. R-squared	-0.01	0.11	0.12	0.44
Model F	0.70	2.23 +	2.68 *	8.78 ***
Degrees of freedom	3, 47	5, 45	4, 46	5, 45

$^{+}$ p <.10 * p < .05 ** p < .01 *** p < .001

In our third hypothesis, we argued that perceived benevolence, ability, and integrity would result in higher levels of trust. In year one, we have only measures of benevolence and ability so those are included in model B (table 2). Consistent with our hypothesis, it appears from model 3A that perceived benevolence is negatively related to checking (ß=-.36, p<.05), suggesting moderately higher levels of trust. Ability had a negative, but not significant, relationship to checking in model B (ß=-.10, n.s.). Hypotheses 4 proposed that perceived

trustworthiness (composed of benevolence, ability, and integrity) increases trust. When benevolence and ability were combined in Model C their significance increased (ß=-.41, p<.01), providing initial support for Hypothesis 4. As predicted in hypothesis 5, perceived performance had a positive relationship with perceived trustworthiness, although it was not significant (r=-.23, p<.10).

Year 2

In year two, we collected data at three points in time to enable tests of our longitudinal hypothesis (H6). We also collected data on integrity so that we could fully test hypotheses 4, 5 and 6, removed our measure of general trust because we found that it provided little explanatory power in year 1, and increased the size of our sample. The descriptive statistics for and correlations between our variables for year 2 are provided in table 3. Consistent with year 1, the correlation between checking and benevolence (r=-.41, p<.001) was negative and significant in year 2 (at month three) as were the relationships with ability and integrity (r=-.55, p<.001 and r=-.50, p<.001, respectively). As expected, risk was positively correlated with checking (r=.32, p<.01) and reward had a negative relationship (r=-.19, p<.05), more clearly supporting hypothesis 2. Again, as predicted in hypothesis 5, perceived performance had a highly significant, positive relationship with perceived trustworthiness (r=-.50, p<.001).

Table 3. Descriptive Statistics and Correlation Table for Year 2, Month One (1) and Month Three (3) (N=104)

	Mean	S D.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11	12.
1. Checking (1)	2.53	.86												
2. Risk	2.10	.43	.17+											
3. Reward	2.46	.56	-.09	.04										
4. Benevolence (1)	3.53	.78	-.16	-.10*	.07									
5. Ability (1)	3.62	.88	-.22*	-.19*	.04	0.65***								
6. Trustworthiness (1)	3.58	.75	-0.21*	-.16+	.06	0.89***	0.92***							
7. Perceived performance (1)	3.91	.81	- .45***	-.20*	.23*	0.49***	0.57***	0.59***						
8. Checking (3)	2.42	.70	.32***	.30**	-.19*	-0.42***	-0.38***	-0.44***	-0.44***					
9. Benevolence (3)	3.54	.74	-.08	.03	.03	0.59***	0.43***	0.55***	0.32***	-0.41***				
10. Ability (3)	3.84	.81	-.14	-.14	.05	0.55***	0.60***	0.64***	0.53***	-0.55***	0.76***			
11. Integrity (3)	4.36	.94	-.15	-.40***	-.02	0.14	0.26**	0.22*	0.29**	-0.50***	0.32***	0.47***		
12. Trustworthiness (3)	3.91	.69	-.14	-.23*	.02	0.50***	0.51***	0.56***	0.46***	-0.60***	0.82***	0.89***	0.76***	
13. Perceived performance (3)	3.99	.68	-.04	-.11	.17+	0.40***	0.50***	0.50***	0.50**	-0.66***	0.62***	0.78***	0.50***	0.76***

[1] N =85, $^{+}$ p <.10 * p < .05 ** p < .01 *** p < .001

To test hypotheses 2, that perceived risk would increase trust and reward would decrease trust, against the data collected in year 2, we again conducted OLS regression analyses predicting checking (table 4, models A1 and A3). Trustor's perceived risk was positive, but not significant (ß=.16, $p < .10$), and reward was negative and significant (ß=-.19, $p<.05$), providing some support for hypotheses 2.

Table 4. Comparison of OLS estimates (standardized beta values) of checking behavior for year 2, Month 1 (1) and Month 3 (3) (N = 106).

	Model A1	Model A3		Model B1		Model B3		Model C1		Model C3	
Intercept	***	***		***		***		***		***	
Risk	.14	.16	+	.14		.18		.09		.21	**
Reward	-.08	-.19	*	-.08		-.20	*	.02		-.13	+
Benevolence	-.03	-.08									
Ability	-.17	-.34	**								
Integrity		-.25	**								
Perceived trustworthiness				-.18	+	-.55	***	.10		-.17	
Perceived performance								-.49	***	-.49	***
Adj. R-squared	.03	.40		.04		.41		.18		.50	
Model F	1.91	15.00	***	2.47	+	24.83	***	6.76	***	26.79	***
Degrees of freedom	4, 100	5, 98		3, 101		3, 100		4, 100		4, 99	

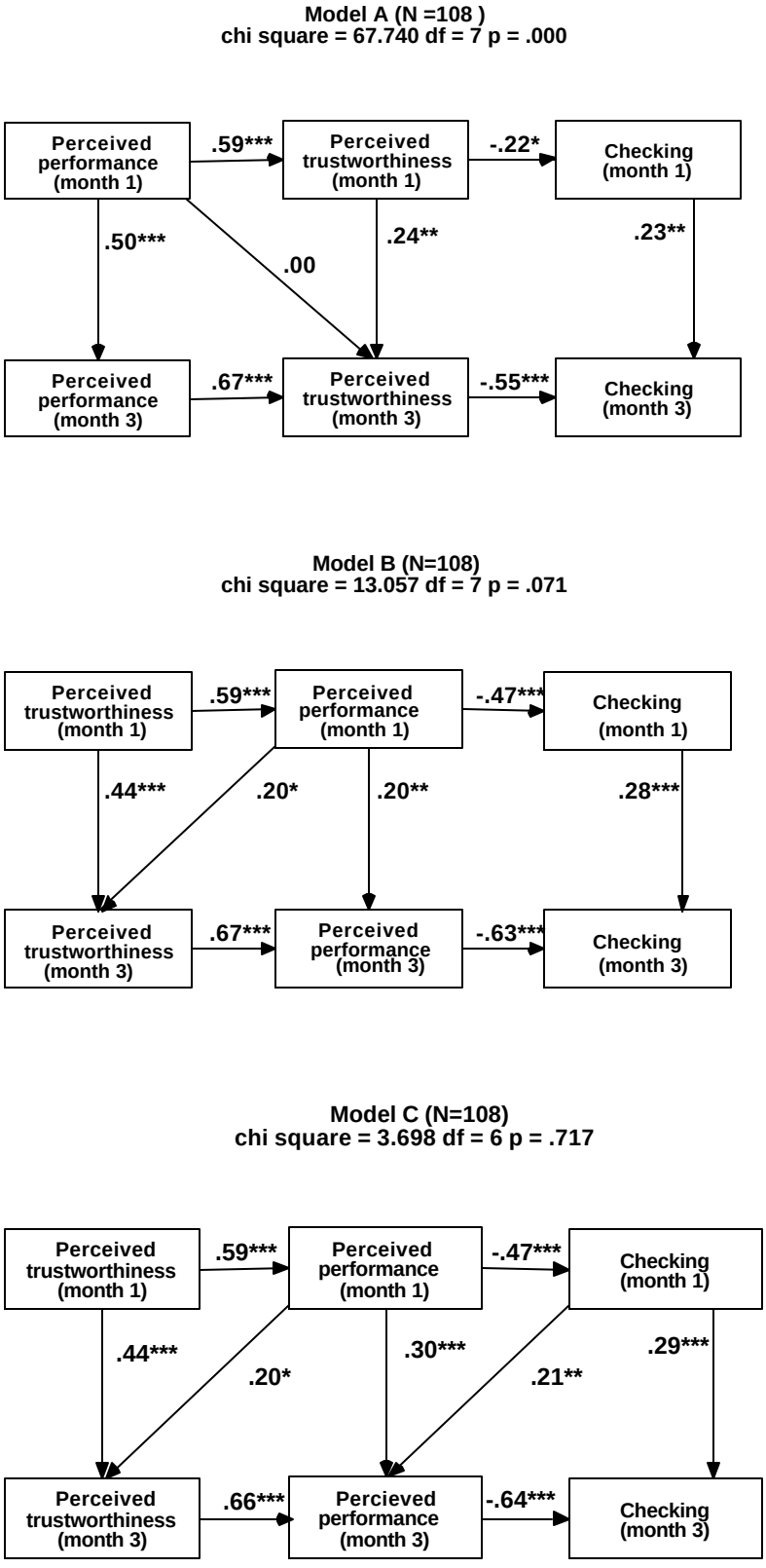
$^{+}$ p <.10 * p < .05 ** p < .01 *** p < .001

Next, we examined the three dimensions of perceived trustworthiness – benevolence, ability, and integrity – hypothesized to increase trust (H3 and H4). As indicated in model A3, our analysis suggests a strong and negative relationship between ability and checking (ß=-.34, p<.01) and between integrity and checking (ß=-.25, p<.01) thus providing support for our argument that perceived ability and integrity would increase trust. Although the relationship between benevolence and checking also was negative (ß=-.04, n.s.) this relationship was not significant. Thus, partial support is provided for hypothesis 3. We then created a perceived trustworthiness measure that combined benevolence, ability, and integrity (see table 4, model 4B) to test hypothesis 4. In model B3, it can be seen that perceived trustworthiness is significantly and negatively related to checking (ß=-.55, p<.001), providing support for our hypothesis that perceived trustworthiness (composed of benevolence, ability, and integrity) would lead to higher levels of trust. The adjusted r-square for model B3 was .40, suggesting that perceived trustworthiness explain a significant amount of the variance in checking, and thus trust, in cross-functional, global teams. We then added perceived performance to models C1 and C3 to find that it, too, was significant in predicting trust (ß=-.49, p<.001), although when added to the model, perceived trustworthiness was no longer significant (ß=-.17, n.s.).

Longitudinal Model

To test our hypotheses about the effects of initial perceptions of trustworthiness, and perceived performance on later trust, we used structural equation modeling (AMOS). We predicted that trust will be stable over time (H6), but that there will be some change related to perceived performance (H5). To test these hypotheses, we created a structural equation model (see figure 4, model A) that reflected the predicted relationships. However, this model was an extremely poor fit to the data $?^2$ (7, N = 104) = 67.74, p<.001.

Figure 4. Structural equation model estimation of standardized coefficients.



In conducting a mediation analysis based on regression models, we saw some evidence that during a single time period, perceived performance might be mediating the relationship between perceived trustworthiness and checking rather than the reverse. We therefore tested a revised model (figure 4, model B). The model provided a better fit to the data $?^2$ (7, N = 104) = 13.05, p = .07. The Bollen-Stine bootstrap provided increased evidence of model fit (p = .08). This analysis suggests that during a single time period perceived trustworthiness (benevolence, ability, and integrity) may affect the trustor's *perception* of the extent to which the trustee is following through on commitments. That is, if people perceive their cross-disciplinary team members as trustworthy, they may believe that their team members are performing as expected. However, consistent with hypothesis 5, this analysis also indicates that perceived performance early in the project affects perceived trustworthiness later in the project suggesting that team members also are updating their perceptions of trustworthiness based on how their team members' behaviors match expectations.

The data provide strong support for hypothesis 6 – that perceptions of trustworthiness, perceived performance, and trust will be stable over time (see figure 4, model B). Perceived trustworthiness at month one strongly predicted perceived trustworthiness at month three. Perceived performance at month one predicted perceived performance at month three. And, checking at month one predicted checking at month three.

Modification indices indicated that a direct relationship between checking at time one and perceived performance at time two would improve the model fit. Doing so (see figure 4, model C) improved model fit $?^2$ (6, N = 104) = 3.70, p = .72. Goodness of fit indices also indicated a high level of fit (NFI = 0.998, INI = 1.0, CFI = 1.0). The new relationship between checking at month one and perceived performance at month four is highly significant (p<.01), suggesting

that checking on one's team members may have the positive effect of increasing trust by providing confirming evidence that the team member is performing as hoped.

Although all of the dyads we analyzed were cross-functional, 31 of the dyads in year 2 were collocated. We do not have adequate data to thoroughly compare collocated with distributed dyads; however, we were able to compare 77 distributed with 31 collocated dyads by generating separate structural equation models for each. In the distributed dyads, trust at month one was more predictive of trust at month three ($p<.001$) than in collocated dyads ($p<.10$), suggesting that trust on cross-functional, collocated teams may change more over time compared with cross-functional, distributed teams. A simple comparison of trust scores from month 1 to month 3 suggests that cross-functional, collocated dyads appear to increase (19%) and decrease (16%) trust more so than do cross-functional, distributed dyads (only 9% increased and 10% decreased trust). A comparison of the two models suggests that model C (figure 4) fits better for distributed (χ^2 [6] = 3.12, p=.79) than for collocated dyads (χ^2 [6] = 5.15, p=.52) although both models fit reasonable well. These results argue for future work comparing trust development on collocated teams with trust development on teams that are geographically distributed.

Discussion

Our data suggest that trust develops on cross-functional, global teams and that models of trust development on traditional teams obtain for cross-functional, global teams. Consistent with the model proposed by Mayer et al (1995), we found that perceived trustworthiness was associated with higher levels of trust. To the extent that participants viewed their team members as caring, capable, and of high integrity, they were less likely to check on their performance. The construct of perceived trustworthiness was strongly related to trust in our correlation analyses and our longitudinal analyses indicated that perceived trustworthiness at one month

predicted perceived trustworthiness at three months into the project suggesting that first impressions may be particularly important in cross-functional, distributed teams.

Contrary to models of trust development on traditional teams, our longitudinal analysis, also suggests that perceived performance mediates the relationship between perceived trustworthiness and trust. In these cross-functional, global teams, it appears that participants relied on their perceptions of their team members to evaluate the extent to which these team members met expectations. This suggests that perceiving team members as caring, capable, and of high integrity may affect trustor's perceptions of the extent to which team members have followed through and that evaluating the performance of cross-functional, global team members is not an objective matter. It may be difficult for team members to objectively evaluate the work of team members from other disciplines, particularly when they are not physically collocated and their work process is not visible. We believe that this effect also may hold for collocated team members of cross-functional teams and distributed team members of teams that rely heavily on "knowledge work" – work that is cognitive and more difficult to evaluate objectively.

The results of our longitudinal analysis also suggest that people are observing the behavior of their team members and updating their perceptions of trustworthiness. Perceived performance at month one predicted perceived trustworthiness at month three, suggesting that one's behavior relative to expectations may contribute to higher perceived trustworthiness. This finding is consistent with theories of history-based trust that argue that trust is an outcome of cumulative interactions between individuals and is updated based on the trustor's experience of the trustee's behavior. These results also point to the central role of perceived (not necessarily actual) performance on cross-functional, global teams and may indicate that sharing information about work progress could help to build trust in these teams. This notion is consistent with

O'Leary, Orlikowski, and Yates' (2002) study of trust and control in the Hudson Bay Company in which they found that providing regular reports to headquarters went hand-in-hand with establishing trust between these distant locations.

We also found that checking team member's performance at month one predicted perceived performance later in the project. Although we had not predicted this relationship, its presence provides further evidence that trust can build as a result of observing others' behavior. It also suggests that a lack of trust may have the positive outcome of enhancing trust in the long run to the extent that team members check on one another and gather information that affirms their trustworthiness. Although this finding is contrary to Strickland's (1958) laboratory experiment showing that the more one checks on another's performance, the less one can learn to trust, our study differs from Strickland's in two important ways. First, our participants worked together over a four month period, much longer than the single day participants were engaged in his study and had the opportunity to learn from their monitoring. Second, our participants were working on a project that had personal meaning and consequences, so learning to trust and work well together may have been a higher priority. However, further research is needed to better understand how and on what basis trust is updated.

Taken together, the data indicate that perceived performance on cross-functional, global teams may have strong subjective and objective components. To the extent that people can observe and evaluate their team members' performance, they may use this information to recalibrate. However, to the extent that performance cannot be observed or evaluated, subjective evaluations may influence the development of trust.

The results of our study contribute to the nascent work on trust in globally distributed teams. Consistent with the work reported by Jarvenpaa and Leidner (1999), our results suggest

that trust can develop in these teams and that what occurs early in the life of the team is crucial. Jarvenpaa and Leidner (1999) showed that early communication in distributed teams is important to trust. We suspect that early communication contributes to higher levels of perceived trustworthiness on global teams. Perceived trustworthiness may then affect perceptions of performance, thus strengthening trust. However, our work also suggests that information about behavior over time can affect trust and that trust may be fairly stable (as opposed to fragile) on these teams.

There are several limitations to the studies we report. First, the studies were conducted with student teams. Although these student teams operated in ways that are similar to teams in the construction industry, the teams were artificial in the sense that students were taking a class for which they would receive a grade, students were not employees of a firm, there were no immediate financial stakes, and they had little expectation of working with these team members on future projects. Researchers have identified relationships between trust and work group performance that are not simple and may be mediated by factors such as coordination and motivation (e.g. Dirks, 1999) and may be complicated by organizational level (Zaheer, McEvily, and Perrone, 1998). Such factors are more difficult to assess in student teams. In an ethnography of the Hudson Bay Company, O'Leary and his colleagues (O'Leary et al, 2002) describe the relationship between trust and control in a distributed work setting. In our student teams, no binding contracts were signed and students had few ways of controlling their peers. Although this may also often be the case in non-student work groups, the relationship between control and trust is an important one and emphasizes the importance of conducting further research in organizational settings to understand the complexity of trust between team members and determine the generalizeability of the results reported here.

Our tests of general trust in year 1 suggest that general trust is not a predictor of trust in these cross-functional, global teams. The general trust scale developed by Rotter (1971) has been used to predict trust in a number of studies (Yamagishi and Yamagishi, 1994, Yamagishi, Cook and Watabe, 1998). However, our measure of trust proved to have low reliability (alpha=.47), which may have contributed to problems with prediction. We therefore believe it is necessary to conduct further research to determine the importance of general trust in predicting trust within cross-functional, global teams.

Another important characteristic of our study setting was that team members met face-to-face for two days at the start of the project. Others have argued for the importance of geographically distributed teams meeting early in the life of a project as a way of developing rapport and establishing a shared vision (Armstrong and Cole 2002, Kraut, Galegher, Fish and Chalfonte, 1992). However, many distributed teams never meet face-to-face. In those cases, we suspect that trust may be slower to develop and *swift trust* based on expectations about roles will be more crucial (see Jarvenpaa and Leidner, 1999). More research is needed to better understand the impact of face-to-face meetings on the development of trust in cross-functional, global teams.

Finally, the conclusions that we draw are for cross-functional, global teams, although the model we tested was derived from models developed for traditional (mono-functional, collocated) teams. Because we did not compare cross-functional, global teams with traditional teams, we are not able to draw conclusions about the differences that exist or about trust on traditional teams. However, we suspect that perceived trustworthiness will be an important antecedent to trust in all teams. We also suspect that there may be differences between functionally homogeneous and cross-functional, global teams. In particular, we believe that cross-functional, global teams may be less able to gather information about their team members

and may be less able to objectively assess their team members' performance. Thus, we believe that assessments of performance may be particularly subjective on these teams. We therefore anticipate that functionally homogeneous teams may rely more heavily on behavioral indicators of performance rather than using perceptions about the trustworthiness of team members to assess performance.

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