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Interpersonal trust in cross-functional, geographically distributed work: A longitudinal study

Roxanne Zolin [a,*], Pamela J. Hinds [b], Renate Fruchter [c], Raymond E. Levitt [c]

[a] *Graduate School of Business and Public Policy, Naval Postgraduate School, PO Box 433, Marina, CA 93933, USA*
[b] *Department of Management Science and Engineering, Stanford University, USA*
[c] *Department of Civil and Environmental Engineering, Stanford University, USA*

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Abstract

With increasing globalization and the proliferation of communication technologies, more people are working in cross-functional, geographically distributed teams. Although trust is clearly an important ingredient in these collaborations, little is known about the challenges this new work and social environment creates for the development of trust. Different disciplinary perspectives, different regional or national cultures, and the lack of face-to-face interaction when working at a distance raise significant barriers to developing trust between distant co-workers. We, therefore, posit that traditional models of trust need to be adapted to describe the development of trust between cross-functional, geographically distributed partners. To test our hypotheses, we conducted a longitudinal study of architecture, engineering and construction management students engaged in designing and planning a $5 million construction project in distributed teams. Our results suggest that cross-functional, geographically distributed workers may rely on early impressions of perceived trustworthiness when evaluating how their distant partners are delivering on commitments, because reliable information about actual follow-through is lacking or difficult to interpret. Consistent with this, we found that perceived trustworthiness, perceived follow-through and trust were relatively stable over time. We conclude that initial perceptions of trustworthiness are particularly important in cross-functional, geographically distributed work, although research is needed to draw comparisons with traditional work environments.

* Corresponding author. Tel.: +1-831-869-1700; fax: +1-650-725-6014.
E-mail address: rvzolin@nps.navy.nil (R. Zolin).

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1. Introduction

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. Cross-functional, geographically distributed workers provide great advantages by bringing to bear the diverse skills of scarce specialists on problems or projects that span traditional organizational boundaries, in such diverse areas as software development (Carmel, 1999), engineering (Hauptman & Hirji, 1999; Levinthal & Warglien, 1999), nursing (Ireson & McGillis, 1998), purchasing, and new product development (Brunelli, 1999). Although companies are rapidly adopting cross-functional, geographically distributed work (Jasswalla & Sashittal, 1999), little is known about the challenging new social and work environments that these organizational forms create for team members (Maznevski & Chudoba, 2000).

One of the major challenges for workers in cross-functional, geographically distributed work is the development of trust (e.g., Bishop, 1999). Trust is central to teamwork, leadership, and organizational culture (Fairholm, 1994; Nicholas, 1993; Ryan, 1999). Trust may be particularly important in cross-functional projects because many sub-tasks are interdependent, with team members relying on the functional expertise of their team members. The process of developing trust in cross-functional, geographically distributed work environments, however, may be hindered by the characteristics that define this context (e.g., O'Hara-Devereaux & Johansen, 1994). By definition, cross-functional workers belong to different disciplines and therefore have different educational backgrounds, different professional loyalties and often conflicting goals. Trust may be more difficult to establish in cross-functional work because workers are less familiar with the goals, world-views, problem solving approaches, and methods of members from other disciplines (Lawrence & Lorsch, 1967). When geographically distributed, workers often find it more difficult to share information, to observe others' work, and to develop rapport. Geographic distance brings with it differences in regional and national cultures, time zones, and work contexts, all of which may challenge the development of shared interpretations. These characteristics of cross-functional, geographically distributed work may render inadequate traditional models of trust for predicting the development of trust on these teams.

In this paper, we establish analytically that the antecedents of trust may be different in cross-functional, geographically distributed work than in more traditional uni-functional, collocated settings. We then empirically investigate a longitudinal

model of interpersonal trust that reflects the unique context of cross-functional, geographically distributed work. Our research setting is a project-based environment in which teams of architecture, structural engineering and construction management students design, analyze, and plan a $5 million university building over a period of four months.

1.1. Trust

Consistent with Rousseau and colleagues (Rousseau, Sitkin, Burt, & Camerer, 1998: p. 395; see also Mayer, Davis, & 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, irrespective of the ability to monitor or control that other party." Along with others, we also assume that trust can only exist within a particular situation or action (see Gambetta, 1988; Bhattacharya, Divenney, & 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 context.

1.2. Cross-functional work

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 & Smith, 1993). Cross-functional teams are popular for change-orientated projects such as introducing "total quality" practices, business process re-engineering and improvements to a product or to service quality (Bishop, 1999). 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 (Sheppard & Sherman, 1998; Shapiro, 1987), particularly in cross-functional work, because other workers do not have the necessary skills to perform in the breach created by non-performing workers. Sometimes, as is the case with structural engineering, cross-functional workers cannot legally substitute for one another.

Developing trust may be particularly difficult in cross-functional work environments due to unshared and sometimes conflicting goals and perceived differences in professional allegiance. Even though cross-functional workers collaborate to achieve shared project goals, people from different disciplines often have different functional objectives, priorities, and agendas (Jasswalla & 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 as well as the goals of each discipline.

Cross-disciplinary composition of the work environment also means that workers are less likely to perceive themselves as belonging to the same group or category, which is 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 work, disciplinary differences may be particularly salient because of the importance people place on their own specialization (e.g. Schunn, Cowley, & Okada, 1998). Each discipline is in effect a different culture, created by the values and mores of the profession and reinforced by its education and practice. Thus, although task interdependence requires more trust between workers, the multi-disciplinary nature of this work may make the development of trust more difficult.

1.3. Geographically distributed work

The challenges confronting cross-functional workers are compounded when workers are distributed around the globe. Trust can become increasingly difficult to develop when workers 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 workers spend in the presence of one another and therefore is likely to hinder the development of rapport and trust (see Kiesler & Cummings, 2002). Physical proximity and face-to-face interaction may be crucial for developing and maintaining trust (see Nohria & Eccles, 1992). Collocation also can reinforce social similarity and highlight obligations that individuals have to one another (Latane, Liu, Nowak, & Bonevento, 1995). When team members are geographically distant and rely on mediating technologies to interact, information may flow less easily between workers (see Hollingshead, 1996), distributed workers may not develop the same understanding of the information that is shared (e.g., Cramton, 2001), and workers 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.

In addition to spanning geographic distances, distributed teams are likely to be composed of people from different cultures with different basic assumptions (Schein, 1991). The diversity of distributed workers could make the development of trust difficult (Williams and O'Reilly, 1998) because others' perspectives and behaviors are more easily misinterpreted (see Olson & Olson, 2000). Thus, we expect

that geographically distributed workers will have difficulty reconciling issues that arise and developing and maintaining trust.

In an examination of trust development in distributed teams, Jarvenpaa and Leidner (1999) concluded that distributed workers developed "swift trust"—trust based on the role occupied by the person, even when the person is initally unknown (Meyerson, Weick, & Kramer, 1996)—but that it may have been fragile and temporary. 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 distributed teams, but it may be fragile and early interactions between team members are crucial.

1.4. Trust development in cross-functional, geographically distributed work

We modified the Mayer, Davis and Schoorman (1995) model of organizational trust to reflect the context of cross-functional, geographically distributed work. In their integrative model of organizational trust, Mayer and his colleagues argue that trust is a function of the trustor's propensity to trust and the trustor's perception of the trustworthiness of the trustee. They further argue that the trustor's perception of risk will affect the extent to which the trustor is willing to 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 of interpersonal trust also relies on the trustor's propensity to trust and the trustor's perception of risk (see Fig. 1). We, however, have added several components to the model to represent the antecedents to trust in cross-functional, geographically distributed work. First, in addition to considering their own risk, we argue that trustors take into account the potential rewards of trusting the trustee. These rewards can be greater when different disciplines are working together because the project goals cannot be achieved without the participation of all necessary disciplines. Second, we propose that cultural diversity, which is common in geographically distributed work, will reduce perceived trustworthiness. Third, we propose that, because perceived follow-through is difficult to assess in cross-functional, geographically distributed work, initial perceptions of trustworthiness

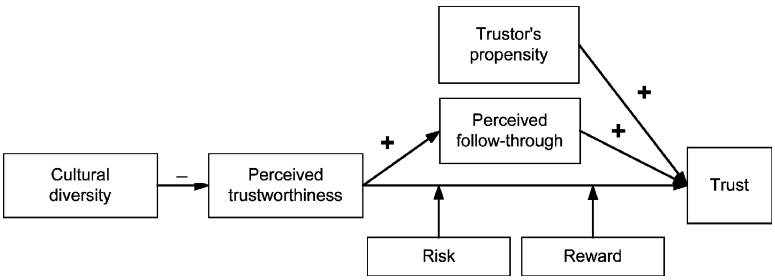

Fig. 1. The proposed model of interpersonal trust in cross-functional global work.

are used to evaluate work follow-through. The Mayer et al.model (1995) proposes that outcomes influence perceived trustworthiness. We argue, however, that assessing performance or follow-through is difficult when people do not share the same disciplinary expertise and when, due to distance, they are unable to observe the work being conducted. We therefore modify the Mayer, Davis, and Schoorman model to reflect the limitations of cross-functional, geographically distributed work. Our model of interpersonal trust in cross-functional, geographically distributed work is pictured in Fig. 1 and described in detail below.

Disposition-based trust theories propose that trust develops based on a person's 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.

Consistent with others, we also posit that the situation faced by the trustor contributes to his or her willingness to trust. We extend the Mayer, Davis and Schoorman model (1995), which includes risk but does not explicitly include reward. Many scholars have argued that risk is a necessary pre-condition for trust (Coleman, 1990; Rousseau, Sitkin, Burt & Camerer, 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 & 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 follow-through, which could include loss of overall project quality, time, cost of resources invested, or reputation of the trustor 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, geographically distributed work because of high task interdependence, the inability of workers to perform the job of others, and the difficulty of getting information about team members' follow-through. As proposed in the Mayer et al.model (1995), we expect that the relationship between perceived trustworthiness and trust will be moderated by risk in cross-functional, distributed work. The trustor may think the trustee trustworthy, but if the risks are too high, higher perceived trustworthiness may be required for trust (see below).

H1. *The relationship between perceived trustworthiness and trust will be moderated by the trustor's perceived risk.*

1.5. Reward

In addition to risk, we propose that the potential for reward is an important situational consideration for the trustor in cross-functional work. There must be some expected benefit to be gained to justify accepting the risk of relying on the other party (Hosmer, 1995). Yamagishi and Yamagishi (1994: p. 129) discuss "a perception of the incentive that leads the interaction partner to act cooperatively."

If the task is highly valued and no one else can perform it, as often happens in cross-functional work, the trustor's reward from trusting is likely to be large and the trustor will be more likely to trust. We therefore believe that the relationship between perceived trustworthiness and trust is moderated by reward. The trustor may perceive the trustee as untrustworthy, but if the potential reward is high enough, then the trustor will trust anyway (see below).

H2. *The relationship between perceived trustworthiness and trust will be moderated by the trustor's perceived reward.*

1.6. 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 perceived trustworthiness of the trustee, such as risk and reward. Perceived trustworthiness is a multifaceted construct (Barber, 1983; Mishra, 1996; Rempel, Holmes, & Zanna, 1985). Consistent with the Mayer et al. (1995) model, we use three dimensions of perceived trustworthiness: benevolence, ability, and integrity. Benevolence, as described by Mayer and colleagues (Mayer et al. 1995: 719), is "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 & Teng, 1998). Benevolence is similar to McAllister's (1995) conception of affect-based trust—trust grounded in reciprocated concern for the other party. Ability is the perception that the trustee has the skills and resources needed to perform the task (e.g. Butler, 1991; Butler & Cantrell, 1984; Sitkin & Roth, 1993). No matter how diligent a worker, if he or she does not have the ability to accomplish the goal, the likelihood of success is small and trust is not warranted. Ability 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., (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 perceived as having integrity are seen as more likely to behave in honorable ways and not deceive co-workers about their intention to follow-through on commitments and expectations. Thus, when trustors see co-workers as high in integrity, they are more likely to perceive them as trustworthy. We posit that these three factors are integral dimensions of perceived trustworthiness (Mayer et al., 1995).

1.7. Cultural diversity

Geographic distribution increases the likelihood that the members of working dyads will be culturally diverse. Just as similarities are proposed to increase trust (Brewer, 1996), cultural diversity is likely to reduce it. As evidence, Luo (2002) found a negative correlation between interpersonal trust and cultural distance in his study of international strategic alliances. He reported that cultural differences impeded the development of trust, although once trust was built, it was equally predictive of performance in culturally diverse and culturally homogeneous alliances. We propose that cultural differences create varying expectations and reduce predictability, resulting in lower perceived trustworthiness, which will then lead to lower trust (see below).

H3. *When there is cultural diversity between the trustor and the trustee, the trustor will perceive the trustee as less trustworthy than when the trustee belongs to the same culture.*

1.8. Perceived follow-through

Our dimension of perceived follow-through is similar to the dimension Mayer et al. (1995) refer to as "outcomes." It is also similar to the "outcomes" variable in Bhattacharya, Devinney, and Pittultia's (1998) dynamic model that describes trust in terms of actions, outcomes and consequences. In both of these models, the variable "outcomes" refers to the positive or negative results of trusting. In our model, perceived follow-through is more specific than outcomes. Perceived follow-through is the extent to which the trustor perceives that the trustee has met expectations.

We argue that in cross-functional work, assessment of follow-through will be difficult due to the lack of information and lack of expertise required to evaluate the performance of a person from another discipline. Further, we anticipate that geographic distance will exacerbate the difficulty in assessing follow-through because information transfer is more challenging and shared understanding is more difficult to develop among geographically distributed workers (Cramton, 2001; Hinds & Weisband, 2003). More biased information exchange and difficulties in transmitting information (Hollingshead, 1996; also Hinds & Bailey, in press) can reduce the performance information available and lead to inconsistent and erroneous interpretations (Cramton, 2001). In the absence of reliable performance information, trusters may evaluate responsiveness rather than performance (Maister, 1993). Even the evaluation of responsiveness, however, is subject to confusing circumstances in geographically distributed work, such as unintentional delays as a result of time zone differences and technology failures (see Cramton, 2001). Therefore, we propose that the trustor will use the limited information they have about the trustee—that formed through initial impressions—to evaluate the trustee's follow-through, rather than assessing follow-through based on the actual work performed (see below).

H4. *In cross-functional, geographically distributed work, perceived follow-through will mediate the relationship between perceived trustworthiness and trust of a trustee.*

1.9. Forces for stability

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, Liberman, & Eagly, 1989), may be resistant to change over time (see Ring and van de Ven, 1994). In cross-functional, geographically distributed work, disconfirming information may be even less available and less visible (see Cramton, 2002). Thus, workers in geographically distributed work environments may be more resistant to changing their opinions of co-workers (see below).

H5. *Trustor's initial perceptions of trustworthiness, follow-through, and trust of their co-workers will predict later perceived trustworthiness, follow-through, and trust in cross-functional, distributed dyads.*

2. Method

To evaluate the development of interpersonal trust among cross-functional, global workers, we studied geographically distributed student building design teams composed of an architect, a structural engineer, and a construction manager. The study we report here is the culmination of a three year project. In the first and second years, we conducted pilot studies to better understand the context and to develop and refine our quantitative measures.

2.1. The architecture/engineering/construction project

The participants for this study were students in a Computer Integrated Architecture-Engineering-Construction (A/E/C) class organized by the Civil and Environmental Engineering Department at Stanford University (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 geographically distributed teams for four months to design a five-million-dollar building according to a client's specifications. 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. These graduate students were assisted by undergraduate "apprentices" and mentored by globally distributed professionals working in each discipline.

During an initial face-to-face meeting attended by all participants, students were randomly assigned to teams. To facilitate assignment to groups, students were randomly given an experience profile (e.g., experience working in an earthquake zone). 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 experience 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 design, each team required at least one team member from each discipline—architecture, engineering, and construction management. Each team included at least one member who was not collocated. After the two-day project launch, the geographically distributed team members did not meet again in a collocated face-to-face setting 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 computer-mediated collaboration tool developed for the course facilitated the posting and retrieval of messages and files. Collocated team members used face-to-face meetings as needed.

2.2. Data collection

We conducted online surveys of 108 dyads formed into 12 teams composed of three to four team members, distributed among 10 locations in six countries—the United States, Switzerland, Holland, Germany, Slovenia, and Japan. All team members participated in the research. A survey during the first week of the project asked questions about the number of courses taken in each discipline, work experience in each discipline and students' perceptions of their own risks and rewards associated with the project. Approximately one month later and three months later, we distributed surveys, which yielded 108 dyadic responses (person A's perceptions of person B) at each time. All students also were interviewed using a structured protocol designed to cover the same topics as the survey.

3. Measures

3.1. Dependent Variable

Our primary dependent variable of interest is trust. We 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 its dimensions of benevolence, 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 than of trust. Our definition of trust is the willingness to accept vulnerability 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), we used checking as a behavioral measure of trust. We 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 trust, we averaged across four items in the dyadic survey (see Fig. 2), which were rated on a 5-point scale with high amounts of checking rated more highly. We then reversed the scale, resulting in a variable ranging from 1 to 5 with high scores indicating higher levels of trust. The scale loads on one factor and reliability for the four items were acceptable (alpha = 0.77 for month 1 and 0.67 for month 3). These data were taken from the dyadic surveys administered at months one and three in the project.

3.2. Independent variables

The primary independent variables of interest in this study are the trustor's propensity to trust, perceived risk and reward, cultural diversity, perceived trustworthiness, and perceived follow-through.

Propensity to trust was measured using the Rotter scale for general trust (Rotter, 1971) modified by Yamagishi, Cook and Watabe (1998). In the year prior to the study reported here, we conducted a pilot study of 68 dyads formed into seven

Trust
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 checked the quality of work of that this team member completed?
4. How often have you checked on this team member's progress on the deliverables promised

Risk
1. How much is at stake for you (what do you have to lose) if one team member does not do their job?

Reward
What goals do you do you hope to achieve with this project? (Not directly used)
1. 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 ideas that may be helpful to you or the group?
5. How frequently has this team member checked to make sure that your discipline's goals are being met?

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 follow-through
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? *

Note: * Indicates items were reverse coded.

Fig. 2. Scale items.

teams to test the scales. Propensity resulted in low scale reliability (alpha = 0.47) and the 12 items loaded on three factors. In the absence of a reliable measure, we dropped propensity from the study.

Risk was measured on the survey by asking respondents "how much is at stake for you (what do you have to lose) if one team member does not do their job?" Answers were reported on a 5-point Likert scale (see Fig. 2).

Reward was elicited using two questions (see Fig. 2). The first question brought forth the respondent's perceived goals for the project; the second question asked how important those goals were. The answers from the second question were reported on a 5-point Likert scale and used as our measure of reward.

Cultural diversity. We used the participant's country of origin to calculate whether the team members of each dyad were of the same or different culture. We created a dummy variable for cultural diversity, coding 1 where the dyad partners belonged to different cultures and 0 where they were from the same culture.

Perceived trustworthiness was measured based on the dimensions of perceived benevolence, ability, and integrity reported by the trustor about the trustee in the dyadic surveys. All items are listed in Fig. 2 and were measured using a 5-point scale with 5 equal to higher levels of benevolence, ability, or integrity. Benevolence was the extent to which the trustee demonstrated sensitive and helpful behaviors that showed concern for the trustee. Ability was the extent to which the trustee exhibited technical, professional, and project level competence. 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 about source credibility, which we therefore adopted. Unfortunately, our measure for integrity was excluded from the survey for month 1, so we only have this measure at month 3. To test the influence of integrity as a dimension of perceived trustworthiness, we created a measure for perceived trustworthiness at month 3, not including integrity, and ran all statistical analyses. The pattern of results was the same. For month 3, we also conducted a factor analysis and confirmed that the items loaded on three factors as expected. For month 1 and month 3, we confirmed that the scale for perceived trustworthiness was reliable as a single scale (alpha = 0.84 and 0.84, respectively). Consistent with our theory, we then averaged across all items to create scales for perceived trustworthiness.

Perceived follow-through was measured based on the trustor's evaluation of the extent to which a co-worker followed through on commitments and completed work on schedule (see Fig. 2). Perceived follow-through was measured at one and three months into the project. The four items were measured on a 5-point scale, where 5 equated to high levels of perceived follow-through. The scale had a reliability of 0.89 (month 1) and 0.88 (month 3), so the four items were averaged to create our measures of perceived follow-through.

4. Results

4.1. 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. Autocorrelation would occur if the trust of person A was related to the trust of person B. Theories of trust based upon reciprocity (Creed and Miles, 1996: 19) suggest that the level of trust between two people is positively related (e.g. the more A trusts B, the higher is B's trust of A), which could cause a problem with first order autocorrelation of the data between dyads. The Durbin-Watson (Hamilton, 1992) test statistic (d) for correlation between the value of checking of the trustor and the trustee were higher than the upper limit ($d = 2.14$) suggesting no positive first-order autocorrelation among the errors. Thus, the reciprocal nature of trust does not appear to be significant in our data.

We also used the estimation procedure of AMOS (Hoyle, 1995; Byrne, 2001) to construct a structural equation model (SEM). Doing so allowed us to observe more complex relationships between variables and changes over time. The AMOS SEM is a test of goodness of fit between the data and the proposed model. Therefore, a low p-value indicates that the null hypotheses, that the model does not fit, can be accepted. A high p-value indicates that the null hypotheses can be rejected and that the model does fit. We adopted a confirmatory analysis approach (Joreskog, 1993). To maintain the same variables as used 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, tended to overestimate the χ^2 statistic and hence could lead to the 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).

4.2. Hypotheses tests

The descriptive statistics and correlations of the variables are shown in Table 1. The majority of the dyads were culturally diverse (84%, see Table 1). Variables measured at two points in time, such as trust, perceived trustworthiness and perceived follow-through, had a higher standard deviation at month 1 than at month 3. For example, the standard deviation of Trust (1) is .87, while the standard deviation of Trust (3) was only 0.70. We noticed a positive relationship between the trustor's perceived rewards in the project and the perceived follow-through of the trustee at month 1 ($r = 0.23$, $p < 0.05$). We also noticed a negative relationship between the trustor's perceived risk and the perceived follow-through of the trustee at month 3 ($r = -0.29$, $p < 0.01$). This could indicate that the higher the rewards for the trustor, the more likely the trustor will be to interpret

Table 1
Descriptive statistics and correlation table for month one (1) and month three (3) ($N = 104$)

	Mean	Std. Dev.	1	2	3	4	5	6	7	8
1. Trust (1)	3.49	0.87								
2. Risk	3.67	0.71	0.12							
3. Reward	4.19	0.91	0.13	−0.08						
4. Cultural diversity	0.84	0.37	0.01	0.02	0.01					
5. Perceived trustworthiness (1)	3.58	0.75	0.22*	−0.26**	0.12	−0.29**				
6. Perceived follow-through (1)	3.94	0.82	0.47***	−0.18	0.23*	−0.12	0.59**			
7. Trust (3)	3.58	0.70	0.32***	−0.17*	0.16	−0.21*	0.44***	0.44***		
8. Perceived trustworthiness (3)	3.93	0.68	0.16	−0.38***	0.05	−0.32***	0.56***	0.46***	0.60***	
9. Perceived follow-through (3)	3.99	0.67	0.04	−0.29**	0.17	−0.21*	0.50***	0.50***	0.66***	0.76***

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

the trustee's follow-through in a positive light early in the project, but that risk becomes more salient later in the project.

We hypothesized that the relationship between perceived trustworthiness and trust will be moderated by the trustor's perceived risk (H1). To test hypotheses 1 we conducted multivariate regression models predicting trust (see Table 2) with terms representing the interaction between risk and perceived trustworthiness. To create the interaction we hypothesized (low risk and perceived trustworthiness), we reversed risk to create low risk and multiplied by perceived trustworthiness. Although the interaction was not significant in the first models, when perceived follow-through was added to the model, it achieved significance at month 1 ($\beta = 1.12$, $p < 0.05$, see Table 2, model E1), providing partial support for hypothesis 1.

We also hypothesized that the relationship between perceived trustworthiness and trust will be moderated by the trustor's perceived reward (H2). We created a variable to represent the interaction between reward and perceived trustworthiness. The interaction variable was significant in model C at month 1 ($\beta = 1.23$, $p < 0.05$), but not at month 3 ($\beta = 0.69$, n.s.). When perceived follow-through was added to the model, the effect was no longer significant, providing mixed support for hypotheses 2 (see Table 2).

Hypothesis 3 states that trustors in culturally diverse dyads will have lower perceived trustworthiness for the trustee. As expected, cultural diversity was significant in predicting perceived trustworthiness at month 1 ($T = -.029$, $r < 0.01$) and month 3 ($r = -0.32$, $p < 0.001$) (see Table 1). We also observed that cultural diversity was significant in predicting trust in month 3 ($\beta = 1.23$, $p < 0.05$, see model A3) until perceived trustworthiness was added to the models (see Table 2, model B3). This suggests that perceived trustworthiness may mediate the relationship between cultural diversity and trust.

Hypothesis 4 proposes that perceived follow-through will mediate the relationship between perceived trustworthiness and trust in cross-functional, geographically distributed work. We found strong correlations between perceived follow-through and trust and also between perceived trustworthiness and trust at both month 1 and month 3. Because both perceived trustworthiness and perceived follow-through predict trust, the variable that maintains significance when both are added to a model predicting trust is the variable that directly influences trust (Baron & Kenney, 1986). In regression models B1 and B2 (see Table 2), perceived trustworthiness predicts trust at month 1 ($\beta = 0.28$, $p < 0.01$) and month 3 ($\beta = 0.61$, $p < 0.001$). When perceived follow-through is added in models D1 and D3, perceived trustworthiness is not significant at month 1 ($\beta = -0.02$, n.s.) and less significant at month 3 ($\beta = 0.24$, $p < 0.05$), suggesting full mediation early in the project and partial mediation later. In contrast, perceived follow-through maintained significance at both month 1 ($\beta = 0.52$, $p < 0.001$) and month 3 ($\beta = 0.48$, $p < 0.001$). Overall, these analyses provide strong support for hypothesis 4.

Table 2
Comparison of OLS estimates (standardized beta values) of trust for month 1 and month 3, ($N = 108$)

Independent variables	Model									
	A1	A3	B1	B3	C1	C3	D1	D3	E1	E3
	Month 1	Month 3	Month 1	Month 3	Month 1	Month 3	Month 1	Month 3	Month 1	Month 3
Intercept	***	***	***	+	*		**		*	
Cultural diversity	0.01	−0.20*	0.09	−0.08	0.09	−0.02	0.06	−0.02	0.07	−0.03
Low risk	−0.13	0.15	−0.20*	−0.06	0.14	−0.08	−0.21*	−0.06	−0.11	0.07
Reward	0.14	0.15	0.11	0.15+	−0.72+	−0.37	0.03	0.08	−0.72+	−0.35
Perceived trustworthiness			0.28**	0.61***	−0.26	0.16	−0.02	0.24*	−0.14	−0.17
Low risk × perceived trustworthiness					−0.47	0.04			1.12*	0.57
Reward × Perceived trustworthiness					1.23*	0.69			−0.65	−0.04
Perceived follow-through							0.52***	0.48***	0.51***	0.48***
Adj. R-squared	0.007	0.07	0.07	0.35	0.09	0.35	0.23	0.44	0.25	0.44
Model F	1.3	3.5*	2.9*	15.5***	2.8*	10.5***	7.6***	17.9***	6.1***	12.9***
Degrees of freedom	*2, 104*	*3, 104*	*4, 103*	*4, 102*	*6, 101*	*6, 100*	*5, 102*	*5, 101*	*7, 100*	*7, 99*

$^{+}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.3. Longitudinal model

In our last hypothesis (H5), we predicted that trustor's initial perceptions of co-workers' trustworthiness, follow-through, and trust would predict later perceived trustworthiness, follow-through and trust in cross-functional, geographically distributed dyads. To test this hypothesis, we used our theoretical model to evaluate the fit of the data using structural equation modeling. Our first structural equation model (Fig. 3, SEM A) indicates that, as expected, perceived trustworthiness at month 1 predicts perceived trustworthiness at month 3. Similarly, perceived follow-through at month 1 predicts perceived follow-through at month 3 and trust at month 1 predicts trust at month 3. This analysis provides strong support for hypothesis 5, suggesting stability of perceived trustworthiness, perceived follow-through, and trust over the three months that this data were collected. Although

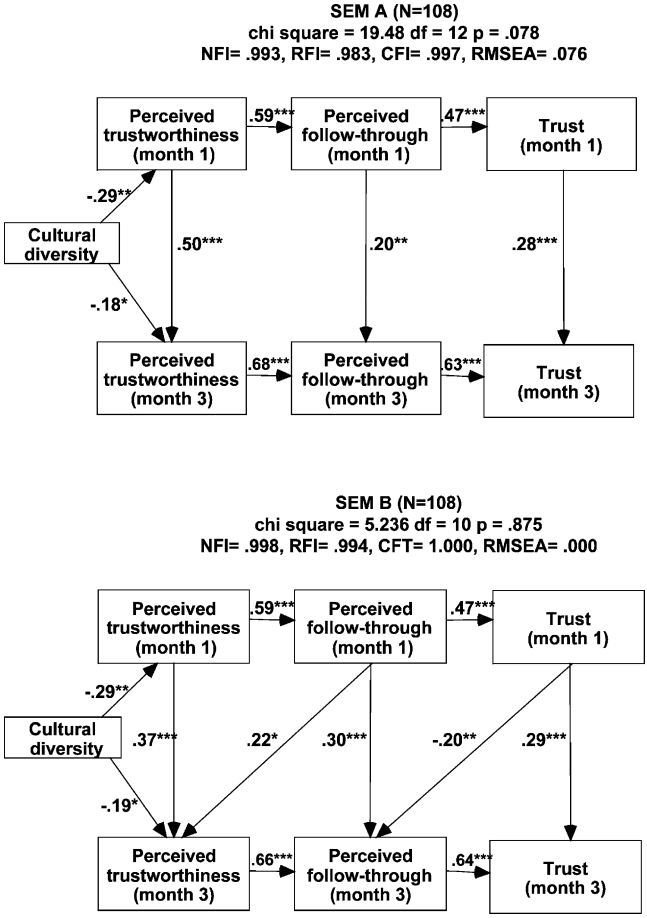

Fig. 3. Structural equation model estimation of standardized coefficients.

model fit statistics indicate a reasonable fit with the data, χ^2 (12, $N = 108$) = 19.48, $p = 0.078$, modification indices suggest that improvements are possible. In particular, a direct relationship between trust at month 1 and perceived follow-through at month 3 and a link between perceived follow-through at month 1 and perceived trustworthiness at month 3 would improve the fit (see Fig. 3, SEM B). The revised model fit our data better, χ^2 (10, $N = 108$) = 5.236, $p = 0.875$, and goodness of fit indices also indicated a higher level of fit (NFI = 0.998, RFI = 0.994, CFI = 1.0, RMSEA = 0.000). The negative relationship between trust at month 1 and perceived follow-through at month 3 is significant ($\beta = -0.20$, $p < 0.01$). This suggests that lack of trust at month 1 may increase monitoring of one's co-workers, which could then increase perceived follow-through at month 3 by providing confirming evidence that the co-workers are performing as hoped. By the same token, high trust at month 1 could mean less checking which leads to lower perceptions of follow-through at month 3.

In both structural equation models, we also confirmed that perceived follow-through mediates the relationship between perceived trustworthiness and trust at months 1 and 3 and that cultural diversity impedes perceptions of trustworthiness in these dyads. In Table 3, we provide a list of our hypotheses, how they were tested, and a summary of the results.

Table 3
Summary of hypotheses, tests and results

	Hypothesis	Tests	Results
H1	The relationship between perceived trustworthiness and trust will be moderated by the trustor's perceived risk.	Regression (Table 2)	Partially supported at month 1
H2	The relationship between perceived trustworthiness and trust will be moderated by the trustor's perceived reward.	Regression (Table 2)	Partially supported at month 1
H3	When there is cultural diversity between the trustor and the trustee, the trustor will perceive the trustee as less trustworthy than when the trustee belongs to the same culture.	Regression and SEM* (Fig. 3)	Supported
H4	In cross-functional, geographically distributed work, perceived follow-through will mediate the relationship between perceived trustworthiness and trust of a trustee.	Mediation analysis and SEM* (Fig. 3)	Supported
H5	Trustor's initial perceptions of the trustworthiness, follow-through, and trust of their co-workers will predict later perceived trustworthiness, follow-through and trust more strongly in distributed dyads than in collocated dyads.	SEM* (Fig. 3)	Supported

*Structural Equation Modeling (SEM).

5. Discussion

Traditional models of trust suggest that if a co-worker performs well, he or she will be perceived as more trustworthy (see Mayer et al., 1995). We found something quite different in the study we report here. Our findings indicate that, among cross-functional, geographically distributed partners, if a worker is perceived as trustworthy, he or she will be perceived as delivering on work commitments. We reason that it may be difficult for co-workers to evaluate the deliverables of colleagues from other disciplines, particularly when they are not physically collocated and their work process is not visible. Thus, the initial perceptions of one's co-workers may determine the extent to which one *believes* these co-workers have followed through on work expectations. This points to the importance of first impressions in cross-functional, geographically distributed work.

An alternative explanation is that those who are perceived as more trustworthy also are more likely to follow-through, either because the original assessment of their trustworthiness was accurate or because the trust that was placed in them caused them to be more diligent. Such explanations call into question existing models of interpersonal trust, which consistently include a link between performance outcomes and perceived trustworthiness, but rarely the reverse.

The results of our longitudinal analysis further support the stability of trust in these dyads. Perceived trustworthiness, perceived follow-through, and trust at month 1 predicted those same variables at month 3, indicating that first impressions played a significant role in determining later perceptions. We do not have the data on actual behavior required to assess the extent to which the stability we observed is the result of first impressions that were not updated with behavioral data, first impressions that were accurate to begin with and did not require updating, or initial impressions that set into motion behaviors that reinforced the status quo. Teasing apart these alternative explanations is an important next step in understanding the role of trust and the generalizeability of these results beyond cross-functional, geographically distributed work.

Although our results generally suggest the stability of trust in cross-functional, geographically distributed dyads, our longitudinal analysis also indicates that some participants updated their perceptions of follow-through and trustworthiness. Perceived follow-through at month 1, for example, predicted perceived trustworthiness at month 3, suggesting that co-workers' behavior sometimes contributed to perceived trustworthiness. Although weaker than the effect of perceived trustworthiness on perceived follow-though, this finding is consistent with existing models of trust (e.g. Mayer et al., 1995) and with theories of history-based trust, which 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 important role of perceived (not necessarily actual) follow-through in cross-functional, global work and may indicate that sharing information about work progress could help to build trust between these co-workers. 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 distant locations.

We also found that cultural diversity was associated with lower perceived trustworthiness. This effect was stronger later in the project, suggesting that it may be the result of cultural misunderstandings rather than prejudices. Thus, the greater the cultural diversity in cross-functional, distributed work, the more fragile the trust as people struggle to find common ground and search for signs of benevolence, ability, and integrity—all characteristics whose manifestations and interpretations may be heavily influenced by culture. In the study we report here, we can merely state that cultural diversity was associated with less perceived trustworthiness. Further studies are needed to understand how culturally diverse, cross-functional, distributed co-workers negotiate their differences over space and time.

Each discipline also has its own culture created by shared professional paradigms and reinforced by education. All of the dyads in our study were cross-functional, not allowing us to compare with uni-functional dyads, but we found evidence of discipline-based cultural differences during our qualitative work in our pilot study. 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 work. 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. Our respondents reported that making ''personal sacrifices for the good of the team'' built trust. ''Seeing someone do something to save himself,'' was described as severely damaging trust. International differences in holidays that were not discussed also caused problems because several teams did not coordinate their spring break and left their team members wondering where they were for two weeks. Interacting with different disciplines, being geographically and temporally distributed (e.g., being in different time zones), and relying on technology all reportedly made trust more difficult.

There are several limitations to the study 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. Because the 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, although there was some awareness of the opportunity to be recruited by the industry mentors to work in their companies. 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, & Perrone, 1998). Such factors are difficult to replicate 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.

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 & Cole, 2002; Kraut, Galegher, Fish, & 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 & Leidner, 1999). More research is needed to better understand the impact of face-to-face meetings on the development and maintenance of trust in cross-functional, geographically distributed work.

For this study, we created a measure of trust based on participants' desire to check and the extent to which they actually checked on their co-workers. Because monitoring can reduce uncertainty, authors have noted that the desire to monitor another's behavior is directly associated with trust (Nooteboom, 2002; Wicks, Berman, & Jones, 1999). Buskens, for example, uses the number of legal and financial safeguards in a contract as an inverse measure of trust (Buskens, 2002). Monitoring can therefore be considered a type of safeguard in cross-functional, distributed work where contracts are not used. Using monitoring, rather than trust attitude, as a measure helped us to overcome the problem of many attitudinal measures that make it difficult to separate trust from perceived trustworthiness. Our measure, however, also has some limitations. First, although we were attempting to generate an indicator of behavior, ours is not a behavioral measure. It is possible that self-reported checking and desire to check are biased by one's recall of the checking event. In our study context, this could have resulted in a bias toward more checking because of the salience of the checking events. Second, checking on one's co-workers is undoubtedly challenging in cross-functional, distributed work. It requires effort, is likely to be difficult to do unobtrusively, and may be difficult to coordinate. Cross-functional, distributed workers may therefore monitor their co-workers infrequently, not because they trust them, but because it is too challenging to check on them. Both of these factors suggest a possible bias in our data toward less checking, which could indicate that less trust exists between these co-workers than is captured by our data. Although we believe the items that measured *desire to check* help to alleviate these biases, some bias may remain. Because these biases do not affect the measurement of our independent variables or the relationship between our independent variables and trust, we anticipate that eliminating any residual bias would strengthen our findings, but additional research is needed to better understand the relationship between monitoring and trust between cross-functional, distributed co-workers. Future work that observes more closely the

interactions between co-workers over time will help to shed light on these relationships.

Due to poor scale reliability, we were unable to assess the role of trust propensity in cross-functional, geographically distributed dyads. The scale developed by Rotter (1971) has been used to predict trust in a number of studies (Yamagishi & Yamagishi, 1994; Yamagishi, Cook, & Watabe, 1998). However, our measure of trust propensity proved to have low reliability (alpha = 0.47), which contributed to problems with prediction. We speculate that trust propensity may be more easily observed in laboratory experiments than in working relationships, where the strength of the context may overwhelm individual differences. We further speculate that the international cross-cultural nature of the dyads in our study may contribute to low reliability of the scale. We believe it is necessary to conduct further research to determine the importance of trust propensity in predicting trust within cross-functional, global work.

Finally, the model that we developed and the conclusions that we draw are for dyads conducting cross-functional, geographically distributed work. Because we did not compare cross-functional with uni-functional dyads or distributed dyads with collocated dyads, we are not able to draw conclusions about the differences that exist or about trust in traditional dyads. We anticipate that uni-functional dyads rely more heavily on behavioral indicators of follow-through than on perceptions about the trustworthiness of co-workers to assess follow-through. We also suspect that cross-functional, geographically distributed workers may be less able to gather information about their co-workers and objectively assess co-workers' follow-through. Thus, we believe that assessments of follow-through may be particularly subjective in cross-functional, distributed work. These comparisons are left for future research.

6. Conclusion

In this study, we tested a model of trust modified to reflect the context of cross-functional, geographically distributed work. In contrast to traditional models of trust, we found that perceived trustworthiness may determine perceived follow-through rather than the reverse. Based on our findings, we offer several recommendations for those who manage or are engaged in cross-functional, geographically distributed work. First, our results reinforce the importance of building rapport and trust early in a project. In particular, creating an environment in which co-workers can evaluate one another's perceived trustworthiness (benevolence, ability, and integrity) may help to set the tone for the partnership well into the future. Creating opportunities to assess trustworthiness is especially important in cross-functional and cross-cultural relationships where trustworthiness may be more difficult and time-consuming to evaluate accurately. Second, our findings suggest that trust, once established, may be fairly stable in cross-functional, global work. If high levels of trust are established early in the development of the partnership, this may be beneficial. It may also, however, increase project risk if trusted partners fail to

deliver, but continue to be perceived as following through. It is therefore important that information is shared and reviews be instituted so that risk can be averted.

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