

The Strength of Trust Over Ties: Investigating the Relationships between Trustworthiness and Tie-Strength in Effective Knowledge Sharing

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Abstract: The purpose of this research is to better understand the interaction between notable structural and relational factors, which positively influence organizational knowledge sharing. Specifically, to investigate the effects of multiple dimensions of trust (i.e., competence-, integrity-, benevolence-based perceived trustworthiness) on the relationship between tie-strength and effective knowledge sharing. Knowledge sharing was examined in two ways, first through the knowledge receiver's perception of how useful the shared knowledge was, and second through their willingness to use that knowledge. Willingness to use was further classified into explicit and tacit forms of knowledge. A total of 275 surveys were collected from legal professionals, working on projects, at one of Canada's largest law firms. Data were analyzed using linear regression, mediation, and moderator analyses. The study revealed four main findings. The first was that strong ties lead to the receipt of useful knowledge. Second, both competence- and integrity-based trustworthiness strongly mediated the link between strong ties and receipt of useful knowledge. Third, when trust was taken into account, any positive effect of strong ties on the receipt of useful knowledge was removed. Fourth, the mediating effect of competence-based trustworthiness was of similar magnitude for willingness to use explicit and tacit knowledge. Practical implications suggest organizations should cultivate competence- and integrity-based trustworthiness and develop networks consisting of both weak and strong ties, balancing network density and range.

Keywords: Trust, Knowledge sharing, Social Capital, Networks, Tacit knowledge, Knowledge workers

1. Introduction

A popular proverb goes: *It's not what you know, but who you know*. What this means is that significant individual, community, and organizational benefits await those companies that effectively leverage their social networks (Baker, 2000; Burt, 1992; 2005; Coleman, 1988; Putnam, 1995; Uzzi, 1996). Many of those benefits directly relate to information and knowledge sharing (e.g., Allee, 2000). Unfortunately, organizational networks "develop dysfunctional structures [if] left to their natural progression" (Krackhardt & Stern, 1988, p. 138) and, therefore, call for meticulous design, cultivation, and management.

The purpose of this research is to better understand structural and relational factors that positively influence organizational knowledge sharing, since creating and maintaining effective knowledge sharing, requires organizations to consider both (Nahapiet & Ghoshal, 1998). A common factor used to explore structural relationships is tie-strength (e.g., Granovetter, 1973) which is based in part on interaction and communication frequency and in part on a feeling of closeness between people. Strength of tie generally ranges from strong to weak, with strong ties displaying higher interaction and communication frequency and/or closeness. A problem, however, is that research on tie strength does not seem to agree on what its influence is on knowledge sharing. Specifically, it is unclear if, when, and how strong ties are more important to knowledge sharing than weak ties (Hansen, 1999).

Research seems to agree that one of the most important relational factors in knowledge sharing contexts is trust (e.g., Evans, 2013). Trust is inherently dependent on interpersonal relationships, and their perceived outcomes and risks. Trust is "fundamentally a social process, since [the underlying] psychological mechanisms and expectations are emergent features of a social structure that creates and reproduces them through time" (Uzzi, 1997, p. 45). Judging someone as trustworthy involves making oneself vulnerable through an "expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (Mayer et al., 1995, p. 712).

In most cases, studies examining structural characteristics of networks (i.e., tie-strength) do not examine relational characteristics (e.g., norms, trust) at the same time. This is an important oversight as relational

characteristics govern the structural ones (Nahapiet & Ghoshal, 1998). Trust is the result of social processes (Mayer, Davis, & Schoorman, 1995; Uzzi, 1997), which is likely why it influences both tie-strength and knowledge sharing (Evans, 2012; Levin & Cross, 2004). However, few empirical studies have considered the influence of trust when determining whether it is weak or strong ties that are better for knowledge sharing (Levin & Cross, 2004). Moreover, the few that did have not been generalized to other organizational contexts. The current research takes into account the interaction between the most important structural and relational factors by examining the relationships between tie-strength, trust, and effective sharing knowledge. Knowledge sharing is investigated in two ways. First by looking at knowledge worker's perceived receipt of useful knowledge and second, by looking at their willingness to use explicit and tacit forms of knowledge. Trust in the knowledge source, by the knowledge user, is measured using Mayer, Davis, and Schoorman's (1995) three dimensions of perceived trustworthiness: competence-, integrity-, and benevolence.

2. Theoretical Foundations

The following section describes the theoretical foundations, discusses the literature, defines important terms, and identifies gaps.

2.1 Tie-strength

Tie-strength is defined as the "combination of the amount of time, the emotional intensity, the intimacy, and the reciprocal services which characterize the tie" (Granovetter, 1973, p. 1361). It generally ranges from strong to weak ties, based on relationship closeness and interaction frequency (Granovetter, 1973; Hansen 1999; Marsden & Campbell, 1984; Levin & Cross, 2004). Depending on the discipline, strong ties are associated with network density (Granovetter, 1983), closure (Burt, 2005; Coleman, 1988), embeddedness (Uzzi, 1996; 1997; 1999), and philos ties (e.g., Krackhardt, 1992), while weak ties are associated with sparse networks (Adler & Kwan, 2002), brokerage (i.e., the filling of structural holes, Burt, 1992; 2005; Obstfeldt, 2005), bridging (Putnam, 1995), and arm's length ties (Uzzi, 1996; 1997; 1999; Uzzi & Lancaster, 2003).

2.1.1 Weak Ties

Granovetter (1983) argues that because of their unique social links, weak ties are more likely than strong ties to provide access to "information from distant parts of the social system" (p. 202). A sparse network provides more information benefits (Burt, 1992) since weak ties bridge networks that are otherwise disconnected (Krackhardt, 1992). Bridges provide access to distinct information and knowledge (Reagans & McEvily, 2003). In addition, weak ties create shorter (Granovetter, 1973; 1982) and more cost-effective information pathways (Hansen, 1999; Nahapiet & Ghoshal, 1998; Reagans & McEvily, 2003; Uzzi, 1999), leading to improved productivity (Reagans & Zuckerman, 2001) and innovation (Krackhardt, 1992; Obstfeldt, 2005; Uzzi, 1999). In project work, weak ties have been shown to help information seekers find useful information and speed up projects, when knowledge is not complex (Hansen, 1999; 2002).

Weak ties provide the seeker with opportunities for receiving timely, useful (Burt, 1992; Granovetter, 1973; 1982), novel (Bakshy et al., 2012; Granovetter, 1973; 1982; Krackhardt, 1992; Nahapiet & Ghoshal, 1998; Uzzi, 1996; 1997), and non-redundant (Burt, 1992; Granovetter, 1973; 1995; Nahapiet & Ghoshal, 1998) information (e.g., job opportunities). Weak ties are conduits for access to, or transfer of, public market information (Uzzi, 1996; 1997; 1999; Uzzi & Lancaster, 2003), "simple knowledge" (Reagans & McEvily, 2003, p. 263), codified knowledge (Hansen, 1999; 2002), ideas (Granovetter, 1982), technical advice/problem solving (Constant, Sproull, & Kiesler, 1996), and online information (Bakshy, Rosenn, Marlow, & Adamic, 2012).

2.1.2 Strong Ties

When tie-strength is high, the knowledge seeker and their strong ties share both familiarity and established communication channels (Hansen, 1999). Through frequent interactions, individuals develop shared expectations, inferences, and protocols (Uzzi, 1999), which are associated with shared codes, languages, and narratives. Such shared perspectives act as a prerequisite to, and normative constraint on, the network (Mael & Ashforth, 1995; Nahapiet & Ghoshal, 1998; Obstfeldt, 2005) leading to better problem solving (Uzzi, 1996), communication (Obstfeldt, 2005), crisis handling (Krackhardt & Stern, 1988), learning (Reagans & McEvily, 2005; Uzzi, 1996), and innovation (Obstfeldt, 2005). Strong ties are also more likely, willing, and able to facilitate tacit knowledge transfers (Boisot, 1995; Hansen, 1999; Reagans & McEvily, 2003; Uzzi, 1996; 1997), likely because they better organize and exchange complex and fine-grained information in chunks (Uzzi, 1997). However, these individuals are also more likely to know what other network members know (Burt, 1992); that

is, strong ties “are trafficking in information the seeker already knows” (Levin & Cross, 2004, p. 1478). Therefore, the dense network is inefficient, in that it returns less diverse information for the same cost as a sparse network (Nahapiet & Ghoshal, 1998).

Closed networks are governed by a number of key principles, such as reputation and trustworthiness (Coleman, 1988). In closed networks, individuals better see and judge the actions of their colleagues, allowing for reputation and trustworthiness to formulate over time. Both are further reinforced through the implementation of effective norms (encouraging positive behavior) and sanctions (limiting negative behavior), which monitor and guide behavior (Coleman, 1988). Effective norms exist because individuals in closed networks know that sanctions may be collectively instituted against them when norms are violated (Coleman, 1988).

Another important set of governing principles are obligations, expectations, and reciprocity. In closed networks, individuals are more likely to become aware of co-workers who have many outstanding obligations (Coleman, 1988). If it becomes clear to the network that someone is not reciprocating these obligations, the network becomes less likely to trust them, or to extend favors. However, reciprocity need not be pre-negotiated, as it may take the form of delayed reciprocity (i.e., the sharer develops an expectation of reciprocation, and the receiver an obligation to reciprocate in the future) (Coleman, 1988). Interestingly, Hansen (1999) found that teams with weak ties were less likely to reciprocate than strong ones. Having trustworthiness and reciprocity creates a network where reputations arise, and where the reciprocity is governed by social protocol (Blau, 1964; Coleman, 1988; DiMaggio & Louch, 1998; Portes & Sensenbrenner, 1993; Uzzi, 1999). Organizations should actively govern expectations, especially to reduce opportunistic behavior and fears of how shared information may be used (Coleman, 1988; Uzzi, 1999).

2.2 Trust

Perhaps the most important aspect of strong ties is that they are commonly associated with trust. Trust is inherently dependent on interpersonal relationships, and their perceived outcomes and risks. Moreover, trust is “fundamentally a social process, since [the underlying] psychological mechanisms and expectations are emergent features of a social structure that creates and reproduces them through time” (Uzzi, 1997, p. 45). Judging someone as trustworthy involves an “expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party” (Mayer et al., 1995, p. 712). Trust allows for the development, maintenance, and governance of strong ties (Coleman, 1988; Uzzi, 1996), just as “strong ties constitute a base for trust” (Krackhardt, 1992, p. 85). This may explain why trust is “amplified” (Burt, 2005, p. 119) among strong ties. However, after repeated abuses, trust turns into distrust (Uzzi, 1997), which is also amplified among stronger ties (Burt, 2005).

In most conceptualizations of trust, risk is central (e.g., Boon & Holmes, 1991; Johnson-George & Swap, 1982; Mayer et al., 1995; Schoorman, Mayer, & Davis, 1996; McEvily & Tortiello, 2011). Trust is about the willingness to take risk (Johnson-George & Swap, 1982) or making oneself vulnerable in risky situations (Mayer et al., 1995). Since strong ties have more trust, they perceive less risk in sharing (Uzzi, 1997), which reduces transactional uncertainty (Uzzi, 1996), opportunism (Nahapiet & Ghoshal, 2003), and the need for monitoring devices (Levin & Cross, 2004; Currall & Judge, 1995; Uzzi, 1997; Uzzi & Lancaster, 2003; Zaheer, McEvily, & Perrone, 1998).

Trust among strong ties motivates the willingness to use and share knowledge (Author 1 et al., 2018; Levin & Cross, 2004; Szulanski, 1996; Tsai & Ghoshal, 1998) and the exchange or transfer of different kinds of important resources, including advice (Krackhardt, 1992), “fine-grained” information (Uzzi, 1996, p. 677), private information (Uzzi, 1999; Uzzi & Lancaster, 2003), assets and privileged resources (Uzzi, 1997), intellectual capital (Nahapiet & Ghoshal, 1998), and tacit/explicit knowledge (Reagans & McEvily, 2003). Knowledge transfer is also more cost effective (Currall & Judge, 1995; Hansen, 1999; Levin & Cross, 2004; Levin, Cross, & Abrams, 2002), partially because monitoring is reduced (Uzzi, 1997; Dore, 1983; Asanuma, 1985; Smitka, 1991; Gerlach, 1992; Zaheer, McEvily & Perrone, 1998) and protections from misuse are increased (Uzzi & Lancaster, 2003; Zaheer, McEvily & Perrone, 1998). In addition, strong trusted ties show more openness toward one another (Albino, Garavelli, & Schiuma, 1998; Wathne, Roos, & Von Krogh, 1996; Zaheer, McEvily & Perrone, 1998) and participate more in cooperative activities (e.g., Nahapiet & Ghoshal, 1998). They are better at complex problem solving (Luhmann, 1979; Nahapiet & Ghoshal, 1998; Uzzi, 1996; 1997) and in

competitive situations (Uzzi, 1997). Finally, they create mechanisms for delayed reciprocity, which, in turn, reinforce and build trust (Coleman, 1988; Uzzi, 1996).

2.3 The Interaction of Structural and Relational Factors on Knowledge Sharing

Trust is formed through interaction, time, and affection (Krackhardt, 1992). Frequent interactions provide opportunities to share information, while sufficient time allows relationships to develop, based on the outcomes of information sharing. Affection specifies an evaluative component where the information seeker likes, or feels affection towards, the source. Positive affect provides motivation to share and disincentivizes actions that hurt the other person (e.g., misusing information). However, as previously mentioned, few studies look at the combined effect of these structural and relational variables on knowledge sharing.

One, highly influential, study (Levin & Cross, 2004) investigated the effect of tie-strength (a structural variable) and trust (a relational variable) on, what they termed, receipt of useful knowledge. Knowledge was perceived as useful when it had positive project outcomes. In their study, 127 employees, from across three different divisions (R&D, financial modeling, oil exploration) of three companies (US pharmaceutical, British bank, and Canadian oil/gas), completed a 40-60-minute survey measuring tie-strength, trust, and receipt of useful knowledge. Employees were working on projects with a reliance on colleagues for information to solve problems and coordinate work.

Tie-strength was measured using Hansen's (1999) modification of Marsden and Campbell's (1984) traditional scale. Hansen adapted the original affective measure of closeness to reflect a meaning that was applicable to organizations. A third interaction frequency item was added to improve reliability. Trustworthiness was based on Mayer et al.'s (1995) model, specifying three factors of perceived trustworthiness: ability-, benevolence-, and integrity-based, of which Levin and Cross measured the first two. The measure for ability-based trust, which they called competence-based trust, was a selected pair of items from McAllister's (1995) cognition-based trust (also used by Chattopadhyay, 1999). The measure for benevolence-based trust was an adaptation of three items from Johnson, Cullen, Sakano and Takenouchi (1996). To measure receipt of useful knowledge the authors developed an eight-item scale asking about the extent to which the knowledge received was helpful to project outcomes. Four items pertained to project efficiency (i.e., time and budget) and four to project effectiveness (Hansen, 1999; Hansen & Haas, 2001; Keller, 1994; Szulanski, 1996). Levin and Cross (2004) also adopted measures from Hansen (1999), asking respondents to comment on the level to which knowledge received was codified. This allowed the exploration of differential effects of tacit and explicit knowledge.

Mediation analysis revealed four main findings. First, strong ties had a positive overall effect on receipt of useful knowledge. Second, the link between strong ties and receipt of useful knowledge was mediated by benevolence- and competence-based trustworthiness. Third, after controlling for both types of trustworthiness, "the structural benefit of weak ties emerged" (Levin & Cross, 2004, p. 1477). In other words, weaker ties were more important than stronger ties in leading to the receipt of useful knowledge. Fourth, competence-based trust was more important to the receipt of useful knowledge, when the knowledge was tacit, rather than explicit.

Although no subsequent work appears to replicate Levin and Cross (2004) using similar constructs and analyses, two studies (Lin, 2007; Zhou, Siu, & Wang, 2010) examined the combined effects of structural and relational variables on knowledge sharing, within a Chinese context. Lin (2007) examined a theoretical framework relating co-worker ties and tacit knowledge sharing, with trust as a mediator. The study operationalized co-worker ties using two measures: instrumental ties (e.g., those ties who may cooperate merely to achieve an immediate work goal) and expressive ties (i.e., those ties with more of an emotionally strong commitment)¹ (Manev & Stevenson, 2001). Trust was a unidimensional construct (Morgan & Hunt, 1994; Yilmaz & Hunt, 2001), but had one additional item to put more emphasis on competence. The outcome measure, tacit knowledge sharing, included items for sharing job experience, expertise, ideas, and tips (Bock & Kim, 2002; Daft, 2001). The results showed that, after controlling for trust, the direct effect between co-worker ties (instrumental and expressive) and tacit knowledge sharing were positive. In other words, stronger co-worker ties facilitated tacit knowledge sharing.

¹ "Instrumental ties arise in the performance of work and facilitate the transfer of physical, informational, or financial resources to their team members, while expressive ties stand for offering friendship and social support" (Lin, 2007, p. 417).

Similarly, Zhou et al. (2010) examined the relationships between Chinese co-worker ties and explicit/tacit knowledge transfer, with affect/cognition-based trust as mediators. The study builds on Lin (2007) by including multidimensional measures for trust and knowledge sharing/transfer. The measure for cognition-based trust was based on McAllister (1995), and the one for affect-based trust was based on Levin and Cross (2004) and McAllister (1995). The scale for tacit knowledge transfer was adapted from Lin (2007) and the one for explicit knowledge from Cummings (2004). The study used Lin's measures for instrumental and expressive ties.

Building on Levin and Cross (2004), Zhou et al. (2010) highlighted the strength of weak ties by showing that when cognition- and affect-based trust were controlled for, the direction of the effect of expressive ties on knowledge transfer became negative. Moreover, the effect of instrumental ties remained positive. Interestingly, Lin (2007) found that this relationship remained positive for both expressive and instrumental ties, providing evidence for the strength of strong ties. Moreover, the Lin and Zhou et al. studies suggest that there is an indirect effect of trust between co-worker ties and knowledge sharing. Further, Zhou et al. confirm that the mediating effect of trust depends on the dimensions of trust.

Levin and Cross' (2004) analysis, exploring the differential effects of tacit and explicit knowledge, uncovered that competence-based trust was particularly important for tacit knowledge to be judged as useful, but not for explicit. Zhou et al. (2010) also compared explicit and tacit knowledge sharing, finding that expressive ties led to less explicit knowledge sharing, with no significant effects from instrumental ties. In other words, instrumental ties were relatively more important than expressive ties in sharing explicit knowledge. No significant effects were found on tacit knowledge sharing from either type of tie.

When generalized, Lin (2007) and Zhou et al. (2010) add to Levin and Cross' (2004) theoretical framework but also left gaps which need to be addressed. First, Lin considered two types of co-worker ties, but only on tacit knowledge sharing. Zhou et al. (2010) further tested these relationships, but added two dimensions of trust and two forms of knowledge sharing (i.e., tacit and explicit). Second, the hypotheses, concepts, and operationalizations in Lin (2007) and Zhou et al. (2010) were different from Levin and Cross (2004), making it difficult to synthesize the results into a coherent picture. Most importantly, Lin (2007) and Zhou et al. (2010) used different dependent variables (i.e., knowledge sharing vs. receipt of useful knowledge).

3. Research Model and Hypotheses

The present study addresses the aforementioned gaps while also extending the line of work by Levin and Cross (2004), Lin (2007), and Zhou et al. (2010) in four different ways. First, the study adopts a more representative measure for tie-strength, equally balancing interaction/communication frequency and relationship closeness, and it makes a distinction between co-worker tie-strength *prior to* working on a project and tie-strength developed *while on* a project. Second, the study adopts a more inclusive multidimensional measure of trust. Specifically, it includes all three dimensions of perceived trustworthiness proposed by Mayer et al. (1995). Levin and Cross (2004) chose not to include integrity-based trust, stating that it was not "clear that the usefulness of knowledge received from another person is contingent on that person's following a particular set of principles consistently" (p. 1478). The authors argue that knowledge seekers would not make a distinction between integrity- and benevolence-based trust, but they invite researchers "to examine this issue in more detail" (p. 1479). This study seeks to examine this in more detail. Third, knowledge sharing and use is investigated in multiple ways. One similar to Levin and Cross (2004), which explores the knowledge receiver's perception of how useful the shared knowledge is, and another examining their willingness to use the knowledge. Willingness to use is further classified into explicit and tacit forms of knowledge, which was not tested in the above-mentioned studies. Fourth, this study considers a different country (i.e., Canada) and organization (i.e., legal professional service firm) which presents an opportunity for generalization by testing the relationships between tie-strength, trust, and effective sharing knowledge in another context.

Based on the work discussed above it may be hypothesized (see Figure 1A) that:

- H₁: Stronger ties, more so than weaker ones, lead to the receipt of useful knowledge (RUK);
- H₂: The link between strong ties and receipt of useful knowledge is mediated by benevolence- (BBT), competence- (CBT), and integrity-based trust (IBT);
- H₃: After controlling for each dimension of trust, weaker ties, more so than stronger ones, lead to the receipt of useful knowledge;

Since previous studies did not employ measures for willingness to use knowledge, this study used correlation analysis to predict the effects of tie-strength and trust on it. Receipt of useful knowledge and willingness to use were highly and positively correlated²; therefore, it may be hypothesized that the influence of tie-strength on receipt of useful knowledge (H_1 - H_3) should be similar on willingness to use ($H_{4a,b}$, H_5):

H_{4a} : After controlling for each dimension of trust, weaker ties, more so than stronger ones, lead to the willingness to use tacit knowledge

H_{4b} : After controlling for each dimension of trust, weaker ties, more so than stronger ones, lead to the willingness to use explicit knowledge

H_5 : The effect of trust on receipt of useful knowledge interacts with willingness to use tacit knowledge more than with explicit knowledge

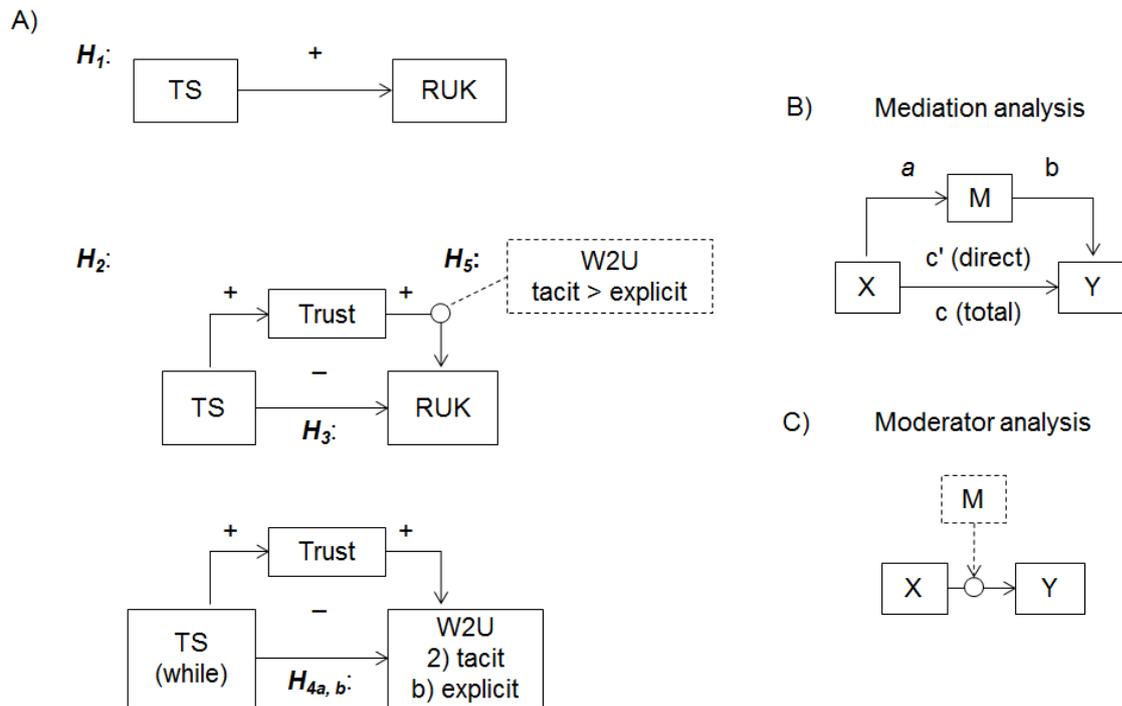


Figure 1: (A) Theoretical framework and hypotheses (H). Conceptual diagrams of a mediation (B) and a moderator (C) analysis. TS: tie-strength; RUK: receipt of useful knowledge; Trust includes competence-, integrity-, and benevolence-based trustworthiness. W2U: willingness to use knowledge. +/- signs indicates a positive or negative relationship, respectively.

4. Method

4.1 Research Site, Participants, and Procedure

This study was conducted at one of Canada's preeminent and largest law firms, with offices in six cities nationwide. The firm manages a large number of project teams consisting of legal professionals (i.e., knowledge workers working on legal matters). The nature of their work requires a reliance on co-workers, across offices nationwide, for explicit and tacit knowledge. The types of projects allow respondents to objectively evaluate project outcomes, giving a better sense of the effects of knowledge shared.

After pretesting, an online survey was published using the Qualtrics survey suite. A senior partner sent a firm-wide email inviting approximately 900 legal professionals and paralegals/law clerks from all six offices to participate. Respondents had to be assigned to a project with at least two co-workers. Of the potential respondents, 775 were legal professionals: lawyers (735), trademark/patent agents (30), accountants (5), or governmental professionals (5). In addition, 120 questionnaires were sent to paralegals and law clerks. No administrative staff participated. Respondents were asked to mentally select two co-workers: one they had

² Willingness to use explicit and receipt of useful knowledge, $r = 0.517$; Willingness to use tacit knowledge and receipt of useful knowledge, $r=0.524$.

worked best with on a project, and one they had not worked well with. The survey integrated items for both types of co-workers, who remained anonymous. In total, 275 anonymous surveys were completed for a 30.6% response rate (see Evans et al., 2018 for a breakdown of demographics). The survey was active for 31 days and took approximately 15-20 minutes to complete. As a token of appreciation, respondents were rewarded with a \$5 gift card to a popular coffee shop.

4.2 Measures

Measures were adapted to match the legal domain and items were added to increase reliability (Appendix A provides a list of example items³).

4.2.1 Tie-strength

Tie-strength was measured using two similar four-item scales (*While on* Cronbach $\alpha = 0.887$; *Prior to* $\alpha = 0.889$): Three items from Levin and Cross (2004) (two for “interaction frequency” and one for “closeness”), plus a new item for “closeness”, based on a rethinking of Marsden and Campbell’s (1984) understanding on tie-strength. This additional item was suggested by Levin (personal communication, October 2010), to give equal weight to “interaction frequency” and “closeness”. This is also consistent with Levin, Walter, and Murnighan (2011), which suggests that emotion-based (or “closeness”) measures were, at the very least, as important as interaction and communication frequency measures.

It was reasoned that tie-strength *prior to* working on a project is different from tie-strength developed *while on* a project in two ways. First, the frequency with which co-workers interact varies from project to project; higher frequency can exist *prior to* working on the project and still have no relation to the tie-strength felt *while on* a new project. Second, as co-workers continue to work and interact together, their perceived closeness can change. However, past interaction or communication may not guarantee, or be a predictor for, tie strength between the same co-workers while they are working on a new project together. Since this conceptual difference may have a different effect on the dependent variables, a distinction between the two was made.

4.2.2 Trust

Based on Mayer et al.’s (1995) model, trust was measured using a 24-item scale, across three dimensions of perceived trustworthiness: competence (CBT 9-items, $\alpha = 0.932$), integrity (IBT 6-items, $\alpha = 0.783$), and benevolence (BBT 9-items, $\alpha = 0.943$). Items for CBT and BBT were similar to those from Levin and Cross (2004). To increase reliability, additional items were included. Specifically, CBT was combined with adapted items from similar constructs – i.e., Mayer & Davis’ (1999) ability-based trust; McAllister’s (1995) cognition-based trust, and Chattopadhyay’s (1999) trust. Items for BBT were adapted and combined from similar items – i.e., Johnson et al. (1996), Levin, Whitener, and Cross (2006), Mayer and Davis (1999). Items for IBT were adapted directly from Schoorman et al. (1996) and Mayer and Davis (1999).

4.2.3 Receipt of Useful Knowledge

Receipt of useful knowledge (RUK) was measured using a six-item scale ($\alpha = 0.917$). One notable difference from Levin and Cross (2004) was a reduction from three to one item asking respondents about the cost and time it took them to complete the part of the project they were responsible for. The original three items related to the overall project budget, time, and cost; information most respondents may not have.

4.2.4 Willingness to Use Knowledge (Tacit and Explicit)

Willingness to use (W2U) knowledge was measured using a four-item scale for tacit knowledge ($\alpha = 0.932$) and a one-item scale⁴ for explicit knowledge. The five items were similar to Holste (2003; Holste & Fields, 2010). The one notable difference was that Holste’s items to measure willingness to use explicit knowledge (W2Uexplicit) were reduced to a single item since remaining examples of explicit knowledge were not relevant (e.g., lectures, databases, spreadsheets).

³ Evans (2012) provides a complete list of items and a detailed explanation of how they were adapted. Factor analysis, using varimax rotation, distinguished all measures.

⁴ Norman (2010) showed conducting regression analyses on single-item measures is valid and robust.

4.3 Data Analysis

Three statistical methods were used for testing the hypotheses (Figure 1A). Two linear regressions addressed H_1 (one for *while on* and one for *prior to* working on the project). Two mediation analyses addressed H_2 and H_3 (one for *while on* and one for *prior to*). Two additional mediation analyses addressed H_4 (one for W2Utacit – H_{4a} and one for W2Uexplicit – H_{4b}). H_5 was tested using three moderator analyses, which used W2Utacit as the moderator, once for each type of trustworthiness. These three tests were then rerun with W2Uexplicit.

Figure 1B depicts the logic of a mediation analysis. Lowercase letters correspond to regression coefficients: a is the coefficient for the regression of trustworthiness on the independent variables (X), b for one of the dependent variables (Y) on trustworthiness, c is the total effect of X on Y, and c' is the direct effect of X on Y. The indirect effect (ab), and its mathematical relationship to the total and direct effects, is $c = c' + ab$. Moderator analysis (Figure 1C) determines whether the effect of X (trust) on Y (RUK) is moderated by a third variable, M (W2U) (Hayes, 2013).

Mediation and moderator analyses were conducted using the SPSS macro PROCESS (Hayes, 2013). For decades, the workhorse of mediation analysis was Baron and Kenny's (1986) method. Recently, however, concerns have been raised regarding this method. (Hayes, 2013)⁵. In short, it requires strict criteria that make it conservative to the extent that it is susceptible to falsely rejecting the alternative hypothesis. Alternative methods have been introduced (e.g. MacKinnon, Fairchild, & Fritz, 2007; Hayes, 2009; 2013) to address these concerns. PROCESS is one implementation of these alternative methods that supports both mediation and moderator analyses. For mediation, it provides estimates of the indirect effect, four effect sizes and their statistical significance. In this paper, the partially standardized indirect effect is reported (Hayes, 2013).

5. Results

H_1 : *Stronger ties, more so than weaker ones, lead to the receipt of useful knowledge.* The results confirm H_1 . Strong ties (*while on*) (Figure 2A), had a significant positive effect on RUK ($R^2 = 0.118$, $F(1,258) = 34.37$, $p < 0.001$; $\beta = 0.260$). Incidentally, the coefficient was close to Levin and Cross' ($\beta = 0.21$). The effect of strong ties (*prior to*) (Figure 2B) was considerably less, but still significant ($R^2 = 0.039$, $F(1,258) = 10.43$, $p = 0.01$; $\beta = 0.082$).

H_2 : *The link between strong ties and receipt of useful knowledge is mediated by benevolence-, competence-, and integrity-based trust.* The results partially confirm H_2 . While mediation analysis showed that trustworthiness mediates the link between tie-strength and RUK, the mediation depended on the type of trustworthiness, and on whether it was *while on* (Figure 2C) or *prior to* (Figure 2D) the project. Both CBT (effect size: 0.168, 95%CI = [0.221; 0.504]) and IBT (0.146, [0.036; 0.282]) were significant mediators between tie-strength (*while on*) and RUK. Contrary to Levin and Cross (2004), there was no significant mediating effect from BBT (0.022, [-0.079; 0.171]). IBT *prior to* (0.037, [0.009; 0.085]) was a significant mediator between tie-strength and RUK, although CBT (0.039, [-0.002; 0.099]) and BBT (0.014, [-0.027; 0.059]) were not. Interestingly, IBT was the only significant mediator between tie-strength and RUK, both *while on* and *prior to*.

H_3 : *After controlling for each dimension of trust, weaker ties, more so than stronger ones, lead to the receipt of useful knowledge.* The results contradict H_3 . The analysis revealed that while strong ties (*while on*) (Figure 2C) had an overall benefit ($c = 0.237$, $p < 0.001$, 95%CI = [0.146; 0.829]), this benefit was no longer significant after controlling for trustworthiness ($c' = 0.063$, $p = 0.175$, [-0.028; 0.153]). This was also true for *prior to* (Figure 2D) ($c = 0.074$, $p = 0.047$, [0.023; 0.125]; $c' = 0.030$, $p = 0.170$, [-0.013; 0.074]).

$H_{4a,b}$: *After controlling for each dimension of trust, weaker ties, more so than stronger ones, lead to the willingness to use tacit/explicit knowledge.* The results do not confirm H_{4a} and H_{4b} . Trustworthiness mediated the link between tie-strength *while on* project and W2Utacit (Figure 2E). Only CBT (0.176, 95%CI = [0.099; 0.286]) was a significant mediator, as there were no significant mediating effects from IBT ([-0.082; 0.072]) and BBT ([-0.018; 0.158]). After controlling for the effects of trustworthiness, the direct effect of tie-strength on W2Utacit was still significant (0.131, $p = 0.036$, [0.009; 0.254]). CBT (0.198, [0.113; 0.313]) was again the only significant mediator for W2Uexplicit (Figure 2F). Moreover, after controlling for the effects of trustworthiness,

⁵ A more in-depth account of these concerns can be found in Evans et al., (2018).

the direct effect of tie-strength on W2Uexplicit was no longer significant (0.079, $p = 0.202$, [-0.043; 0.201]), suggesting that the mediating effect of CBT is stronger *prior to* than *while on* project.

(A) Linear regression *while on* and (B) *prior to* working on the project. (C-F) Mediation analyses, with n's showing the number of valid cases used. Significant regression coefficients are indicated with an asterisk and solid lines, non-significant effects are illustrated by dotted lines. Indirect effects (*ab*) are in italics and partially standardized effect sizes in brackets. TS: tie-strength; RUK: receipt of useful knowledge; CBT: competence-based trust; IBT: integrity-based trust; BBT: benevolence-based trust. W2U: Willingness to Use shared knowledge.

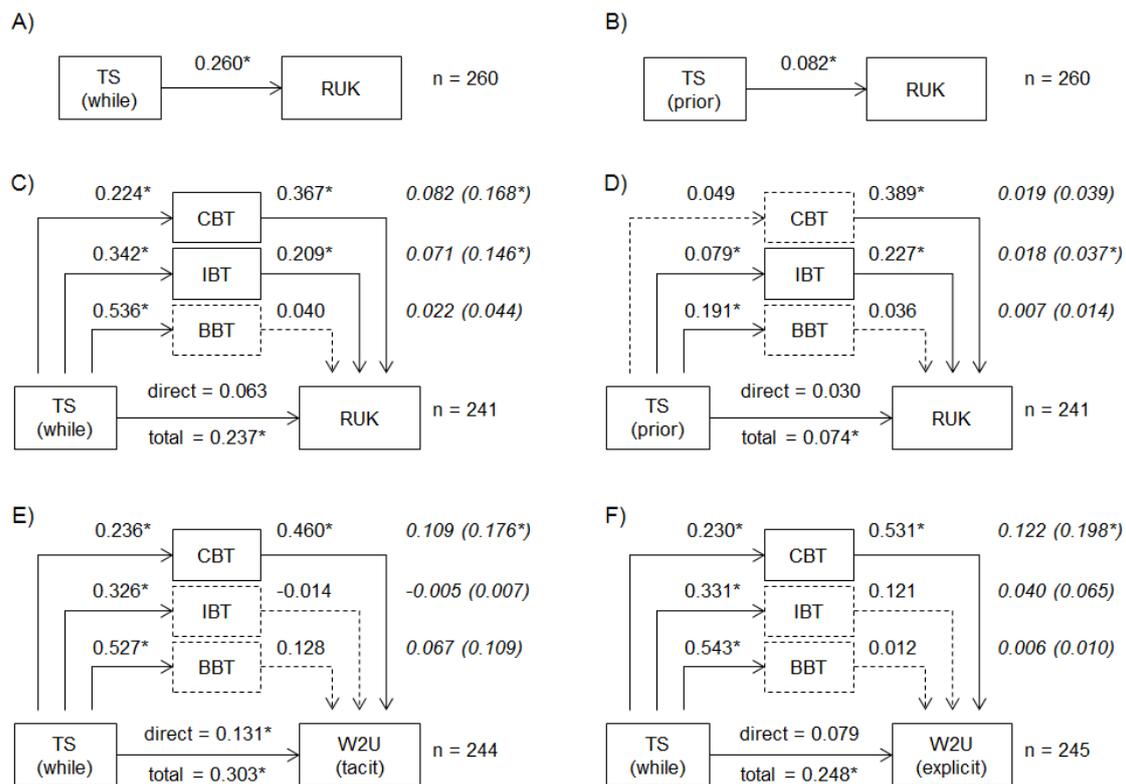


Figure 2: Results for hypotheses 1-4.

H₅: The effect of trust on receipt of useful knowledge interacts with willingness to use tacit knowledge more than with explicit knowledge. The results do not confirm H₅. None of the moderating effects of W2Utacit between trustworthiness and RUK were significant (CBT: 0.101, $p = 0.082$; IBT: -0.029, $p = 0.695$; BBT: 0.031, $p = 0.625$). Similarly, there were no moderating effects from W2Uexplicit (all p -values > 0.14).

6. Research Implications

This study builds on previous research examining the interaction effects of tie-strength and trust on effective knowledge sharing and use. The results of the study revealed four key findings with implications for organizational behaviour and sociology, as well as for knowledge management scholars and practitioners. The first important finding confirms earlier research (Levin & Cross, 2004) showing that strong ties lead to receipt of useful knowledge. This is consistent with research showing that strong ties transfer more complex or tacit knowledge (Boisot, 1995; Hansen, 1999; Reagans & McEvily, 2003; Uzzi, 1996; 1997), which may be perceived as more useful forms of knowledge. Not surprisingly, the overall effect of strong ties was smaller *prior to* than *while on* the project. This may be because *prior to* the project, communication and interaction with, and/or feelings of closeness towards, the person sharing were low.

A second key finding was that both competence- and integrity-based trustworthiness strongly mediated the link between strong ties and receipt of useful knowledge. This is generally consistent with other knowledge

sharing research that found mediating effects from affective- and cognition-based trust (Lin, 2007; Zhou et al., 2010), although this was the first study to test all three factors of Mayer et al.'s (1995) model of perceived trustworthiness. While the mediating effect of competence-based trust was also observed by Levin and Cross (2004), this study found an additional effect from integrity-based trust. Moreover, the mediating effect from integrity-based trust was of comparable importance to competence-based trust. This is an important contribution since integrity-based trust is a well-grounded dimension of trust (Mayer et al., 1995) that was not included in Levin and Cross (2004). Notably, *prior to* working on a project, integrity-based was the only dimension of trustworthiness that had a mediating effect between tie-strength and receipt of useful knowledge. Interestingly, *while on* the project, the size of this effect increased four times. Further, this study found no mediating effect from benevolence-based trustworthiness, which is contrary to Levin and Cross.

The observed influence of competence- and integrity-based trustworthiness may be better understood when considering the constructs (Mayer et al., 1995) and their operationalizations (Mayer & Davis, 1999). Competence-based is demonstrated through a set of trustee characteristics that garner influence within a domain. These characteristics may be displayed through the trustee's decision making, problem solving, and professional skills (Zand, 1972; Mayer et al., 1995; Mayer & Davis, 1999). Integrity-based trustworthiness is a perception that the trustee follows a set of principles and values that is acceptable to the trustor (Mayer et al. 1995; Mayer & Davis, 1999). This may be displayed through positive feedback about the trustee from other trusted parties, a belief that the trustee has a strong sense of justice and fairness, consistency in actions and words, and perhaps most importantly, value congruence (Mayer et al., 1995; Mayer & Davis, 1999). These two forms of trustworthiness are distinct, yet complementary (Mayer et al., 1995). Together they reinforce the willingness of the trustor to believe in, or depend on, the trustee.

A third key finding was that, when perceived trustworthiness was taken into account, any positive effect of strong ties on the receipt of useful knowledge was removed. This goes against a major result of Levin and Cross' (2004), who found a "switch from the overall benefit of strong ties before controlling for perceived trustworthiness to the benefit of weak ties after controlling for perceived trustworthiness." (p. 1485). In this study, there were no effects of weak ties. It was trust, more so than weak ties, that lead to the receipt of useful knowledge.

One possible explanation for the second and third finding is that this study was conducted in a legal setting. Information and knowledge sought was highly-specific, requiring both shared language (for assessing competence) and shared values (for integrity). Both competence- and integrity-based trustworthiness require a history of past interaction, which is a governing principle of strong ties. The complex domain knowledge may put particular importance on the trustee's perceived competence (i.e., legal ability) and integrity (i.e., values). Using someone else's legal information and knowledge may carry risks for the information seekers, making them vulnerable to misunderstanding or misapplying information, which could incur legal ramifications. It may be that both types of trustworthiness act as a mechanism to reduce the trustor's perception of risk in the knowledge exchange.

The fourth important finding pertains to the willingness to use tacit and explicit knowledge. The mediating effect of competence-based trust was indiscriminate of the form of knowledge shared. In fact, the mediation effect sizes were similar for willingness to use explicit and tacit knowledge. The finding is inconsistent with Levin and Cross (2004), who discovered that competence-based trust was more important for tacit knowledge to be judged as useful. It may also be inconsistent with Zhou et al. (2010), who found that, when sharing explicit knowledge, the type of tie mattered. Instrumental ties were more important than expressive ties. When sharing tacit knowledge, however, the type of tie did not matter.

7. Practical Implications

The most compelling implication for organizations looking to improve knowledge sharing is building competence- and integrity- based trust among their employees. Mayer et al. (1999) suggest balancing the two, since their relative importance may change by situation and individual. For example, in highly technical knowledge exchanges, it is competence-based trust that has a greater impact, while in politically-sensitive situations, it is integrity-based trust (Mayer et al., 1999).

Competence-based trust is built when employees see (or hear from trusted sources about) a colleague's work-related abilities or skills. For this reason, organizations should publicly highlight employee competencies (e.g., expert locators, employee profiles, newsletters) or encourage their employees to showcase them (e.g., public talks, tutorials, or workshops). Integrity-based trust is built when there is a match among co-workers' personal values and principles, which are rarely displayed in technical work environments. Building integrity-based trust may be easier in environments where employees can interact informally (e.g., brown-bag lunches, retreats, off-site social events/activities). Overall, organizations should consider actively governing expectations to reduce opportunistic behavior and fears of how shared information may be used (Coleman, 1988; Uzzi, 1999).

The benefits of weak ties (network range) and those of strong ties (network cohesion) are not mutually exclusive and need not be compromised for each other (Reagans & McEvily, 2003). Whereas this study points to the importance of strong ties mediated by trust, comparable studies record the importance of weak ties mediated by trust (Levin & Cross, 2004; Zhou et al., 2010). Based on these divergent findings, implications should be predicated on the suggestion by several researchers to cultivate a mixture of both ties (Krackhardt & Hansen, 1993; Hansen, 1999; Uzzi, 1996; 1999). For example, if an organization is dealing with crises, then weak ties should be leveraged, since they have been shown to reduce the frequency and magnitude of crises (Krackhardt & Stern, 1988). Strong ties should be cultivated when the organization is dealing with complex problems (Krackhardt & Stern, 1988) or complex knowledge (Hansen, 1999). What constitutes an optimal network structure for one organization, may not work for another. In short, organizations must strategically leverage both weak and strong ties in order to foster effective knowledge sharing.

The goal is to achieve an optimal amount of network density and range, which Putnam (1995; 2001) argues is created through bonding and bridging social capital (sometimes referred to as closure and brokerage, respectively). Here, bonding refers to social capital based on familiarity and trust, with efficient communication and interaction. However, the bonding created by trust has a limit in terms of network range, since trust deteriorates as the distance between individuals in a network increases; declining significantly after the third degree of separation (Dodds et al., 2003). Bridging, on the other hand, refers to social capital which provides access to novel resources and opportunities (Burt, 2005). Bridges are used to expand the network range and help spread knowledge. Putnam (1995; 2001) and Burt (2005) argue that these two forms of social capital strengthen each other. This was demonstrated empirically by Burt (2005), who showed that maximum performance occurred in networks where bonding and bridging worked together to "enhance coordination across structural holes" (p. 139).

Organizational knowledge sharing and trust networks should be analyzed by conducting a social network analysis (Cross & Parker, 2004; Cross, Parker, & Sasson, 2003; Wasserman & Faust, 1994). If the sociogram reveals too many strong ties (i.e., high closure or density), it may be prudent to add non-redundant weak ties (Burt, 1992). Possible techniques include moving employees with similar expertise across projects, departments, or divisions. This encourages individuals to transfer their knowledge outside of their immediate closed network (Reagans & McEvily, 2003). Holding casual and informal "all-hands" social events may create similar effects, with less commitment and risk. On the other hand, a network with too many weak ties may be strengthened by facilitating resource pooling, coordination, and project work between and across weakly tied co-workers (Uzzi, 1996).

Reagans and McEvily (2003) provide an interesting perspective around constructing networks based on "matching type of tie to type of knowledge" (p. 264), similar to Uzzi's (1999). Basically, strong ties are better for transferring tacit knowledge and weak ties are better for transferring explicit knowledge. More explicit knowledge may be diffused across a bridge with less time and effort, and by a larger number of people, since less ability is required. If less ability is needed to transfer knowledge, it may require less competence-based trust. In contrast, tacit knowledge depends on ability, making it difficult to transfer, requiring more time and effort. Therefore, it is a more efficient use of time to share this type of knowledge among strong ties. Research also suggests that higher network diversity is associated with less efficient knowledge transfers in the short term, because individuals do not immediately have similar expertise in the domain. In the long term, however, it increases network range and social capital, producing "individuals who integrate the knowledge network" (Reagans & McEvily, 2003, p. 265).

8. Limitations and Future Directions

There was a notable difference in the nature of the samples between this study and the previous ones, impeding generalizability. This sample was taken from a single legal setting, as opposed to from different divisions of three kinds of companies (Levin & Cross, 2004), or from Chinese professionals/part-time business administration students (Lin, 2007; Zhou et al., 2010). The legal context may have been instrumental in emphasizing the importance of strong ties, as well as in revealing the influence of a combination of competence- and integrity-based trust. Since the interplay between tie-strength, trust, and knowledge sharing have been tested in few contexts, it is recommended that future research extends into other domains.

It would be also prudent to heed the advice by Reagans and McEvily (2003) that strong ties may be confounded with social cohesion. Furthermore, Levin and Cross controlled for physical proximity of knowledge seeker and source, and for homophily. These measures were not included in this study, although homophily was reported as an independent variable in other studies (Evans, 2012; Evans et al., 2015; 2018). Future research may consider the role of both physical proximity and social cohesion to determine what effect they have on tie-strength. Further, future work should expand the measure of knowledge sharing as the current measures only focus on the willingness of individuals to use knowledge and the perceived usefulness of knowledge shared. Finally, researchers should use qualitative methods, such as interviews, to further understand why trust is so important. From a procedural point of view, there may be a limitation related to asking respondents to free select anonymous co-workers. This is because it relies on unspecified internal criteria on the part of the respondent of what constitutes “working best with”.

9. Conclusion

This study contributes to the research on interpersonal knowledge sharing and use, through a better understanding of the structural and relational dimensions that govern them. The results show that while stronger ties lead to the receipt of useful knowledge, this is entirely mediated by competence- and integrity-based trustworthiness. Notably, competence-based trust has a similar effect on the relationship between tie-strength and willingness to use, irrespective of the knowledge type.

These findings converge on the importance of trust on knowledge use (Levin & Cross, 2004) and on knowledge sharing more broadly (Lin, 2007; Zhou et al., 2010). Notably, this study contributes to the literature by confirming the importance of competence-based trust, while suggesting that integrity-based trust is equally important. Practically, the findings suggest that organizations should cultivate competence- and integrity-based trust among employees, and develop networks that consist of both weak and strong ties, balancing network density and range.

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Appendix

Construct	Sample Items ¹
Tie-strength (While on)	[While working on the matter or firm-related project you shared,] - [...] how close was your working relationship with each of the co-workers you mentally selected? ² - [...] how often did you communicate with the two co-workers you mentally selected? ³
Tie-strength (Prior to)	[Prior to working with each of the co-workers on the matter or firm-related project you shared,] - [...] to what extent did you typically interact with each of them? ⁴ - My relationship with each of the co-workers I mentally selected was a very intense, strong relationship [...] ⁵
Competence-based trust ⁵	- This person is very capable of performing his/her job - This person has much knowledge about the work that needs done - I feel confident about this person's skills
Integrity-based trust ⁵	- This person has a strong sense of justice - I like this person's values - Sound principles seem to guide this person's behavior
Benevolence-based trust ⁵	- This person is very concerned about my welfare - This person would not knowingly do anything to hurt me - I feel like this person is on my side
Receipt of useful knowledge ⁵	[The information I received from each of the co-workers made (or is likely to make) the following contribution to:] - client satisfaction with the project, - this projects quality - the project teams overall performance - the overall success of [FIRM NAME] - the cost and/or time it took to complete the portion of the project I am responsible for - my individual performance on the project
Willingness to use (Tacit) ⁵	- I would welcome the opportunity to spend significant time observing and collaborating with this individual in order for me to better understand and learn from their work - I would welcome and use any rules of thumb, tricks of the trade, and other insights they have learned - I would eagerly receive and consider any new ideas this individual might have
Willingness to use (Explicit) ⁵	- I would eagerly receive and use tools developed by this person including precedents, memos, client information, and industry information

¹See Evans, 2012 for all items

²Scale: No Prior Contact; Distant; Somewhat Distant; Somewhat Close; Close; Very Close (minus "No Prior Contact" for *While on*)

³Scale: Never; Once every 3 months or less; Once every 2nd month; Once a month; Twice a month; Once a week; Twice a week; Daily (minus "Never" for *While on*)

⁴Scale: To No Extent; To Little Extent; To Some Extent; To a Great Extent; To a Very Great Extent

⁵Scale: 1 (Strongly Disagree) – 5 (Strongly Agree)