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Knowledge Sharing Through Computer Mediated Social Ties

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Abstract

Understanding social interactions and knowledge sharing behavior in the organizational context is important as an organization's success is increasingly dependent on how efficiently and effectively knowledge workers share information with others. Knowledge workers are increasingly interacting via computer and communication technologies. In this research we integrate theories of computer mediated communication with theories and prior mixed findings about the strength of social ties and knowledge sharing to theorize about the effects of computer-mediated communication (CMC) on social ties and ultimately on knowledge sharing between individuals in firms. Specifically we theorize about the ability of CMC to a) support diverse social ties, and b) facilitate frequency-based strong social ties that hold strong trust – both supporting knowledge sharing. In a social network survey of 70% of employees in an innovation driven organization located in China, our analysis confirms our theorizing and offers contributions to IS and organizational researchers as well as practitioners.

Key Words: social interactions, computer mediated communication, social ties, social networks, knowledge sharing

Introduction

Understanding social interactions and knowledge sharing behavior in the organizational context is important as an organization's success is increasingly dependent on how efficiently and effectively knowledge workers share information with others (Prusak and Davenport, 1998). This knowledge comes from a variety of sources: knowledge repositories; company manuals; best practice guides; and people. In spite of substantial investments in technological resources for storing knowledge, knowledge workers often turn to peers for insight that is critical to their work (Linden et al., 2002). Thus, knowledge sharing via social interactions between individuals plays an important role in today's innovative organizations. Social interactions have been understood and studied in terms of social networks, since this perspective helps uncover interaction patterns that sustain knowledge sharing (e.g., Borgatti and Cross, 2003). A crucial attribute of social interactions is the relative strength of relationship between two people, since that has implications for many outcomes including knowledge sharing.

The existing literature is full of mixed findings on the role of social ties strength in knowledge sharing. Some scholars have found that strong social ties lead to knowledge sharing (e.g., Hansen, 1999) because such ties are based on strong trust (e.g., Krackhardt, 1992), which provides the motivation to share knowledge (e.g., Szulanski, 1996). This line of argument suggests that weak social ties lack trust and hence the motivation to share knowledge. However, others found that weak social ties are responsible for knowledge sharing (e.g., Burt, 2004) as these ties connect a focal individual with diverse others (e.g., Podolny and Baron, 1997) who probably have knowledge that is not already available to the focal individual through people they already know (e.g., Granovetter, 1973).

The preceding arguments, rooted as they are in FtF (FtF) social interactions, present an interesting *knowledge sharing conundrum:* (1) employees share knowledge with those that they trust; and this trust is present in strong social ties; (2) in a FtF social interaction, the strong social ties of a focal individual are less diverse and tend to know each other; generally have the same knowledge and it is difficult to get unique or novel information and diverse perspectives; and (3) diverse perspectives tend to come from contacts who are not linked to each other, and who are demographically diverse which in a physical settings generally means contacts that are weak social ties who tend to lack the trust to share. This conundrum highlights two important aspects of knowledge sharing through social ties: focal individuals should have diverse ties and these ties should be characterized by relational trust.

In this paper, we seek to resolve this knowledge sharing conundrum by drawing insights from the effects of computer-mediated communication (CMC) on social ties; specifically, the ability of CMC to a) support diverse social ties, and b) facilitate frequency-based strong social ties that hold strong trust. Our approach is particularly salient in a workforce which is seeing the entrance of the generation Y demographic, representing a group of individuals fluent in and increasingly reliant on CMC to create and maintain their social networks. Additionally, the increasing acceptance of social networking technologies into organizational settings, suggests that understanding the role of CMC use by individuals and the effects of this

on important outcomes such as knowledge sharing are important to contributions to guiding both research and practice.

Conceptual Foundations and Hypotheses

In today's knowledge economy, organizations represent a social entity in which knowledge is created, organized, shared, and reused. Kogut and Zander (1996) state that a "firm should be understood as a social community specializing in speed and efficiency in the creation and transfer of knowledge" (p. 503). Scholars in the knowledge management field stress the notion that knowledge resides within individuals and is shared by individuals; thus, individuals play a central role in knowledge sharing (Nonaka, 1994). They share knowledge with and through their informal contacts (e.g., Borgatti and Cross, 2003). A significant amount of new information that individuals need for their day-to-day work comes from these networks of relationships rather than from knowledge repositories (e.g., Linden et al., 2002).

Social networks scholars have studied how the nature of ties between individuals affects knowledge sharing (e.g., Friedkin, 1982). Most of these early studies were based on the assumptions of FtF social interactions. There were two particularly important assumptions: a) the strong ties of an individual tend to know each other (Granovetter, 1973) because in FtF social interactions, if individual A regularly interacts with individuals B and C, then according to balance theory (e.g., Heider, 1958), B and C will also become strong ties of each other. This suggests that strong ties tend to be less diverse (Granovetter, 1973); and b) weak ties do not possess trust because trust develops over time due to frequent interactions and weak ties are characterized by lack of frequent interaction (Krackhardt, 1992; Nelson, 1989).

In the social context that was mostly driven by FtF interactions, Granovetter (1973) found that weak social ties were instrumental in providing job related information. The argument was that weak ties, being more diverse than strong ties, have a higher potential to provide unique or new information (Friedkin, 1982); in addition, diverse sources of information increase the probability of finding the correct answers or useful information, i.e., advice from more diverse social ties will be more useful than advice from less diverse social ties (Constant et al., 1996). However, Krackhardt (1992) and Nelson (1989) reemphasized the importance of strong ties in an organizational context. More recently, in comparison to weak ties, strong social ties were found to be beneficial for receiving useful knowledge (Hansen, 1999; Szulanski, 1996). In fact, Hansen (1999) found that strong social ties were better for knowledge sharing because they possess trust. Cross and Sproull (2004) found that strong ties were generally more useful than weak ties in obtaining actionable knowledge. Levin and Cross (2004) also found that strong ties facilitate knowledge sharing. Nonetheless, Morrison (2002) found that tie strength has no role in organization knowledge sharing although strong ties are related to other work environment outcomes such as organizational commitment.

These mixed results around became more ambiguous as researchers started studying CMC based social ties – ties that are mostly maintained through email or other types of computer mediated interactions. Many scholars labeled CMC-based ties as inherently weak social ties (e.g., Constant et al., 1996; Kavanaugh et al., 2005; Pickering and King, 1995), irrespective of the nature of the interactions. The common explanation is that because CMC is a relatively lean channel of communication (Daft and Lengel, 1986; Daft et al., 1987), the ties thus created must be weak ties (Pickering and King, 1995). Pickering and King (1995) argued that CMC supported ties are characterized by less frequent interactions and should be similar to traditional weak ties. Constant and colleagues (1994; 1996) also adopted this view of CMC supported ties.

This conceptualization of CMC-based ties as weak rests on two assumptions: a) CMC is lean media for social interactions, and b) CMC-based ties are low in frequency of interaction. The first assumption can be challenged on the basis of theoretical arguments presented in various CMC theories. Social information processing (SIP) theory of CMC (Walther, 1995) suggests that individuals are able to accommodate the perceived shortcomings of the medium. Thus, provided sufficient time for interactions and frequency of exchanges, the individual interacting through CMC for socialization can overcome any limitation the media might inherently possess or be perceived to possess (Walther, 1995). Similarly, channel expansion theory (Carlson and Zmud, 1999) posits that repeated interactions with the same person over time, even using a so-called lean medium, create a sufficient context so that individuals can carry complex social communication. The communication channel's perceived capability to share social information expands over time due to repeated interactions that create familiarity with the content, medium, context and individuals involved in the interaction. These communication media theories focus on repeated interactions between individuals using

CMC. Repeated interactions enable richer social context through even the same lean media over time. Thus, frequency of interaction appears to be an important feature of sustaining social ties through CMC.

This brings us to the second assumption that CMC-based interactions are low in frequency. Increasingly various communication technologies are being used by employees in organizations. Most employees now have access to multiple tools with which to communicate. In addition, the convenience (and sometimes organizational insistence) of interaction across different time zones, locations, and hierarchies makes CMC-based social interactions more convenient than FtF. It is much more likely that CMC-based interactions occur much more frequently today than in the past when there were fewer tools. Thus, there is the possibility that CMC-based social ties may develop strength due to frequent interactions.

Having discussed above some conceptual foundations and establishing the importance of using frequency as an indicator of strength of ties, below we outline two aspects of social ties that have important implications for knowledge sharing and that were briefly discussed in the introduction: diversity of social ties and trust.

Conceptual Model

Figure 1 presents the overall conceptual model. In this Figure double headed arrows indicate associational rather than causal relationship.

Figure 1: Conceptual Model
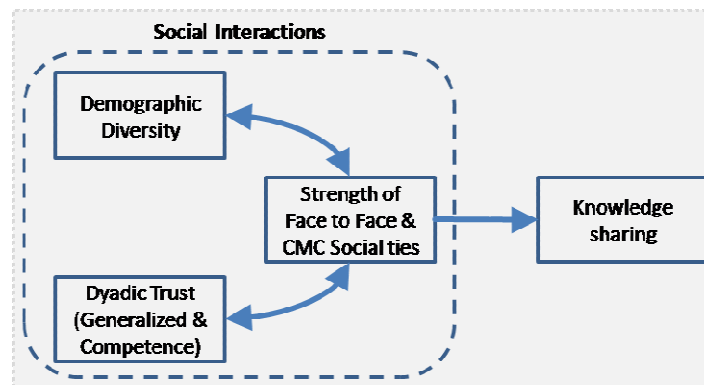
This research model depicts the knowledge sharing conundrum that was mentioned in the introduction. Diversity of contacts and trust are two important foundational aspects of social ties that enable knowledge sharing. Below we develop hypotheses based on integrating prior social tie research with CMC research to theorize about how knowledge sharing is impacted by these factors.

 Demographic Diversity: Demographic diversity can be defined as the diversity of ties held by an individual (Ibarra, 1995). The word demography is used here in a broad sense to include gender, culture, and departments, among other such aspects. Demographic diversity benefits the focal individual because s\he can draw from less-redundant experiences among his/her ties (Ancona and Caldwell, 1992) to obtain new ideas, information, and resources (Reagans and Zuckerman, 2001). In contrast, due to homophily effects, less diverse ties are easier to form and maintain, and are cohesive (e.g., McPherson et al., 2001). However, the benefits accruing to a focal individual from his/her homophilic ties are limited by the relative redundancy of the others' perspectives, information, and resources (e.g., Ancona and Caldwell, 1992). In comparison, greater demographic diversity involves relationships with people of different sets of contacts, skills, information, and experiences, thus providing the focal individual with potentially more resources to generate ideas and solve problems (e.g., Bantel and Jackson, 1989).

In a FtF interaction environment, the homophily effect is very strong as visual and cultural similarity can play a major role in who interacts with whom. In contrast CMC facilitates the creation and maintenance of diverse social ties because of its ability to provide the benefits of social interactions without the conventional limitations of proximity and temporality. CMC can be asynchronous and does not demand strict instant reciprocity (Daft and Lengel, 1986), which provides an opportunity to respond at the most opportune time. This leads to the creation and maintenance of social ties across time zones and geography.

Moreover, CMC carries fewer social context cues than FtF interactions (Daft and Lengel, 1986; Sproull and Kiesler, 1986) and tends to be less formal than written communication (Finholt and Sproull, 1990; Fish et al., 1993). This helps in creating diverse ties across a hierarchy and other social barriers (Constant et al., 1996; Sproull and Kiesler, 1986). As most cultural aspects are visual (attire, gestures, facial expressions,

etc.), a less rich communication appears to break the homophily barriers (Tidwell and Walther, 2002). Social interactions in FtF situations are complex: they are full of formality, traditions, protocols, and customs (Walther and Parks, 2002). This is especially so when one encounters diversity. Various socio-cultural connotations come in the way of effective interaction; however, in CMC supported interaction, even though some of these nuances still remain, a faceless person (without associated social cues) is easier to interact with if the primary discrimination factor may be the "face" (gender, culture, and traditions) itself. Thus, CMC supports diverse ties by connecting even those individuals who lack homophily.

H1: CMC-based socializing ties will be more diverse compared to FtF socializing ties.

H2: Weak ties will be more diverse compared to corresponding strong ties, i.e. weak CMC ties will be more diverse than strong CMC ties, and weak FtF ties will be more diverse than strong FtF ties.

Trust: Trust is the most studied relational feature of social ties (Coleman, 1988; Portes, 1998). Trust is a belief that those individuals one chooses to rely upon will not act opportunistically by taking advantage of a situation, and will behave in a dependable, ethical, and socially appropriate manner (Hosmer, 1995). Trust has been defined in terms of integrity, benevolence, and competence (Mayer et al., 1995): benevolence indicates the "extent to which a trustee is believed to want to do good to the trustor" (p. 718); integrity represents that "the trustee adheres to a set of principles that the trustor finds acceptable" (p. 719); and competence is "perceived expertise" that forms a critical characteristic of the trustee (p. 717).

An organizational environment provides some degree of generalized trust where the focal individual has no reason not to believe the integrity and benevolence of others unless proven otherwise. Moreover, repeated interactions in an organizational environment will strengthen generalized trust (Mayer et al., 1995) amongst individuals having social ties. This is no different for CMC-based social ties. Walther (1995), in a longitudinal experiment, found that there was no difference in generalized trust between members of a FtF group and those of a CMC-based group. Thus,

H3: Generalized trust will be positively associated with the FtF as well as CMC-based social ties.

H4: Generalized trust will be positively associated with strong as well as weak social ties.

Competence-based trust is also important to knowledge sharing (e.g., Butler, 1991; Mishra, 1996)). This has been variously described in the literature as trust in ability (e.g., Kramer, 1999; Mayer et al., 1995) and expertise (e.g., Giffin, 1967). In organizational settings, CMC-based social ties may be initiated precisely due to the perceived competency of an individual (as provided in a web directory or expert locater feature), while as discussed earlier, FtF social ties would more often be based on homophily. Some features of CMC, such as automatic recording of the past interaction history and searchability of those interactions, enable an individual to respond to the focal individual's query in the context of the interaction history. This has the potential to provide correct and relevant responses, enhancing competency-based trust. Thus,

H5: Competence-based trust will be more strongly and positively associated with CMC-based social ties compared to FtF social ties.

In the case of CMC-based ties, as argued above, at least some of the social ties are initiated due to competence-based trust. Over time, as the tie of a focal individual continues to respond with expertise, competence-based trust will increase as will the strength of the social tie due to frequent interaction. Thus,

H6: Competence-based trust will be more strongly and positively associated with CMC-based strong social ties compared to CMC-based weak social ties.

In the case of FtF social ties, homophily plays a major role in strong ties in comparison to weak ties. Thus, competence-based trust will be less salient for FtF strong ties in comparison to FtF weak ties. Stanton-Salazar and Dornbusch (1995) found that higher ability was marginally associated with weak social ties, whereas Mayer and Puller (2008) found that differences in ability result in less likelihood of having strong socializing ties. None of these articles provide any theoretical explanation to these observations; however, it can be argued that an individual prefers to contact someone, for work related interactions, whose ability or competence s/he trusts, but in FtF social settings, differences in competence may give rise to some awkward situations. For example, when someone who is highly competent in a particular technology cracks a high-tech joke over lunch with an individual who is not as competent in that technology, the entire conversation may be lost. Thus, it may be more common that individuals will form weak FtF social ties with those in whom they have high competence-based trust and would avoid forming strong social ties with these individuals. Thus,

H7: Competence-based trust will be positively associated with weak FtF social ties whereas it will be negatively associated with strong FtF social ties.

Types of Social Ties and Knowledge Sharing: It is important to recall the earlier knowledge sharing conundrum. This conundrum highlights two important aspects of knowledge sharing through social ties: focal individuals should have diverse ties and these ties should possess relational trust. In traditional FtF social interactions, the strong ties of focal individuals tend to be less diverse and lack new information, while the weak ties of focal individuals lack the trust required to share useful information. This conundrum can be resolved if we identify the ties of a focal individual that are diverse, and hence have diverse information, as well as trust to share that information. In the preceding sub-sections, we argue that CMC-based ties are more diverse and thus have the potential to possess unique information. Moreover, CMC-based strong ties are associated with generalized trust and higher competence-based trust. This suggests that CMC-based strong ties have unique information as well as the trust necessary to share that information with the focal individual. Thus,

H8: CMC-based strong social ties will be the most significant in the sharing of unique information compared to CMC-based weak ties, FtF strong ties, and FtF weak ties.

Control Variables: Familiarity: Hinds et al. (2000) associate familiarity with social ties. Familiarity reduces uncertainty and risk in a relationship, and individuals prefer to interact with those who are familiar. Hinds and colleagues use the number of months that individuals worked together as an indicator of familiarity; in this research, we use three indicators of familiarity: a) number of projects worked on together in the past; b) number of projects currently working on together; and c) number of months known to each other. This control variable was used for the models predicting types of ties as well as for the models predicting knowledge sharing.

Tenure: The number of years an individual has spent in a company has the potential to be associated with the information others seek from him/her (Reagans and Zuckerman, 2001; Sparrowe et al., 2001). This control variable was used in the models predicting knowledge sharing.

Research Methodology

The hypotheses were tested by studying social and knowledge sharing interactions amongst the employees of Innosoft (a pseudonym). A brief discussion of the research site, the research methods adopted, and their suitability is presented below.

Research Site: Innosoft is a small entrepreneurial firm, founded in 2002 in southeast China. Innosoft specializes in the design and development of embedded middleware and operating systems, which have a market in China and overseas. They operate in a fiercely competitive market, have a flat organizational structure and were reasonably small and agile.

A voluntary online survey soliciting dyadic and demographic information was administered to the potential respondents. Of the total 135 employees, 95 (37 women, 58 men) responded to an online survey within three working days, a response rate of over 70%. The average age of the employees was 26 years with 85% of them less than 30 years old. An average employee has spent around two years with the company and most of the employees have at least a bachelor degree. Slightly over 76% of employees were in the Generation Y age group (< 28 years).

Data Collection: Network data were collected using the roster method (Scott, 2000; Wasserman and Faust, 1994). In this method, respondents were provided with an alphabetical listing of the names of all their colleagues (134, their own name was excluded). To minimize participant fatigue and make it convenient to locate colleagues, the names of the employees on the list were grouped together by department (total 10 departments). We asked them to indicate their degree of relationship with each name on the list.

Measures: The data collected in this Study are mainly dyadic in nature. Dyadic data reflect a relationship between two individuals. This type of data is not the property of an individual (i.e., a node); instead, it is the property of a pair of individuals. Thus, A and B might have a strong tie, whereas A and C may have a weak tie. Dyadic data allow a researcher to directly examine who interacts or shares information with whom.

Dyadic Measures: Social Ties

FtF socializing ties: Participants were asked to indicate the average frequency of their in-person (FtF) interaction with each of their colleagues for informal (non-work related) activities such as socializing, sharing jokes, eating lunch, playing sports, and other similar activities. They were asked to choose one of seven options: 1) never; 2) several times a year; 3) once a month; 4) once a week; 5) several times a week; 6)

once a day; and 7) several times a day. Option 1 was coded as no FtF social tie, options 2 to 4 were grouped together as weak FtF social ties, and options 5 to 7 were grouped together as strong face -to-face social ties. This measure is based on the frequency of a tie between two individuals.

 Online socializing ties: Again, respondents were asked to indicate the frequency of social interactions with their colleagues through CMC-based communication such as email, online, internal social networking sites, bulletin board systems, telephone, cell phone, and SNS for non-work related activities such as online socializing, forwarding jokes, sending e-cards, and playing online games together. Weak and strong ties were coded as mentioned above.

Dyadic Measures: Knowledge Sharing

FtF knowledge sharing: This was measured in two different ways: a) providing unique information, and b) receiving unique information. In the former case, respondents were asked to indicate how frequently they provide in-person (FtF) information to each of their colleagues. They were specifically asked about "information that is related to his/ her [their colleague's] work and that he/ she did not know before and would not have easily found in company manuals and other offline or online documents". The frequency scale was the same as mentioned above, i.e. 1= Never and 7= Several times a day. In the latter case, respondents were asked how frequently they receive unique information in person (FtF) from each of their colleagues. The response '1' was re-coded as '0' in both the matrices to indicate there were no information sharing ties. Other responses were left as is.

Online knowledge sharing: As above, questions were very similar except that these questions asked information providing (receiving) though CMC such as email, online chat, telephone, cell phone, and SNS.

Dyadic Measures: Trust

General trust: On a scale of 1 (strongly disagree) to 7 (strongly agree), respondents were asked to indicate for each of their colleagues whether they would completely trust him/ her.

Competence-based trust: On a scale of 1 (strongly disagree) to 7 (strongly agree), respondents were asked to indicate whether they would trust their colleague's competence on work related issues.

Demographic Diversity

Demographic diversity was measured as the opposite of homophily matrices, i.e. the more homophilous contacts of a focal individual there are, the less the demographic diversity would be. Homophily matrices were calculated from the demographic data provided by the individual and were calculated for gender, province, department, and hierarchy. The four homophily matrices were then created in which '1' indicates that the two individuals are similar in that attribute and '0' indicates that they are different. For example, for the same hierarchy matrix, '1' indicates that two individuals belong to same hierarchy, whereas '0' means they belong to different hierarchy levels.

Dyadic Control Variables

Familiarity: This was measured using three separate dyadic matrices: a) months known to each other; b) number of projects currently working on together; and c) number of projects worked on together in the past.

Tenure: Through an online survey, respondents were asked the total number of months they had been working for Innosoft. For relevant information, an individual is expected to go to a colleague who is more experienced (i.e. with longer tenure). To capture this effect, a matrix for tenure was created in such a way that the tenure of each individual (a row in the matrix) was repeated in the respective column of the matrix (representing their ties).

Analysis and Results

In social network data, observation cannot be assumed to be independent. For this reason, standard statistical tests cannot be used for social network data. To get around this problem of bias, Krackhardt (1988; 1993) proposed a Multiple Regression Quadratic Assignment Procedure (MRQAP), which, with updates and extensions, has been implemented in UCINET software (Borgatti et al., 2002) and labeled as "Double Dekker Semi-Partialling MRQAP." We use this semi-partialling extension to the MRQAP for analysis.

MRQAP results for hypotheses H1 to H7 are presented in Table 1. There are four models, one for each type of social ties. In Model A, the dependent variable (DV) is FtF strong social ties. In Models B, C, and D, DVs are FtF weak ties, CMC strong ties, and CMC weak ties respectively. DVs in all four models are coded in such a way that it is '1' if that type of tie exists and '0' if that type of tie does not exist.

H1 states that CMC-based socializing ties will be more diverse when compared to FtF ties. To test H1, it is necessary to compare model A with model C, and model B with model D. The results for Model A

suggests that all the homophily matrices were significant for FtF strong social ties. The regression coefficient sign were positive for all the coefficients, which indicates that similarity in gender (β=0.051, p < 0.001), province (β=0.025, p < 0.1), hierarchy (β=0.023, p<0.1), and department (β=0.210, p < 0.001) were associated with FtF strong social ties, i.e., there was less diversity in these ties. In comparison, for Model C, similarity in department (β=0.093, p < 0.05) and similarity in hierarchy was significant (β=0.031, p < 0.1). Thus, homophily plays a less significant role in CMC-based strong ties. Consequently, they are more diverse than FtF based strong ties. Similarly, a comparison between Model B and Model D presented in Table 1 indicates that CMC-based weak ties are more diverse than FtF weak ties. Thus, hypothesis H1, which states that CMC-based socializing ties will be more diverse in comparison to FtF socializing ties, is supported. In addition to these tables, we produced network diagrams to graph and compare the relative attributes of FtF and CMC based social ties. These diagrams confirmed our results (not presented to conserve space).

Table 1: MRQAP Results (DV: Social ties)

N (8930)	Model A (ftf Strong Social ties)	Model B (ftf Weak Social ties)	Model C (CMC Strong Social ties)	Model D (CMC Weak Social ties)
Familiarity				
Months known	0.187***	0.264***	0.006	0.036*
Current Projects	0.194***	0.002	0.171***	-0.091***
Past Projects	0.121***	0.010	0.076***	-0.006
Homophily				
Same gender	0.051***	-0.017	0.016	-0.018+
Same province	0.025+	0.012	0.022	0.006
Same hierarchy	0.023+	-0.001	0.031+	-0.009
Same department	0.210***	-0.066***	0.093*	-0.055***
Trust				
General trust	0.327***	0.229***	0.469***	0.449***
Competence-based trust	-0.040+	0.017	0.112*	-0.027
R^2	0.421	0.181	0.496	0.164
*** p<0.001; ** p<0.01; * p<0.05; + p <0.1; Cell value represents standardized coefficients.				

H2 states that weak ties will be more diverse in comparison to corresponding strong ties. To test H2, it is necessary to use Table 1 to compare model A with model B, and model C with model D. A comparison between Model A and Model B presented in Table 1 indicates that Model A shows a strong homophily effect compared to Model B. None of the coefficients for gender, province, and hierarchy were significant, and the coefficient for department (β=-0.066, p < 0.001) was negative in Model B, which indicates FtF weak social ties are more likely to form across departments. Thus, FtF weak ties are more diverse than FtF strong ties. Similar observations about CMC-based strong and weak social ties can be made by comparing Model C and Model D. Thus, hypothesis H2, which stated that weak ties will be more diverse in comparison to corresponding strong ties, was supported.

Hypothesis H3 and H4 predict that generalized trust will be associated with FtF as well as CMC-based social ties irrespective of whether they are weak or strong. The regression coefficient for generalized trust is significant for all the four models and thus, H3 and H4 were supported.

Hypothesis H5, which predicted that competence-based trust will be strongly associated with CMC-based social ties compared to FtF social ties, was partially supported. Regression coefficients were compared and for competence-based trust for Model C (CMC-based strong ties) it was significant and positive (β=0.112, p < 0.05): for Model A (FtF strong ties) it was significant and negative (β=-0.040, p < 0. 1). This supports H5; but coefficients for competence-based trust were non-significant for both types of weak ties leading to partial support for H5.

Hypothesis H6 was supported as the coefficient of competence-based trust was significant and positive in Model C, while it was non-significant in Model D. Hypothesis H7 was partially supported. Competence-based trust was significant and negative (β=-0.040, p < 0. 1) in Model A; however, it was non-significant (β=0.017, ns) in Model B.

Familiarity matrices were used as controlled variables for all these models. The results indicate that the familiarity matrices, as measured by months known to each other, number of projects worked on together in the past, and number of projects currently working on together, were positively associated with FtF social

ties in comparison to respective CMC-based ties. They were also positively associated with strong ties as opposed to corresponding weak ties. This means that familiarity, in terms of duration one knows a colleague, number of project worked with him/ her in past, and number of projects working currently with him/ her, plays a more important role in FtF ties compared to CMC-based, and in strong ties compared to weak ties.

Results presented in Table 2 supports hypothesis H8, which stated that CMC-based strong ties are most significant in knowledge sharing. Table 2 contains five models. Models 1, 2, 3, and 4 are hierarchical. In Model 1, only control variables were included, and successively in Model 2, 3 and 4, FtF ties, CMC-based ties, and all types of ties were added. Model 5 represents a robustness test that will be discussed after initial discussions of Models 1-4.

Table 2: MRQAP Results (DV: Provide Information FtF)

Model	1	2	3	4	5
Tenure	0.028*	0.044**	0.013*	0.019**	-0.001
Familiarity					
Current Projects	0.205***	0.084***	0.049***	0.029***	0.197***
Past Projects	0.104***	0.040***	0.042***	0.029***	0.119***
Months Known	0.270***	0.044**	0.085***	0.046***	0.286***
Homophily					
Same Gender	0.027*	0.001	-0.004	-0.009	0.020
Same Hierarchy	0.033+	0.027+	0.003	0.005	0.015
Same Department	0.251***	0.136***	0.087***	0.069***	0.209***
FtF Social Ties (Strong)		0.445***		0.140***	
FtF Social Ties (Weak)		0.296***		0.057***	
CMC Social Ties (Strong)			0.645***	0.580***	
CMC Social Ties (Weak)			0.314***	0.295***	
Strong FtF – No CMC					0.045***
Weak FtF- No CMC					0.003
Strong CMC – No FtF					0.318***
Weak CMC – No FtF					0.219***
N (8930)					
R2	0.318	0.460	0.650	0.659	0.461
*** p<0.001; ** p<0.01; * p<0.05; + p <0.1; Cell value represents standardized coefficients.					

Results of the Model 1, shown in Table 2 suggest that together, tenure, familiarity, and homophily matrices explain a 32% variance in the strength of FtF information providing ties. All the control variables were significant. The addition of FtF socializing ties to control variables (Model 2) improves a variance explained by 14%. Strong and weak social ties are both significant; however, the standardized regression coefficient for strong ties is much larger than that of weak ties.

In Model 3, CMC-based social ties were added to control variables instead of FtF social ties. The explained variance was increased by 33% to 65%, which was 19% higher than when FtF social ties were added to control variables. CMC-based strong and weak social ties were both significant; however, the standardized regression coefficient for CMC-based strong social ties was more than double that of CMC-based weak ties.

In Model 4, FtF and CMC-based ties were added to control variables together and explained variance change by less than 1% over Model 3. A comparison of Model 2 and 4 suggests that addition of CMC-based social ties to the model that contains control variables and FtF social ties increases explained variance by 20%. Thus, comparisons of Models 2, 3, and 4 indicate that CMC-based ties are better predictors of the presence and strength of FtF information providing ties. Model 4 suggests that CMC-based strong ties are the strongest predictor of information-providing ties.

These results were replicated for the three other dependent variables: information provided through CMC, information received FtF, and information received through CMC (to conserve space the tables of these results are not included). Thus, H8, which stated that CMC-based strong social ties will be the most significant in the sharing of unique information, is supported.

In all the models (Model 1 to 4) used in Table 2, the FtF and CMC ties were not mutually exclusive; for example, individual A and B could simultaneously have a strong CMC-based tie and a weak FtF tie or vice versa. Thus, one may argue that Models 2 to 4 may not exclusively capture the effects of CMC and FtF based ties. In order to test the effects of exclusive ties, Model 5 was created. For Model 5, four matrices were created in such a way that Matrix "Strong FtF – No CMC" contains 1 if individuals A and B have a strong FtF tie but no CMC-based tie. Similarly, matrices "Weak FtF – No CMC," "Strong CMC – No FtF," and "Weak CMC - No FtF" were created. The results presented for Model 5 in Table 2 indicate that CMC-only ties (either weak or strong) have a much higher regression coefficient compared to FtF only ties. As expected, these results are even more prominent for DVs "Provide Information through CMC" and "Receive Information through CMC" (results not included due to lack of space). Thus, robustness analysis supports the original findings of H8.

Discussion and Future Research

In this Study, an attempt was made to integrate the theories of CMC with social networks literature to resolve the debates about the role of tie strength in knowledge sharing. The results indicate that CMC-based strong ties do possess the required trust as well as unique information to share with the focal individual. Once CMC ties are taken into account, the addition of F2F ties adds little predictive ability, and they explain only less than 1% variance over and above what is already explained by CMC-based ties. Hence in this work we have provided unique insights by integrating CMC theories with social ties and re-conceptualizing CMC-ties as CMC-based strong ties and CMC-based weak ties. The past mixed findings about the role of tie strength in knowledge sharing may be partly attributed to the aggregation of disparate kinds of communication ties into a single measure of tie strength (Gibbons, 2004; Podolny and Baron, 1997).

Our work addresses the call for using multitheoretical perspectives in social network research (e.g., Contractor et al., 2006; Fulk and Boyd, 1991) by using communication theories for predicting network structural attributes. As well, by explicitly separating CMC-based social ties and FtF social ties, our work addresses the call for the disaggregation of tie strength for a fine-grained analysis of its effect on outcomes (Fulk and Boyd, 1991) such as knowledge sharing and our work has helped prior conflicting findings in the literature on tie strength in the context of knowledge sharing. Our work also demonstrates that diversity and competence-based trust are most significantly associated with CMC-based strong ties and this finding paves the way for future investigation of other dyadic attributes formerly treated as undifferentiated ties (not explicitly CMC-based ties).

Past research has noted that strong ties are costly and require time and other resources to maintain versus weak ties (e.g., Friedkin, 1982). Our work indicates that CMC-based strong ties have dual characteristics: because they are strong, they possess trust (like FtF strong ties) but it can be argued that the cost of the temporal (same time) and spatial (same place) commitment of maintaining such ties is much less compared to FtF strong ties. This insight makes an important contribution to practitioner research. Organizations would gain if they could find ways to encourage CMC-based strong ties. For example Generation Y would continue to spend an increasing amount of time on SNS if organizations have a strategy to encourage employee use of the organization's internal SNS to interact with other employees during their private time. This practice will create CMC-based strong ties without much additional investment.

Further our work suggests that companies that are involved in the development of innovative products in a competitive environment will gain from encouraging creation and maintenance of CMC-based strong ties. One way of achieving that may be the deployment of social networking software and tools that will help in creating CMC-based strong ties, which will facilitate knowledge sharing among the developers. Some organizations are already moving in that direction. Wachovia Bank is an example of an early adopter of social networking technology. By the end of June 2008, Wachovia had rolled out this technology to its 60,000 employees and has plans of extending it to 120,000 employees by the end of 2008[1].

During the interviews, Innosoft's senior management and employees expressed compatible opinions. Innosoft's employees are very young with an average age of 26, and 85% of employees are less than 30 years of age. In an online survey, 11.7% of employees indicated various levels of turnover intentions. This is a

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[1] "Wachovia set to give 120,000 users access to wikis, blogs and social networks." Computerworld.
http://www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=909521 9

substantial number when one takes into account the social desirability issues involved with such a question. This makes retention of employees and their knowledge important issues in this organization. Social networking tools can help in both these goals since they encourage individuals to create CMC-based strong ties, and strong ties are known to reduce turnover intentions (McPherson et al., 1992; Moynihan and Pandey, 2007). Further, social networking sites embed tools, such as blogs and wikis, that can be used effectively to capture employee knowledge for future use. Finally, 44% of employees at Innosoft have joined in the past 12 months or less. This is a very large proportion and requires a well-thought socialization process. Many employees at Innosoft agree that implementation of a social networking site would help in this socialization process as employees of this Generation Y-dominated company already use public domain social networking sites extensively; in addition, they are favorably disposed to any future initiative of implementing company-wide social networking tools.

Limitations, Future Research and Conclusions

Issues of the choice of organizational boundary, common method variance, respondent bias, cross sectional design and ties strength operationalization as frequency as opposed to other choices represent limitations of the research project. Undertaking longitudinal analysis, expanding the knowledge sharing boundary beyond the firm and investigating other attributes of social ties such as structural holes, centrality and number of ties would be fruitful extensions of this work.

Organizations can be conceptualized as social communities (Kogut and Zander, 1996) where social interactions – through either FtF or CMC – result in the formation and maintenance of social ties. These informal ties play a crucial role in organizational activities as most of the work in an organization is done through informal ties rather than following the rigid vertical hierarchical structure (Cross and Parker, 2004; Galbraith, 1973). Social ties are important as they coordinate activities and facilitate the diffusion of information within and across teams, divisions, and locations (Hansen, 1999; Tsai, 2002). Through social ties, individuals gain more opportunities to share their resources or ideas and thus increase knowledge sharing within the organization. Thus, social ties provide channels for knowledge sharing among members of an organization.

As organizations become more virtual and work becomes more distributed, social interactions in organizations will be increasingly facilitated through CMC. However, contrary to widespread apprehension, this need not lead to a decrease in social capital. As the demography of organizations changes to include increasingly higher proportions of Generation Y employees, the emphasis may shift from FtF based strong ties to CMC-based strong ties, but benefits in general and knowledge sharing in particular will continue to accrue through organization-wide social ties. However, to make the best use of this situation, researchers and practitioners must understand the circumstances and tools that help in creating CMC-based strong ties. The theoretical arguments and results presented in this research represent a small but important step in that direction.

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