Evaluating the Usefulness of Knowledge Sharing Connections in Multinational Construction Companies

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ABSTRACT

Although knowledge is a vital resource for construction companies, most organizations do not take full advantage of their knowledge resources. In many cases, knowledge management is a game of extremes; either managers take a hands off approach and employees fail to initiate connections that would otherwise be useful, or they embrace a spirit of collaboration that saturates employees with relationships and information flows that are redundant, time intensive, and distracting. To better understand what drives effectiveness in knowledge sharing networks, this study examines the relationship between structural and relational factors and the perceived usefulness of knowledge sharing connections. Results indicate that there is no association between usefulness and communication frequency, media richness, or geographic and disciplinary boundary spanning. These results and their implications are discussed in depth.

KNOWLEDGE TRANSFER AND CONSTRUCTION ORGANIZATIONS

Understanding the value of knowledge sharing in any organization is a unique challenge. In construction organizations, most managers struggle to facilitate value adding knowledge transfer without overloading their workers and distracting them from the high intensity project tasks which are typical of the industry. Although each project represents a discreet opportunity to learn and grow for construction companies, we often find that the same problems repeatedly plague both projects and organizations. For example, past research has demonstrated lackluster performance in the construction industry's adherence to budget, schedule, and quality measures (Flyvbjerg et al. 2002) and stagnant productivity and safety statistics (Hallowell 2011). At the same time, knowledge sharing can reduce repeated mistakes, focus organizational resources on providing a quality product, and foster an innovative environment which will advance the construction industry (Javernick-Will and Levitt 2009).

Even though knowledge is one of the most important resources of a firm (Grant 1996), it is difficult to track or measure. This is because most knowledge is not written down, but exists in the "mental maps, beliefs, paradigms, and viewpoints" of an individual combined with their "concrete know how, crafts, and skills that apply to a specific context" (Alavi and Leidner 2001). When it is embedded within individuals, knowledge is referred to as "tacit" in nature (Nonaka 1994), and it is this characteristic that differentiates it from other resources in the firm (Liebeskind 1996). Because of this, there are unique challenges associated with mobilizing tacit knowledge because exchange occurs predominately in the context of individual relationships (Javernick-Will and Hartmann 2011), which makes it difficult to transfer, even within the boundaries of the organization (Szulanski 1996).

In multinational construction companies, managers are aware that learning from projects around the world can give them a competitive advantage if global expertise is transferred and applied to localized settings (Javernick-Will and Levitt 2009). Because most organizational knowledge is tacit in nature, the interpersonal networks made up of individual relationships are

the only way that tacit knowledge can be transferred on a global level (March 1991). As a result, many multinational organizations create knowledge management programs to create knowledge sharing connections (KSC) to transfer this valuable tacit knowledge. However, while these KSC can provide employees with useful knowledge, they can also saturate employees with inapplicable information or unproductive, yet time intensive relationships. Thus, we must determine if there are consistent factors that contribute to the practical value of individual knowledge sharing connections (KSC).

USEFULNESS AND KNOWLEDGE SHARING

While there are a number of different ways to establish the practical value of a knowledge sharing connection, one of the most direct methods is to determine if those engaged in the relationship find it to be useful. Although it is difficult to theoretically claim that usefulness is an objective measure, it offers some distinct advantages. Usefulness transcends the content shared and relational dynamics to give a more holistic perception of a connection. Prior studies have discussed the importance or utility of certain types of knowledge content (Javernick-Will and Levitt 2009), and defined outcomes such as creativity (Sosa 2011) and individual performance (Cross and Cummings 2004). Other studies have examined individual and social motivations for sharing knowledge (Javernick-Will 2012; Quigley et al. 2007), with the hope that management can capitalize on these motivations to influence knowledge sharing activities. Furthermore, knowledge sharing connections can serve a variety of different roles, each of which provide different, but valuable knowledge content (Cross and Sproull 2004). Interestingly, however, few scholars have asked employees engaged in a KSC if their connection is useful. Usefulness can help differentiate between connections which add value, and those which overload employees with redundant or difficult relationships, leading to a deeper understanding of the characteristics of a connection that give it practical value.

This study investigates the perceived usefulness of KSCs from several different perspectives. Thus far, there are two strains of research which we have labeled “network structure” and “connection dynamics,” which explain why knowledge sharing connections are valuable. Both approaches are used in our analysis. First, we account for each employee’s position within the structure of the knowledge sharing network to analyze whether inter-disciplinary connections or those that link different geographies are perceived as more useful than those that do not. Next, we determine if the connection dynamics of frequency of interaction and method of communication used affect the efficacy of a relationship in transferring knowledge, and therefore the perceived usefulness of the connection.

NETWORK STRUCTURE

One potential source of value for a knowledge sharing connections is that they provide a bridge to knowledge resources that would otherwise be inaccessible. According to structural holes theory (Burt 1992), non-redundant connections to unique knowledge bases provide individuals with new perspectives and more up to date knowledge that they would not otherwise see in a localized context. Furthermore, these benefits put an individual in a position of power due to their network position as a gatekeeper of knowledge. Knowledge sharing networks act to distribute best practices and lessons learned throughout the network such that well connected employees benefit from the best possible knowledge that the organization has to offer.

Practically speaking, construction companies have geographically distributed employees engaged in multi-disciplinary work, which requires a high degree of coordination between

different groups defined within these attributes. Geographic work location provides a convenient boundary condition characterized by different projects, different cultural patterns of thinking, and differing contextual knowledge. Connections that link individuals in different countries are well placed to take advantage of the best knowledge from varying geographic knowledge bases.

Similarly, the technical expertise of various disciplines varies widely, and inter-disciplinary knowledge sharing connections are well placed to access the knowledge unique to each discipline. Cummings (2004) studied multi-lateral work groups that were geographically distributed and multi-disciplinary. He found that the "structural diversity" of spanning multiple knowledge bases led to increased work group performance (Cummings 2004). Thus, structural holes theory would indicate that inter-geographical and inter-disciplinary connections would provide access to unique knowledge bases that would enhance the knowledge sharing potential of the network as a whole, and increase the individual usefulness of that particular connection.

CONNECTION DYNAMICS

Another potential source of value in knowledge sharing connections comes from relational characteristics such as frequency of interaction and method of exchange. Indeed we would expect that without the proper connection dynamics to accurately and easily transfer knowledge, a KSC would not be very useful. Granovetter (1973) drew attention to this idea in his seminal paper on the "strength of weak ties" in which he argued that the dynamics of individual ties have resounding effects on relational and network outcomes. Weak ties, which are characterized by lower time investment, lower emotional intensity, and lower degrees of intimacy, are ill suited for conveying complex tacit knowledge, and may fail to meet the needs of individuals who maintain them.

Although there has been widespread application of the term "strong tie," there is inconsistency in the metrics that define tie strength. Two of the most consistent metrics are the frequency of exchange, with higher frequencies indicating stronger ties (Granovetter 1973; Lin et al. 1978), and the method of exchange, where more social forms of communication are better able to convey complex knowledge (Cummings et al. 2002; Javernick-Will and Hartmann 2011). This assumption comes from media richness theory, which examines the strengths and shortcomings of various communication media in accurately transferring knowledge between people. A study examining the role of computer mediated communication on a number of important relational outcomes defines richer communication as that which properly communicates more subtle communicative cues such as facial expressions and body language (Dennis and Kinney 1998). Using media richness theory, further studies have empirically demonstrated that media richness has a positive impact on decision quality (Kahai and Cooper 2003). It follows that richer methods of communication would create an environment in which complex knowledge can be transferred between individuals, potentially leading to an increase in the perceived degree of usefulness.

POINT OF DEPARTURE

This paper seeks to unite these two strains of research through an empirical investigation into the usefulness of dyadic connections. If the theories above hold true, then connections to different knowledge bases will provide individuals with access to unique ideas, leading to more useful connections. Furthermore, strong ties characterized by increased frequency of exchange and more social methods of communication should be associated with more useful connections. Both lines of inquiry have deepened our knowledge regarding the effectiveness of knowledge

sharing, though very few studies have examined both structural and connection level factors in the same analysis. Furthermore, most studies have attempted to quantify the benefits of knowledge sharing in terms of team level performance outcomes rather than individual perceptions. This gap in current research is concerning, as a fundamental outcome of a knowledge sharing connection is whether or not it is useful to the participating individuals. This study will unite these two strains of research into a single quantitative study that examines a potential relationship between the usefulness of knowledge sharing connections, network structure, and connection dynamics.

HYPOTHESIS DEVELOPMENT

To start, we will define usefulness as a connection that provides an individual with *"knowledge that they would otherwise not have figured out on their own."* This definition allows us to establish a degree of objectivity in our assessment because it filters out connections that may be considered useful simply because they are pleasant. From this definition, we develop a number of hypotheses related to the usefulness of a connection based on dyadic and network level variables.

To begin, we examine the relationship between the usefulness of a connection, and the frequency and method of communication. We would expect that with more frequent communication, connections have a higher probability of being useful. This is because a shortened feedback loop between the knowledge provider and knowledge recipient that results from frequent communication allows the personal instruction or "socialization" required to transfer tacit knowledge (Javernick-Will and Hartmann 2011). Furthermore, socialization requires rich methods of communication that give both the provider and recipient access to a social atmosphere. The methods of communication are therefore limited to face to face interactions and meetings, whether virtual or otherwise.

H1: Increased frequency of communication is associated with more useful connections
H2: Richer methods of communication are associated with more useful connections

The next two hypotheses address the structural research that elucidates the benefits of accessing differing knowledge bases. From previous research, scholars have examined the benefits of connecting with different geographic locations and disciplines (Cummings 2004). Similarly, organizational theory and network structures posit numerous benefits to connecting with others who interact with different networks (Burt 1992). Because of the natural silos that tend to occur due to geographic and disciplinary differences, this theory is especially relevant to construction companies. Our hypotheses therefore propose that connections to different disciplines and geographic locations will provide access to new knowledge, therefore producing connections with a higher degree of usefulness.

H3: Geographic boundary spanning is associated with more useful connections
H4: Disciplinary boundary spanning is associated with more useful connections

RESEARCH SETTING

We selected three communities of practice (CoPs) housed within two multinational construction and engineering organizations. CoPs have been adopted in the commercial environment as a mechanism for sharing knowledge, and have been defined as:

"a group of professionals informally bound to one another through exposure to a common class of problems, common pursuit of solutions, and thereby themselves embodying a store of knowledge" (Manville and Foote 1996 p. 80)

To this definition we add several qualifying observations regarding the communities that we have selected. First, within CoPs, employees have the ability to share knowledge between disciplines and geographic locations, as well as the freedom to choose their methods and frequency of communication. These CoPs often involve members who share knowledge because of workflows, but also capture interactions between employees that are not a result of workflows. Because of this, each community offers a diverse and complete view into the informal knowledge sharing that happens within a company to complete work.

As a strategy to increase the external validity of this study, we have used three CoPs within two multiple companies to determine if these effects span multiple CoP and organizational contexts. The three CoPs are profiled briefly below:

Process Improvement CoP: Housed within company A, this CoP consists of 273 individuals spread across 19 countries and 20 disciplines. The members of this CoP serve as internal consultants that provide process improvement expertise for projects. Members share knowledge through an online reporting system, but maintain strong interpersonal relationships as they are relocated to new assignments. Within this CoP, we studied 640 connections, of which 133 were considered useful.

Transportation CoP: Housed within company B, this CoP has 365 members across 10 countries and 16 disciplines. The members all participate in transportation related projects around the world. Members primarily share knowledge through an online forum and knowledge repository, which allows them to do a content-based search of documents and employee profiles. Within this CoP, we studied 352 connections, of which 131 were considered useful.

CAD CoP: Also housed within Company B, this CoP boasts 1152 members in 17 countries and 20 disciplines. Worldwide, the CoP members provide drawings, support, and management for all drafting related activities. Members share knowledge using the same online platform as the Transportation CoP, though there is also extensive sharing of documents such as CAD blocks and standards. Often, individuals post questions to a forum that are answered by others around the world. Within this CoP, we studied 1083 connections, of which 249 were considered useful.

METHOD

Each of the CoPs has membership lists that served as the defining parameters of the study population. We obtained this list, in addition to employee location data, from each organization's HR department. To collect the social knowledge sharing network, we used online survey methods. Using an online survey tool called NetworkGenie, we deployed social network surveys that asked participants three types of questions. The first type of question asked participants about individual preferences and demographic characteristics such as their educational discipline. The next asked each individual with whom they had shared knowledge with in the past six months, allowing them to search the membership list for other employees. The last asked questions of each identified connection to determine the perceived usefulness, frequency of interaction, and method of communication.

Respondents evaluated the usefulness of each of their connections based upon four outcomes: (1) the connection provides the reporting party with knowledge that they would

otherwise not have figured out on their own; (2) the connection provided the recipient with knowledge that saved them time, but they could have figured out on their own; (3) the connection provided the recipient with knowledge that was basic or somewhat incorrect or (4) the connection provided information that was incorrect or made the issue worse. Rather than use a likert scale, these four categories help specify the outcome of a connection in terms of value added to the company. Respondents also provided information on the frequency of interaction, which used a simple ordinal scale. Options included: (1) at least once per day, (2) several times per week, (3) at least once per week, (4) at least once per month, and (5) every six months. Lastly, the media richness variable was derived after asking respondents to identify the two forms of communication used most frequently to share knowledge. These included reports, meetings, intranet, email, personal discussion, and instant messaging. We divided these choices into three categories according to the media richness hierarchy presented by Daft (1987). The categories were (1) face-to-face (virtual or personal, but allows individuals to read facial cues), (2) written and addressed documents, and (3) unaddressed documents.

Using the social network analysis software NetMiner, we created a list of all identified connections within each community, and then assigned dummy variables to geographic and disciplinary boundaries. When a connection spanned a geographical or disciplinary boundary, it was assigned a value of '1', and when a connection did not span a geographical or disciplinary boundary, a value of '0' was assigned.

Due to the categorical nature of our variables, we dichotomized the usefulness variable and conducted a logistic regression. Unlike conventional linear regression, the coefficients in a logistic regression report the change in the log of the odds ratio relative to a unit of change in the independent variables. Because our independent variables are also categorical, our regression evaluates the log of a change in probability of attaining the outcome (usefulness) if a connection has reported a given frequency/media richness, or if boundary spanning is present relative to a base case. Further interpretation follows in the results section.

RESULTS

We present the regression results for all three communities in a single table. Due to space limitations, we only include odds ratios, standard errors, and p values. As an aid to interpretation, frequency of communication decreases as the response number increases, and the richness of communication decreases as the richness score increases. For both of these variables, the first response is omitted from Table 1 as it serves as a base case. The odds ratios can therefore be interpreted as the change in the log probability of a connection being useful relative to the base response of 1. Both geographic and disciplinary boundary spanning were analyzed as dummy variables, so the odds ratios are not presented in categorical form. As a final note, there was a lack of data for the middle category (2) of media richness for the Transportation CoP, so these values were omitted from Table 1.

Table 1 –Regression Results

	Process Imp. (n=365)			CAD (n=471)			Trans (n=145)		
Usefulness	Odds Ratio	Std. Err.	p-value	Odds Ratio	Std. Err.	p-value	Odds Ratio	Std. Err.	p-value
Frequency									
2	0.656	0.373	0.459	1.091	0.532	0.858	2.753	3.411	0.414
3	0.375	0.233	0.115	2.377	1.061	0.052	2.641	3.276	0.434

	4	0.689	0.38	0.510	2.406	1.039	0.042**	3.371	4.094	0.413
	5	0.897	0.495	0.845	3.668	1.658	0.004**	2.651	3.155	0.413
Media Richness										
	2	1.107	0.842	0.894	0.653	0.604	0.645	na	na	na
	3	1.35	0.964	0.674	1.216	1.080	0.826	0.861	0.359	0.720
Geo.BS		1.183	0.3	0.508	0.927	0.221	0.751	2.083	1.063	0.149
Disc. BS		0.823	0.212	0.453	0.943	0.208	0.791	0.866	0.305	0.149
Constant		0.659	0.594	0.644	0.197	0.195	0.102	0.399	0.482	0.447

*** significant at $\alpha = 0.05$*

Beginning with hypothesis 1 and 2, which address the dyadic level variables of frequency and media richness, we do not find support in the Process Improvement or Transportation CoPs that increased frequency of communication or richer forms of communication lead to more useful connections. The odds ratios are all positive and non significant, indicating the lack of a cohesive trend. However, the CAD CoP displays odds ratios that are positive and highly significant for responses 4 (once per month) and 5 (once every six months. This indicates that there is an increase in the log probability that a connection is useful if there is less frequent interaction. With this evidence, we do not accept hypothesis 1 and 2.

In regards to structural factors, geographic and disciplinary boundary spanning variables also yielded odds ratios which were positive and non-significant in each CoP. This shows that knowledge sharing connections which span geographic or disciplinary boundaries do not significantly increase the probability that a knowledge sharing connection is perceived as useful. On this basis we similarly do not accept hypothesis 3 and 4.

DISCUSSION & LIMITATIONS

Although there has been extensive discussion regarding the efficacy of knowledge sharing within communities of practice, there is a dearth of scholarship that empirically ties outcomes to both relational and structural factors. Interestingly enough, we did not find support for any of our hypothesis, which suggests that the usefulness of a knowledge sharing connection may not be explicitly tied to a certain set of characteristics such as frequency, method of communication, or boundary spanning.

To begin, hypothesis 1 and 2 speculated that more frequent interaction through richer communication media would lead to more useful knowledge sharing connections. Our results led us to reject hypothesis 1 and 2. Interestingly enough, we discovered evidence that less frequent interaction can potentially lead to more useful connections, as the odds ratio for the less frequent interaction rates of (4) once per month and (5) once every six months, was both positive and significant. The literal interpretation is that the likelihood that a connection is useful increases when the frequency of interaction changes from more than once per month to less than once per month. At first, this is a puzzling finding, however Granovetter (1973) argued that weak ties can be the ones which provide the greatest benefit to the individual who holds them. Granovetter spoke specifically about the willingness of weak ties to endorse one another, although it may have a more subtle application to knowledge sharing. In our case, we may be observing latent knowledge sharing connections which are in a state of dormancy until one of the parties requires something. Our expectation is that this would lead to infrequent, needs-based

knowledge sharing interactions. These latent ties may provide participants with highly useful relationships at a relatively low cost in terms of time and effort. This would also explain why less frequent ties may be seen as more useful than a more time intensive relationship that does not provide meaningful knowledge with every interaction.

Even more surprising is the lack of association between media richness and the usefulness of a knowledge sharing connection. With the advent of so many IT platforms that facilitate virtual communication, many managers are concerned that virtual interactions are not able to provide the same quality of interaction and produce an individualistic culture that severely limits collaborative knowledge sharing. Our results do not indicate that this concern is validated, but rather show that there is no association between more social modes of communication and the perceived usefulness of the connection.

Furthermore, our results did not show that inter-disciplinary connections or connections spanning geographic boundaries were perceived as more useful. There are a number of reasons why this may be so, but the most plausible is that there is simply less need to seek knowledge from someone with a different disciplinary background or contextual experience. In construction organizations, most employees are focused on discipline specific tasks and projects which occur within a fixed region. We can reasonably expect the size of most multinational construction organizations makes it so that, most employees can find the knowledge that they need without leaving their region. It is important to realize however, that there are still theoretical performance benefits to sharing knowledge across disciplinary and geographic boundaries. Just because it is not perceived as useful by individuals does not mean that it is not aligned with the strategic goals of the company. This reveals an important rift between the perceptions of individuals and the direction of the firm that is rooted in bounded rationality. Even if individuals desire to tap in to the global expertise of the company, they cannot know what everyone else knows. They are therefore limited in their ability to know where to go within the company for knowledge resources, access global knowledge, and perceive its benefits.

One theory which has been researched more extensively is the power of interpersonal relationships to either encourage or impede knowledge sharing. Prior work has theorized that knowledge is difficult to transfer within organizations due to the "arduousness of the relationship" (Szulanski 1996), and many other works have examined the importance of trust in knowledge transfer (Abrams et al. 2003; Handy 1995; Szulanski et al. 2004). If someone is not trusted, knowledge sharing is less likely to be effective and useful regardless of the frequency of communication, method of exchange, or advantageous connection to different knowledge bases. On the other hand, with a fully trusting relationship, it is still possible that one party or the other lacks the knowledge required to make an exchange useful. Future work would do well to consider the relational dynamics, knowledge content, and the connection dynamics together to determine what makes a connection useful.

Although it is not within the scope of this study, the authors are also conducting interviews with select members of each of the three CoPs. During these interviews, participants are asked about specific connections that they have within the network, the types of knowledge that they share, and what makes particular connections useful. Most commonly, respondents indicate that they have an existing relationship, and that the person has the expertise they need and is willing to take the time to share it. On the other hand, non-useful connections occur when the respondent indicates that their connection does not have the expertise to provide them with what they really need.

With this study, there are several limitations which must be considered. To begin, our unit of analysis is the individual connection. While we use structural holes theory as a basis to claim the benefits of inter-geographic and inter-disciplinary knowledge sharing, we have not accounted for the lack of redundancy which creates a power differential between individuals with many structural holes in their networks, and those without such holes. Next, because we dichotomized our usefulness variable, we lost resolution that could lead to a more continuous measure of the value of individual connections. Future research would do well to determine a more continuous scale upon which to measure the outcome of a knowledge sharing connection.

CONCLUSION

Despite the limitations of this study, we have taken a tangible step forward into evaluating the efficacy of knowledge sharing at an individual level. By combining relational and structural measures, we have opened the door for future research to incorporate the theorized benefits of social network analysis into more conventional empirical investigations. This study explored the potential relationship between the usefulness of a knowledge sharing connection and the frequency of interaction, method of communication, geographic boundary spanning, and disciplinary boundary spanning. Our results indicated that none of these four factors can significantly predict whether or not a knowledge sharing connection is perceived as being useful by the participants. These findings open the door to future research that further investigates factors which contribute to the practical value of knowledge sharing connections.

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